

Chapter 11

The Basics of Capital Budgeting:
Evaluating Cash Flows

Capital Budgeting Tools

- (1) Payback Period
 - (1a) Discounted Payback Period
- (2) Net Present Value (NPV)
 - (2a) Profitability Index (PI)
- (3) Internal Rate of Return (IRR)
 - (3a) Modified Internal Rate of Return (MIRR)
- (4) NPV Profiles

Use to evaluate the merits of various Capital Budgeting projects

Capital Budgeting

Capital Budgeting (def): The budgeting of capital (long-term) expenditures. Entails the evaluation of projects and decision of which projects to accept.

Types of Capital Budgeting Projects

Types of projects:

- (1) replacement: due to normal wear and tear
- (2) replacement: to increase efficiency or reduce costs
- (3) expansion: enlarge current operations
- (4) expansion: new operations
- (5) regulation: for environmental or safety reasons

How are we going to evaluate projects?

Base it on our risk and return concepts.

Does the project give us ample return for its level of risk?

Capital Budgeting Example

Assume a WACC = $r_a = 10\%$ (discount rate)

Year	Cash Flows	Cash Flows
	Project A	Project B
0	-\$100k	-\$100k
1	+\$50k	+\$20k
2	+\$50k	+\$20k
3	+\$50k	+\$40k
4	0	+\$40k
5	0	+\$80k

Payback Period

Payback Period (def) The number of years to get back the original investment

Payback Period for Project A

Year	Cash Flow	Cumulative Cash Flow
0	-\$100k	-\$100k
1	\$50k	-\$50k
2	\$50k	0

Payback Period for Project B

Year	Cash Flow	Cumulative Cash Flow
0	-\$100k	-\$100k
1	\$20k	-\$80k
2	\$20k	-\$60k
3	\$40k	-\$20k
4	\$40k	+\$20k

Payback Period for Project B

Therefore, Payback for project B is between 3 and 4 years

$$3 \text{ yrs} + \frac{\text{(amount needed after 3 years)}}{\text{(cash flow year 4)}}$$

$$= 3 + (\$20k / \$40k) = 3.5 \text{ years}$$

Decision Rule for Payback Period

If mutually exclusive (one or the other) choose lowest payback period. If not mutually exclusive (can choose both) then choose according to cutoff (below cutoff)

Payback Period

Advantages:

1. Easy to understand
2. Emphasizes liquidity

Disadvantages:

1. Ignores time value of money (TVM)
2. Ignores cash flows after payback
3. Arbitrary cutoff
4. Biased against long-term projects and projects with R&D

Discounted Payback Period

To overcome disadvantage #1 use
discounted payback period

Discounted Payback Period

Project A (r=10%)			
YR	CF	Disc CF	Cuml CF
0	-\$100	-\$100.00	-\$100.00
1	\$50	\$45.45	-\$54.55
2	\$50	\$41.32	-\$13.23
3	\$50	\$37.57	+\$24.34

Discounted Payback Period

Discounted PaybackA = $2 + 13.23/37.57$
= 2.35 years

Discounted PaybackB = $4 + 8/50$
= 4.16 years

But, still ignores CFs after payback!!!!

Net Present Value (NPV)

Definition:

NPV is the present value of all future cash flows less the initial investment

Based on TVM

Net Present Value

$$\begin{aligned} \text{NPV}_A &= \text{PV}(\text{CFs}) - \text{Initial Investment} \\ &= \$124,343 - \$100,000 = \$24,343 \end{aligned}$$

$$\begin{aligned} \text{NPV}_B &= \text{PV}(\text{CFs}) - \text{Initial Investment} \\ &= \$141,758 - \$100,000 = \$41,758 \end{aligned}$$

Net Present Value

Decision Rule: If mutually exclusive (one or the other) choose highest NPV

If not mutually exclusive (can choose both) then choose all with (+) NPV

Problem with NPV

Problem: (1) ignores size of initial investment

example (r=10%)

Year	Project C	Project D	10 Project C's
0	-\$100k	-\$1m	-\$1m
1	\$100k	\$650k	\$1m
2	\$100k	\$650k	\$1m
NPV	\$73,554	\$128,099	\$735,537

Solve by using **Profitability Index**

Profitability Index (PI)

$$\text{PI} = \frac{\text{PV of cash inflows}}{\text{PV of cash outflows}}$$

$$\text{PI}_C = \$173,553 / \$100,000 = 1.7355$$

$$\text{PI}_D = \$1,128,099 / \$1,000,000 = 1.128$$

Profitability Index (PI)

Decision Rule:

If mutually exclusive (one or the other) choose highest PI greater than 1

If not mutually exclusive (can choose both) then choose all with PI greater than 1

Choose C - higher PI

Internal Rate of Return (IRR)

IRR (def) The discount rate that makes NPV=0.

Project A: IRR=23.38%

Project B: IRR=21.82%

Internal Rate of Return (IRR)

Decision Rule:

If mutually exclusive (one or the other) choose highest IRR

If not mutually exclusive (can choose both) then choose all with IRR > cutoff (required rate of return)

BUT, NPV says to choose B and IRR says to choose A

NPV-IRR Conflict

We get different answers because the magnitude of the cash flows and timing of the cash flows vary between the projects

Problem: (1) IRR can give different decision than NPV due to different magnitude of cash flows or different timing of cash flows (unequal lives), (2) If sign of CF changes more than once can get multiple IRR's, and (3) assumes reinvestment rate = IRR

Solve magnitude of cash flow problem and multiple IRR problem by using **Modified Internal Rate of Return (MIRR)** [note: still does not solve for different timing of cash flows]

Modified Internal Rate of Return (MIRR)

Definition of MIRR

The discount rate that makes the future value of all cash inflows equal the present value of all cash outflows.

MIRR

Project A			
Year	CF	PV of Cash Outflows	FV of Cash Inflows
0	-\$100	-\$100	
1	\$50		\$60.50
2	\$50		\$55.00
3	\$50		\$50.00
Total		-\$100	\$165.50

MIRR

$PV = -100$, $FV = 165.50$, $n = 3$, $i = \text{MIRR}$

$\text{MIRR}_A = i = 18.29\%$

$\text{MIRR}_B = i = 17.95\%$

NPV Profiles

The solution to solving this NPV-IRR conflict

Example

<u>Year</u>	<u>Project C</u>	<u>Project D</u>
0	-\$100k	-\$1m
1	\$100k	\$650k
2	\$100k	\$650k

NPV Profiles

Chart NPV at various discount rates:

1. Find NPV at $i = 0\%$
2. Find IRR, the i where $NPV = \$0$
3. Calculate the crossover rate

NPV Profiles

1. $NPV_C = \$100,000$ at $i = 0\%$
 $NPV_D = \$300,000$ at $i = 0\%$
2. $IRR_C = 61.80\%$
 $IRR_D = 19.43\%$

NPV Profiles

3. Calculate the crossover rate

Calculate by taking the difference in Project CFs

Example: Project D - Project C

$CF_0 = -\$900k$; $CF_1 = +\$550k$; $CF_2 = +\$550k$

$i = \text{crossover rate} = 14.49\%$

Problem 1

Anchor Gaming Inc. is considering the following project. Anchor Gaming has a weighted average cost of capital of 14%. What is the payback period for this project? What is the discounted payback period for this project? What is the net present value (NPV) of this project? What is the profitability index (PI) of the project?

Problem 1

Anchor Project	
Year	Cash Flow
0	-\$15,000,000
1	+\$6,800,000
2	+\$5,200,000
3	+\$4,200,000
4	+\$4,900,000

Problem 2

Calculate the NPV and IRR of the following cash flows for a project being analyzed by Intel Corp. Intel Corp. has an after-tax cost of debt of 7.52% and a weighted average cost of capital of 14.23%.

Problem 2

Intel Project	
Year	Cash Flow
0	-\$84,000,000
1	+\$28,000,000
2	+\$37,000,000
3	+\$45,000,000