

Capital budgeting

Methods (techniques): PBP, DPBP, IRR, NPV, PI. Initial cash outlay (ICO), Free Cash Flow (FCF). Capital rationing.

RWJ: Ch. 6, 7, (8 optional)



The process of identifying, analyzing, and selecting investment projects whose *cash flows* are expected to extend beyond *one year*.

CB is NOT the same as Budgeting (=preparing annual financial plans and proforma statements for a business company)



- Generate investment proposals consistent with the firm's strategic objectives.
- Estimate after-tax cash flows for the investment projects.
- Evaluate project cash flows.
- NB: CF, FCF no unified methodology



- Select projects based on a value-maximizing acceptance criterion.
- Reevaluate implemented investment projects continually and perform post-audits for completed projects.

Investment Project Proposals

- 1. New products or product modifications
- 2. Replacement of existing equipment or buildings
- 3. Real estate: hotels, etc
- 4. R&D
- 5. Exploration
- 6. Other (e.g., safety- or pollution-related)

Estimating After-Tax Incremental Cash Flows

Basic characteristics of relevant project flows

Cash (not accounting income) flows Excluding financing costs After-tax flows

Incremental flows

Estimating After-Tax Incremental Cash Flows

Principles that must be adhered to in the estimation

<u>Ignore</u> sunk costs <u>Include</u> project-driven changes in working capital <u>Include</u> effects of inflation

Calculating the Incremental Cash Flows

- Initial cash outflow the initial net cash investment.
- Interim incremental net cash flows those net cash flows occurring after the initial cash investment but not including the final period's cash flow.
- Terminal-year incremental net cash flows the final period's net cash flow.

Free Cash Flows (CIIA program methodology)

FCF =

EBIT* - Tax rate (%) = NOPLAT + Depreciation -/+ △NWC (+/- △AR +/- △Inventory -/+ △AP) -/+ Investments (Fixed Assets) = FCF

*NB: financing costs (=interest expense) shall NOT be taken into consideration

Initial Cash Outflow, ICO

- a) Cost of "new" assets
 b) + Capitalized expenditures
 c) + (-) Increased (decreased) NWC
- d) Net proceeds from sale of
 - "old" asset(s) if replacement
- e) + (-) Taxes (savings) due to the sale of "old" asset(s) if replacement
- f) = Initial cash *outflow*

Terminal-Year Incremental Cash Flows

- a) Calculate the incremental net cash flow for the terminal period
- b) + (-) Salvage value (disposal/reclamation costs) of any sold or disposed assets
- c) (+) Taxes (tax savings) due to asset sale or disposal of "new" assets
- d) + (-) Decreased (increased) level of "net" working capital
- e) = Terminal year incremental net cash flow

Project Evaluation: Alternative Methods

Payback Period (PBP) Discounted PBP (DPBP) Internal Rate of Return (IRR) Net Present Value (NPV) – most popular (\$) Profitability Index (PI)

Other methods: ARR, MIRR, EAC...

Proposed Project Data

Julie is evaluating a new project for her firm, *Basket Wonders (BW)*. She has determined that the after-tax cash flows for the project will be \$10,000; \$12,000; \$15,000; \$10,000; and \$7,000, respectively, for each of the Years 1 through 5.

The ICO is \$40,000.













The management of *Basket Wonders* has set a maximum PBP of 3.5 years for projects of this type. Should this project be accepted?

Yes! The firm will receive back the initial cash outlay in less than 3.5 years. [3.3 Years < 3.5 Year MAX]

The PBP Method Strengths and Weaknesses

Strengths:

Easy to use and understand

Can be used as a measure of liquidity

Easier to forecast short-

term than long-term flows

Weaknesses:

Does not account for TVM

Does not consider cash flows *after* the PBP

Cutoff period is often subjective/disputable

Does not show absolute \$\$

Internal Rate of Return (IRR)

IRR is the discount rate that equates the PV of the future net CF with the initial cash outflow.

(NB: Compare with YTM in bonds!)





$\$40,000 = \frac{\$10,000}{(1+IRR)^{1}} + \frac{\$12,000}{(1+IRR)^{2}} + \frac{\$15,000}{(1+IRR)^{2}} + \frac{\$15,000}{(1+IRR)^{3}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{5}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{5}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{5}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{5}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{5}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{5}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{5}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,000}{(1+IRR)^{5}} + \frac{\$12,000}{(1+IRR)^{4}} + \frac{\$12,$

Need to find the interest rate (=*IRR*) that causes the 5 discounted cash flows to equal ICO of \$40,000.

IRR Solution (Try 10%)

7,000(PVIF_{10% 5}) 40,000 = 10,000(.909) + 12,000(.826) +\$15,000(.751) + \$10,000(.683) + S 7,000(.621) 40,000 = 9,090 + 9,912 + 11,265 +\$6,830 + \$4,347 = \$41,444 [Rate is too low]



```
7,000(PVIF<sub>15% 5</sub>)
40,000 = 10,000(.870) + 12,000(.756) +
  $15,000(.658) + $10,000(.572) +
                                    S
 7,000(.497)
40,000 = 88,700 + 9,072 + 9,870 +
 $5,720 + $3,479
                             = $36,841 [Rate
 is too h gh]
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IRR Solution (Interpolate)



IRR Solution (Interpolate)



IRR Solution (Interpolate)



IRR = 0.10 + 0.0157 = 0.1157 or 11.57%



The management of *Basket Wonders* has determined that the hurdle rate is 13% for projects of this type. Should this project be accepted?

No! The firm will "receive" 11.57% for each dollar "required" for this project at a cost of 13%. [IRR < RRR, "Hurdle Rate"]</p>

IRR Strengths and Weaknesse

the

Strengths:

Weaknesses:

Accounts for Considers all cash flows Less subjectivity TVM Assumes that all cash flows reinvested at the IRR Difficulties with project rankings Difficulties with multiple IRRs Does not show absolute \$\$



NPV is the present value of an investment project's net DCFs minus the project's initial cash outflow.

$$NPV = \frac{CF_{1}}{(1+k)^{1}} + \frac{CF_{2}}{(1+k)^{2}} + \dots + \frac{CF_{n}}{(1+k)^{n}} - ICO$$

$$(1+k)^{n}$$



Basket Wonders has determined that the appropriate discount rate (k) for this project is 13%.

NPV =
$$\frac{\$10,000}{\$(15,000)} + \frac{\$12,000}{(1.13)^2} + \frac{1.13}{(1.13)^3} + \frac{\$10,000}{(1.13)^4} + \frac{\$7,000}{-\$40,000} - \$40,000$$

- = -\$1,428
- $NPV = $10,000(PVIF_{13\%,1}) + $12,000(PVIF_{13\%,2}) +$ $(PVIF_{13\%.3}) + (10,000) (PVIF_{13\%.4}) +$ 7,000(PVIF_{13%.5}) - \$40,000 NPV = \$10,000(.885) + \$12,000(.783) + (15,000(.693) + (10,000(.613) +7,000(.543) - \$40,000 NPV =\$8,850 + \$9,396 + \$10,395 + \$6,130 + \$3,801 - \$40,000





The management of *Basket Wonders* has determined that the required rate is 13% for projects of this type. Should this project be accepted?

No! The NPV is negative. This means that the project is reducing shareholder wealth. Reject if NPV < 0.

NPV Strengths and Weaknesses

Strengths:

(Cash flows assumed to be reinvested at the hurdle rate.)

Accounts for TVM.

Considers all cash flows.

Shows absolute \$ value

in PRESENT \$.

Weaknesses:

Problems with projects' sizes

"Correct" RRR (?)

Net Present Value Profile



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PI is the ratio of the present value of a project's future net cash flows to the project's initial cash outflow.



PI Acceptance Criterion

PI = \$38,572 / \$40,000 = 0.9643 Should this project be accepted?

No! The PI is less than 1.00. This means that the project is not profitable. *Reject* if *PI* < 1.00 times.

PI Strengths and Weaknesses

Strengths:

Same as NPV

Allows for comparison of different scale and lifetime projects

The correct solution in capital rationing

Weaknesses:

Provides only relative profitability (in times) Potential ranking problems

Evaluation Summary

Basket Wonders Independent Project

	Method	Project	Comparison	Decision
	PBP	3.3	3.5	Accept
/	IRR	11.57%	13%	Reject
	NPV	-\$1,424	\$0	Reject
	PI	.96	1.00	Reject

Other Project Relationships

- Dependent A project whose acceptance depends on the acceptance of one or more other projects.
- Mutually Exclusive A project whose acceptance precludes the acceptance of one or more alternative projects.

Potential Problems Under Mutual Exclusivity

Ranking of project proposals *may* create contradictory results.

- A. Scale of Investment
- B. Cash-flow Pattern
- C. Project Life



	NET CA	SH FLOWS
END OF YEAR	Project S	Project L
0	-\$100	-\$100,000
1	0	
0 2	\$400	
\$156,250	Alterna Barill 3. XX	



Calculate the PBP, IRR, NPV@10%, and PI@10%.

Which project is preferred? Why?

<u>Project</u>	<u>IRR</u>		<u>NPV</u>	<u>P</u>
S	100%	\$	231	3.31
L	25%	\$29	9,132	1.29



Let us compare a *decreasing* cash-flow (D) project and an *increasing* cash-flow (I) project.

	NET CAS	H FLOWS
END OF YEAR	Project D	Project I
0	-\$1,200	-\$1,200
1	1,000	
100 <u>2</u>	500	
600 ₃	100	
1.080	a lite and	



Examine NPV Profiles



Fisher's Rate of Intersection



C. Projec	t Life Diffe	
Let us compare a long	life (X) project and a project.	short life (Y)
	NET CAS	H FLOWS
END OF YEAR	Project X	Project Y
0	-\$1,000	-\$1,000
1	0	
2,000 ₂	0	
0 3	3,375	
0		



Calculate the PBP, IRR, NPV@10%, and PI@10%.

Which project is preferred? Why?

 Project
 IRR
 NPV
 PI

 X
 50%
 \$1,536
 2.54

 Y
 100%
 \$ 818
 1.82

Another Way to Look at Things

 Adjust cash flows to a common terminal year if project "Y" will <u>NOT</u> be replaced. Compound Project Y, Year 1 @10% for 2 years.



Results: IRR* = 34.26% NPV = \$818

*Lower IRR from adjusted cash-flow stream. X is still better.

Replacing Projects with Identical Projects

2. Use *Replacement Chain Approach* (Appendix B) when project "Y" will be replaced.





Capital Rationing occurs when a constraint (or budget ceiling) is placed on the total size of capital expenditures during a particular period.

Example: Julie Miller must determine what investment opportunities to undertake for *Basket Wonders (BW)*. She is limited to a maximum expenditure of \$32,500 only for this capital budgeting period.

Available Projects for BW

Pro	<u>ect</u>	<u>ICO,\$</u>	IRR	<u>.%</u>	<u>NPV,\$</u>	<u>PI</u>
Α	\$5	00	18 5	0	1.10	
В	5,000	25	6,500	2.30		
С	5,000	37	5,500	2.10		
D	7,500	20	5,000	1.67	E 12,500	26
500		1.04 F	15,000	28	21,000	2.40
G	17,500) 19	7,500	1.43	H 25,000	15
6,000) 1.2	4				

Choosing by IRRs for BW

P	roject	ICO	IRR	NP	V	<u>PI</u>	
С	\$5,0)00 (37% \$	5,500	2.10		
F	15,000	28	21,000	2.40			
E	12,500	26	500	1.04			
В	5,000	25	6,500	2.30			
	Р	rojects	C, F, and I	E have t	he thre	e larges	t IRRs.

The resulting *increase* in shareholder wealth is \$27,000 with a \$32,500 outlay.

Choosing by NPVs for BW

<u>Pr</u>	<u>roject</u>	ICO	IRR	NPV	<u>PI</u>	
F	\$15	,000 28	3%	\$21,000	2.40	
G	17,500	19	7,500	1.43		
В	5,000	25	6,500	2.30		

Projects F and G have the two *largest NPVs*.

The resulting *increase* in shareholder wealth is \$28,500 with a \$32,500 outlay.

Choosing by Pls for BW

Pro	<u>oject</u>	ICC)	IRR		NPV	PI	
F	\$15,00	00	28%	\$2	21,000	2.40	В	5,000
25	6,5	00	2.30		С	5,000	37	5,500
2.10	D	7,	500	20		5,000	1.67	G
17, <u>500</u>) 1	9		7,500	1.43			
	D					(In		

Projects F, B, C, and D have the four *largest PIs*.

The resulting increase in shareholder wealth is \$38,000 with a \$32,500 outlay.

Summary of Comparison

<u>Method</u>	Projects Accepted	<u>Value Added</u>
PI	F, B, C, and D	\$38,000
NPV	F and G	\$28,500
IRR	C, F, and E	\$27,000

PI generates the *greatest increase* in *shareholder wealth* when a limited capital budget exists for a *single period*.

Post-Completion Audit: Usus Magister Est Optimus

Post-completion Audit

A formal comparison of the actual costs and benefits of a project with original estimates.

Identify any project weaknesses Develop a possible set of corrective actions Provide appropriate feedback

Result: Making better future decisions!

Multiple IRR Problem

Let us assume the following cash flow pattern for a project for Years 0 to 4: -\$100 +\$100 +\$900 -\$1,000

How many *potential* IRRs could this project have?

Two!! There are as many potential IRRs as there are sign changes.

NPV Profile - Multiple IRRs



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NPV Profile – Multiple IRRs



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<u>Hint</u>: Your calculator will only find ONE IRR – even if there are multiple IRRs. It will give you the lowest IRR. In this case, 12.95%.