CHAPTER 5

NET PRESENT VALUE AND OTHER INVESTMENT CRITERIA

Topics Covered

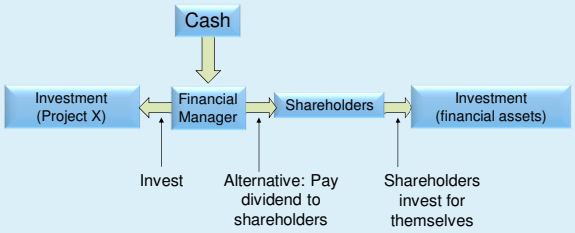
5-2

- A Review of The Basics
- Payback
- Internal (or Discounted-Cash-Flow) Rate of Return
- Choosing Capital Investments When Resources Are Limited

NPV and Cash Transfers

5-3

- Every possible method for evaluating projects impacts the flow of cash about the company as follows.



Three Points to Remember about *N*

5-4

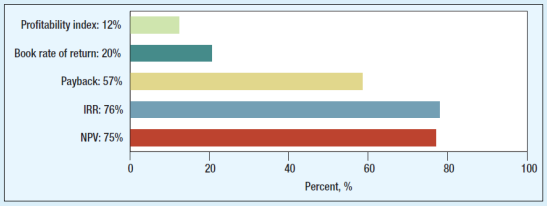
1. A dollar today is worth more than a dollar tomorrow
2. Net present value depends solely on the *forecasted cash flows* from the project and the *opportunity cost of capital*
3. Since present values are all measured in today's dollars, you can add them up

$$NPV(A + B) = NPV(A) + NPV(B)$$

CFO Decision Tools

5-5

Survey Data on CFO Use of Investment Evaluation Techniques



SOURCE: Graham and Harvey, "The Theory and Practice of Finance: Evidence from the Field," Journal of Financial Economics 61 (2001), pp. 187-243.

Book Rate of Return

5-6

Book Rate of Return - Average income divided by average book value over project life. Also called accounting rate of return.

$$\text{Book rate of return} = \frac{\text{book income}}{\text{book assets}}$$

Managers rarely use this measurement to make decisions. The components reflect tax and accounting figures, not market values or cash flows.

Payback

5-7

- The payback period of a project is the number of years it takes before the cumulative forecasted cash flow equals the initial outlay.
- The payback rule says only accept projects that "payback" in the desired time frame.
- This method is flawed, primarily because it ignores later year cash flows and the present value of future cash flows.

Payback

5-8

Example

Examine the three projects and note the mistake we would make if we insisted on only taking projects with a payback period of 2 years or less.

Project	C_0	C_1	C_2	C_3	Payback Period	NPV@ 10%
A	-2000	500	500	5000		
B	-2000	500	1800	0		
C	-2000	1800	500	0		

Payback

5-9

Example

Examine the three projects and note the mistake we would make if we insisted on only taking projects with a payback period of 2 years or less.

Project	C_0	C_1	C_2	C_3	Payback Period	NPV@ 10%
A	-2000	500	500	5000	3	+2,624
B	-2000	500	1800	0	2	-58
C	-2000	1800	500	0	2	+50

Internal Rate of Return

5-10

Internal Rate of Return (IRR) - Discount rate at which NPV = 0

Internal Rate of Return Rule - Invest in any project offering a rate of return that is higher than the opportunity cost of capital

$$\text{Rate of return} = \frac{\text{payoff}}{\text{investment}} - 1$$

Internal Rate of Return

5-11

Example

You can purchase a turbo powered machine tool gadget for $4,000. The investment will generate $2,000 and $4,000 in cash flows for two years, respectively. What is the IRR on this investment?

Internal Rate of Return

5-12

Example

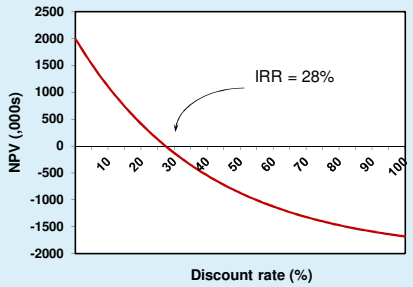
You can purchase a turbo powered machine tool gadget for $4,000. The investment will generate $2,000 and $4,000 in cash flows for two years, respectively. What is the IRR on this investment?

$$NPV = -4{,}000 + \frac{2{,}000}{(1+IRR)^1} + \frac{4{,}000}{(1+IRR)^2} = 0$$

$$IRR = 28.08\%$$

Internal Rate of Return

5-13



Internal Rate of Return

5-14

Pitfall 1 - Lending or Borrowing?

- With some cash flows (as noted below), the NPV of the project increases as the discount rate increases
- This is contrary to the normal relationship between NPV and discount rates

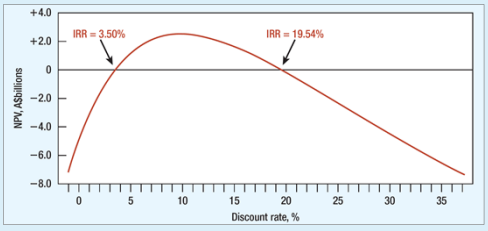
Project	C_0	C_1	IRR	NPV @10%
A	−1,000	+1,500	+50%	+364
B	+1,000	−1,500	+50%	−364

Internal Rate of Return

5-15

Pitfall 2 - Multiple Rates of Return

- Certain cash flows can generate NPV = 0 at two different discount rates
- The following cash flow generates NPV = $A 253 million at both IRR% of +3.50% and +19.54%.



Internal Rate of Return

5-16

Pitfall 2 - Multiple Rates of Return

- It is possible to have a zero IRR and a positive NPV

Project	C_0	C_1	C_2	IRR	NPV @ 10%
C	+1,000	+3,000	+2,500	None	+339

Internal Rate of Return

5-17

Pitfall 3 - Mutually Exclusive Projects

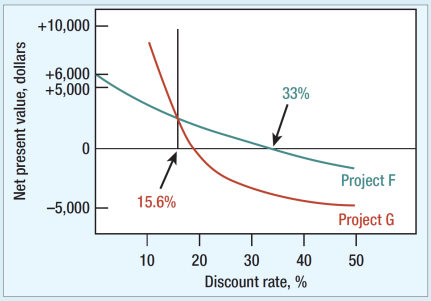
- IRR sometimes ignores the magnitude of the project
- The following two projects illustrate that problem

Project	C_0	C_1	IRR	NPV @ 10%
D	−10,000	+20,000	100%	+8,182
E	−20,000	+35,000	+75%	+11,818

Internal Rate of Return

5-18

Pitfall 3 - Mutually Exclusive Projects



Internal Rate of Return

5-19

Pitfall 4 – What Happens When There Is More than One Opportunity Cost of Capital

- Term structure assumption
- We assume that discount rates are stable during the term of the project
- This assumption implies that all funds are reinvested at the IRR
- This is a false assumption

Capital Rationing

5-20

Capital Rationing - Limit set on the amount of funds available for investment

Soft Rationing - Limits on available funds imposed by management

Hard Rationing - Limits on available funds imposed by the unavailability of funds in the capital market

Profitability Index

5-21

- When resources are limited, the profitability index (PI) provides a tool for selecting amongst various project combinations and alternatives
- A set of limited resources and projects can yield various combinations
- The highest weighted average PI can indicate which projects to select

Profitability Index

5-22

Cash Flows ($ millions)

Project	C_0	C_1	C_2	NPV@10%
A	−10	+30	+5	21
B	−5	+5	+20	16
C	−5	+5	+15	12
D	0	−40	+60	13

Profitability Index

5-23

Cash Flows ($ millions)

Project	Investment ($)	NPV ($)	Profitability Index
A	10	21	2.1
B	5	16	3.2
C	5	12	2.4
D	0	13	0.4

$$\text{Profitability index} = \frac{\text{NPV}}{\text{investment}}$$

Profitability Index

5-24

$$\text{Profitability index} = \frac{\text{NPV}}{\text{investment}}$$

Example

We only have $300,000 to invest. Which do we select?

Project	NPV	Investment	PI
A	230,000	200,000	1.15
B	141,250	125,000	1.13
C	194,250	175,000	1.11
D	162,000	150,000	1.08

Profitability Index

5-25

Example - continued

Project	NPV	Investment	PI
A	230,000	200,000	1.15
B	141,250	125,000	1.13
C	194,250	175,000	1.11
D	162,000	150,000	1.08

Select projects with highest weighted average PI

$$\text{WAPI(BD)} = 1.13 \times \left(\frac{125}{300}\right) + 1.08 \times \left(\frac{150}{300}\right) + 0.0 \times \left(\frac{25}{300}\right)$$
$$= 1.01$$

Profitability Index

5-26

Example - continued

Project	NPV	Investment	PI
A	230,000	200,000	1.15
B	141,250	125,000	1.13
C	194,250	175,000	1.11
D	162,000	150,000	1.08

Select projects with highest weighted average PI

WAPI (BD) = 1.01
WAPI (A) = 0.77
WAPI (BC) = 1.12