



Capital Budgeting Techniques

Fall 2004



1 Outline

Investment Criteria & Techniques

Organization

- 1 Net Present Value
- 2 The Payback Rule
- 3 The Average Accounting Return
- 4 The Internal Rate of Return
- 5 The Profitability Index
- 6 The Practice of Capital Budgeting
- 7 Summary and Conclusions

2 NPV Illustrated

- Assume you have the following information on Project X:

Initial outlay **-\$1,100**

Required return = **10%**

Annual cash revenues and expenses are as follows:

<u>Year</u>	<u>Revenues</u>	<u>Expenses</u>
1	\$1,000	\$500
2	2,000	1,000

- Draw a time line and compute the NPV of project X.

2.1 NPV Illustrated (concluded)

0	1	2
Initial outlay (\$1,100)	Revenues \$1,000 Expenses 500	Revenues \$2,000 Expenses 1,000
↓	Cash flow \$500	Cash flow \$1,000
-\$1,100.00	$500 \times \frac{1}{1.10}$	$1,000 \times \frac{1}{1.10^2}$
+454.54	←	←
+826.45	←	←
<u>+\$180.99</u> NPV		

3 Underpinnings of the NPV Rule

- Why does the NPV rule work? And what does “work” mean? Look at it this way:

A “firm” is created when investors supply the funds to acquire assets that will be used to produce and sell a good or a service;

The market value of the firm is based on the present value of the cash flows it is expected to generate;

Additional investments are “good” if the present value of the increase in the expected cash flows exceeds their cost;

Thus, “good” projects are those which increase firm value - or, put another way, good projects are those projects that have positive NPVs!

Moral of the story: Invest only in projects with positive NPVs.

4 Payback Rule Illustrated

Initial outlay $-\$1,000$

<u>Year</u>	<u>Cash flow</u>
1	\$200
2	400
3	600
4	300

<u>Year</u>	<u>Accumulated Cash flow</u>
1	\$200
2	600
3	1,200
4	1,500



Payback period = $2 + 400/600 = 2.67$ years

5 Discounted Payback Illustrated

Initial outlay $-\$1,000$

$r = 10\%$

<u>Year</u>	<u>Cash flow</u>	<u>PV of Cash flow</u>
1	\$ 200	\$ 182
2	400	331
3	600	451
4	300	205

<u>Year</u>	<u>Accumulated discounted cash flow</u>
1	\$ 182
2	513
3	964
4	1,169



Discounted payback period is just over 3 years (3.175 years)

6 Evaluate the Payback

■ Pros:

- ◆ _____
- ◆ _____
- ◆ _____

■ Cons:

- ◆ _____
- ◆ _____
- ◆ _____
- ◆ _____
- ◆ _____

■ Pros:

- ◆ Easy to understand
- ◆ Adjust for uncertainty of later CF
- ◆ Biased towards liquidity

■ Cons:

- ◆ Ignores TVM
- ◆ Ignores CF beyond the cutoff date
- ◆ Biased against LT projects and their derivatives
- ◆ Arbitrary cutoff point

7 Average Accounting Return Illustrated

■ Average net income:

	Year		
	1	2	3
Sales	\$440	\$240	\$160
Costs	<u>220</u>	<u>120</u>	<u>80</u>
Gross profit	220	120	80
Depreciation	<u>80</u>	<u>80</u>	<u>80</u>
Earnings before taxes	140	40	0
Taxes (25%)	<u>35</u>	<u>10</u>	<u>0</u>
Net income	<u>\$105</u>	<u>\$30</u>	<u>\$0</u>

Average net income = $(105 + 30 + 0)/3 = \$45$

7.1 Average Accounting Return Illustrated (concluded)

- **Average book value:**

Initial investment = \$240

Average investment = $(\$240 + 160 + 80 + 0)/4 = \120

(or) = $\$240/2 = \120

- **Average accounting return (AAR):**

$$\text{AAR} = \frac{\text{Average net income}}{\text{Average book value}} = \frac{\$45}{\$120} = 37.5\%$$

8 Evaluate the AAR

- **Pros:**

- ◆ Easy to calculate
- ◆ Info are available to calc.

- **Cons:**

- ◆ TVM Ignored
- ◆ Based on Accounting book value – not real CF
- ◆ Cutoff rate - Arbitrary

9 Internal Rate of Return Illustrated

Initial outlay = -\$200

<u>Year</u>	<u>Cash flow</u>
1	50
2	100
3	150

- Find the IRR such that NPV = 0

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

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

9.1 Internal Rate of Return Illustrated (concluded)

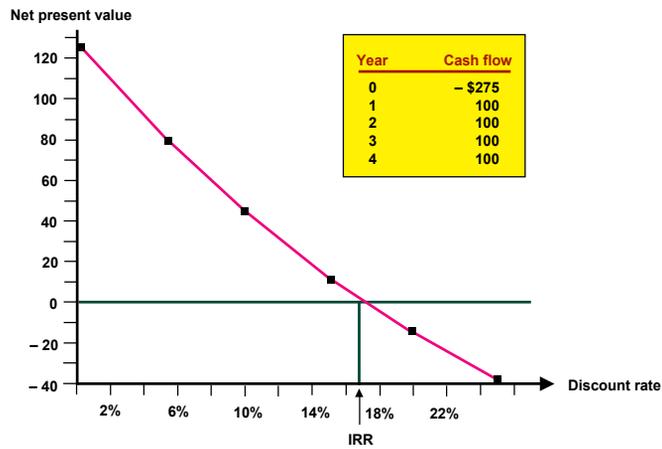
- Trial and Error

Discount rates NPV

0%	\$100
5%	68
10%	41
15%	18
→ 20%	-2

IRR is just under 20%-- about 19.44%

10 Net Present Value Profile



11 Profitability Index Illustrated

- Now let's go back to the initial example - we assumed the following information on Project X:

Initial outlay -\$1,100 Required return = 10%

Annual cash benefits:

<u>Year</u>	<u>Cash flows</u>
1	\$ 500
2	1,000

- What's the Profitability Index (PI)?

11.1 Profitability Index Illustrated (concluded)

- Previously we found that the NPV of Project X is equal to:

$$(\$454.54 + 826.45) - 1,100 = \$1,280.99 - 1,100 = \$180.99.$$

- The $PI = PV \text{ inflows} / PV \text{ outlay} = \$1,280.99 / 1,100 = 1.1645$.
- This is a good project according to the PI rule. Can you explain why?

12 Summary of Investment Criteria

- I. Discounted cash flow criteria

- Net present value (NPV).** The NPV of an investment is the difference between its market value and its cost. The **NPV rule** is to take a project if its NPV is positive.
- Internal rate of return (IRR).** The IRR is the discount rate that makes the estimated NPV of an investment equal to zero. The **IRR rule** is to take a project when its IRR exceeds the required return.
- Profitability index (PI).** The PI is the ratio of present value to cost. The **profitability index rule** is to take an investment if the index exceeds 1.0.

12.1 Summary of Investment Criteria (concluded)

■ II. Payback criteria

A. **Payback period.** The payback period is the length of time until the sum of an investment's cash flows equals its cost. The **payback period rule** is to take a project if its payback period is less than some pre-specified cutoff.

B. **Discounted payback period.** The discounted payback period is the length of time until the sum of an investment's discounted cash flows equals its cost. The **discounted payback period rule** is to take an investment if the discounted payback is less than some pre-specified cutoff.

■ III. Accounting criterion

A. **Average accounting return (AAR).** The AAR is a measure of accounting profit relative to book value. The **AAR rule** is to take an investment if its AAR exceeds a benchmark.

13 Quick Quiz

1. Which of the capital budgeting techniques *do* account for both the time value of money and risk?
2. The change in firm value associated with investment in a project is measured by the project's _____.
 - a. Payback period
 - b. Discounted payback period
 - c. Net present value
 - d. Internal rate of return
3. Why might one use several evaluation techniques to assess a given project?

Quick Quiz

1. Which of the capital budgeting techniques *do* account for both the time value of money and risk?

Discounted payback period, NPV, IRR, and PI

2. The change in firm value associated with investment in a project is measured by the project's *Net present value*.

3. Why might one use several evaluation techniques to assess a given project?

To measure different aspects of the project; e.g., the payback period measures liquidity, the NPV measures the change in firm value, and the IRR measures the rate of return on the initial outlay.
