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Chapter 9

Finance 300

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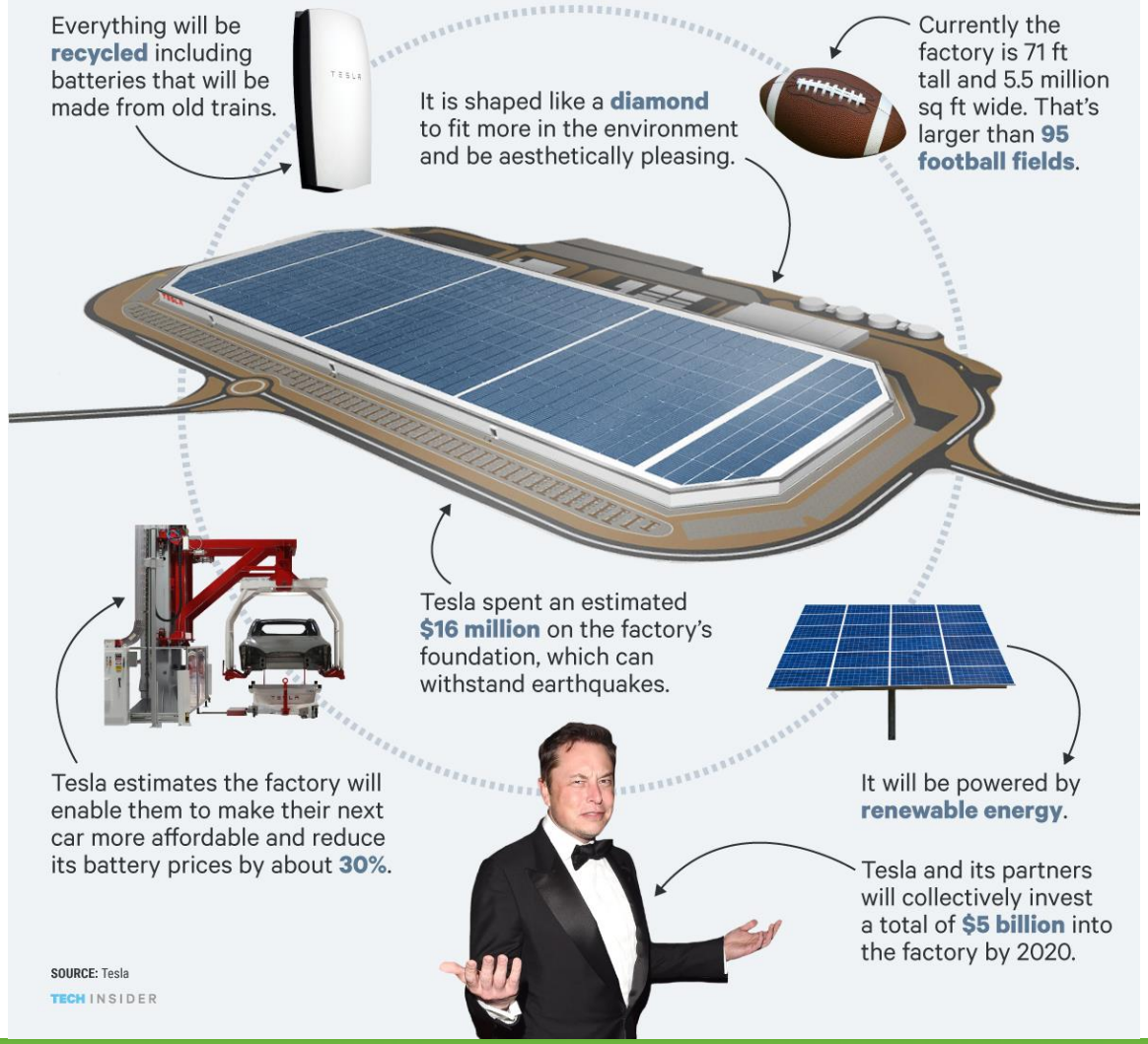
Personal Capital Budgeting Examples

- Graduate school
  - How expensive is grad school?
  - How long will it take?
  - How much more will I make with a grad degree?
  - What are the opportunity costs of wages while in grad school?
- Repair or replace your car
  - How expensive is new car?
  - How much are my expected repair bills going to be with the old car?
  - How long before the old car is inoperable?

7 facts about Tesla's new **Gigafactory**

Tesla is building a giant battery factory in Nevada that will produce more lithium-ion batteries by 2020 than all other battery manufactures combined.



SOURCE: Tesla

TECH INSIDER

College cash flows

- Average costs to attend a 4 year public university in the U.S. have risen from about $10,500 in 1996 to about $19,500 in 2016.

- As of 2015, the average annual earnings for a high school graduate were $30,000. The average starting annual earnings for a college graduate with a business degree were $49,000. For simplicity, let's ignore taxes and just assume these are all after-tax cash flows.

- Assume that you complete the degree in 4 years. You work for 50 years after attaining your degree and college salary grows at 3% annually. All cash flows occur at the end of the period (e.g. no outflows at t=0).

We will come back to this at the end of the lecture

Capital Budgeting

- Analysis of potential projects
  - Fixed Asset
  - New product
  - Enter new market
- Long-term decisions
- Large expenditures
- Difficult/impossible to reverse
- Determines firm's strategic direction
  - Alternative name for capital budgeting

Good Decision Criteria

- All cash flows considered?
- TVM considered?
- Risk-adjusted?
- Ability to rank projects?
- Indicates added value to the firm?

Sample Project Data

- You are looking at a new project and have estimated the following cash flows, net income and book value data:
  - Year 0: CF = -165,000
  - Year 1: CF = 63,120
  - Year 2: CF = 70,800
  - Year 3: CF = 91,080
  - Your required return for assets of this risk is 12%.
- This project will be the example for all problem exhibits in this chapter.

Net Present Value

How much value is created from undertaking an investment?

Step 1: Estimate the expected future cash flows.

Step 2: Estimate the required return for projects of this risk level.

Step 3: Find the present value of the cash flows and subtract the initial investment to arrive at the Net Present Value.

Net Present Value

Sum of the PVs of all cash flows

$$\boxed{NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+R)^t}}$$

NOTE: t=0

Initial cost often is CF_0 and is an outflow.

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+R)^t} - CF_0$$

NPV – Decision Rule

- ***If NPV is positive, accept the project***
- NPV > 0 means:
  - Project is expected to add value to the firm
  - Will increase the wealth of the owners
- NPV is a direct measure of how well this project will meet the goal of increasing shareholder wealth.

Computing NPV for the Project

- Using the formula: $$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+R)^t}$$

NPV = -165,000/$(1.12)^0$ + 63,120/$(1.12)^1$ + 70,800/$(1.12)^2$ + 91,080/$(1.12)^3$ = 12,627.41

Capital Budgeting Project **NPV**

		Required Return =	12%
Year	**CF**	**Formula**	**Disc CFs**
0	(165,000.00)	=(-165000)/(1.12)^0 =	(165,000.00)
1	63,120.00	=(63120)/(1.12)^1 =	56,357.14
2	70,800.00	=(70800)/(1.12)^2 =	56,441.33
3	91,080.00	=(91080)/(1.12)^3 =	64,828.94
			12,627.41

Calculating NPVs with Calculator

- NPV function: =NPV(rate,CF0,CF1-CFt)
  - First parameter = required return entered as a percentage
  - Second parameter = Cash flow at time 0 (enter as negative if outflow)
  - Third parameter=Cash flows from time 1 on: enter using List function
- How to make a list?
  - Enter {
  - Enter Cash flows separated by ,
  - Enter }
  - Hit STO ➡
  - Hit L1

Calculating NPVs with Excel

- NPV function: =NPV(rate,CF01:CFnn)
  - First parameter = required return entered as a decimal (5% = .05)
  - Second parameter = range of cash flows ***beginning with year 1***
- After computing NPV, subtract the initial investment (CF0)

	A	B	C	D
2			**Required Return =**	**12%**
3	**Year**	**CF**	**Formula**	**Disc CFs**
4	**0**	**(165,000.00)**	**=(-165000)/(1.12)^0 =**	**(165,000.00)**
5	**1**	**63,120.00**	**=(63120)/(1.12)^1 =**	**56,357.14**
6	**2**	**70,800.00**	**=(70800)/(1.12)^2 =**	**56,441.33**
7	**3**	**91,080.00**	**=(91080)/(1.12)^3 =**	**64,828.94**
8				**12,627.41**
9				
10		**EXCEL**	**=NPV(D2,B5:B7)**	**177,627.41**
11			**NPV + CF0**	**12,627.41**

Rationale for the NPV Method

- NPV = PV inflows – Cost

  NPV=0 → Project's inflows are "exactly sufficient to repay the invested capital and provide the required rate of return"

- NPV = net gain in shareholder wealth

- **Rule: Accept project if NPV > 0**

NPV Method

- Meets all desirable criteria
  - Considers all CFs
  - Considers TVM
  - Adjusts for risk
  - Can rank mutually exclusive projects
- Directly related to increase in V_F
- <u>Dominant method</u>; always prevails
- Disadvantage: relies heavily on correct discount rate

Payback Period

- How long does it take to recover the initial cost of a project?
- Computation
  - Estimate the cash flows
  - Subtract the future cash flows from the initial cost until initial investment is recovered
  - A “break-even” type measure
- Decision Rule – ***Accept if the payback period is less than some preset limit***

Computing Payback for the Project

Capital Budgeting Project

Year	CF	Cum. CFs
0	$ (165,000)	$ (165,000)
1	$ 63,120	$ (101,880)
2	$ 70,800	$ (31,080)
3	$ 91,080	$ 60,000

Payback = year 2 +
+ (31080/91080)

Payback = 2.34 years

- ***Do we accept or reject the project?***

Decision Criteria Test
Payback

- Does the payback rule:
  - Account for the time value of money?
  - Account for the risk of the cash flows?
  - Provide an indication about the increase in value?
  - Permit project ranking?
- Should we consider the payback rule for our primary decision rule?

Advantages and Disadvantages of Payback

- Advantages
  - Easy to understand
  - Adjusts for uncertainty of later cash flows
  - Biased towards liquidity
  - Good for small projects(<$10,000)

ASKS THE WRONG QUESTION!

- Disadvantages
  - Ignores the time value of money
  - Requires an arbitrary cutoff point
  - Ignores cash flows beyond the cutoff date
  - Biased against long-term projects, such as research and development

Internal Rate of Return

- Most important alternative to NPV
- Widely used in practice
- Intuitively appealing
- Based entirely on the estimated cash flows
- Independent of interest rates

IRR
Definition and Decision Rule

- Definition:
  - **IRR = discount rate that makes the NPV = 0**

- Decision Rule:
  - ***Accept the project if the IRR is greater than the required return***

NPV vs. IRR

NPV: Enter r, solve for NPV

$$\sum_{t=0}^{n} \frac{CF_t}{(1+R)^t} = NPV$$

IRR: Enter NPV = 0, solve for IRR.

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

Computing IRR For The Project

- Without a financial calculator or Excel, this becomes a trial-and-error process
- Calculator
  - Make list of the cash flows as for NPV
  - Use IRR(CFO,L1)
  - IRR = 16.13% > 12% required return
- ***Do we accept or reject the project?***

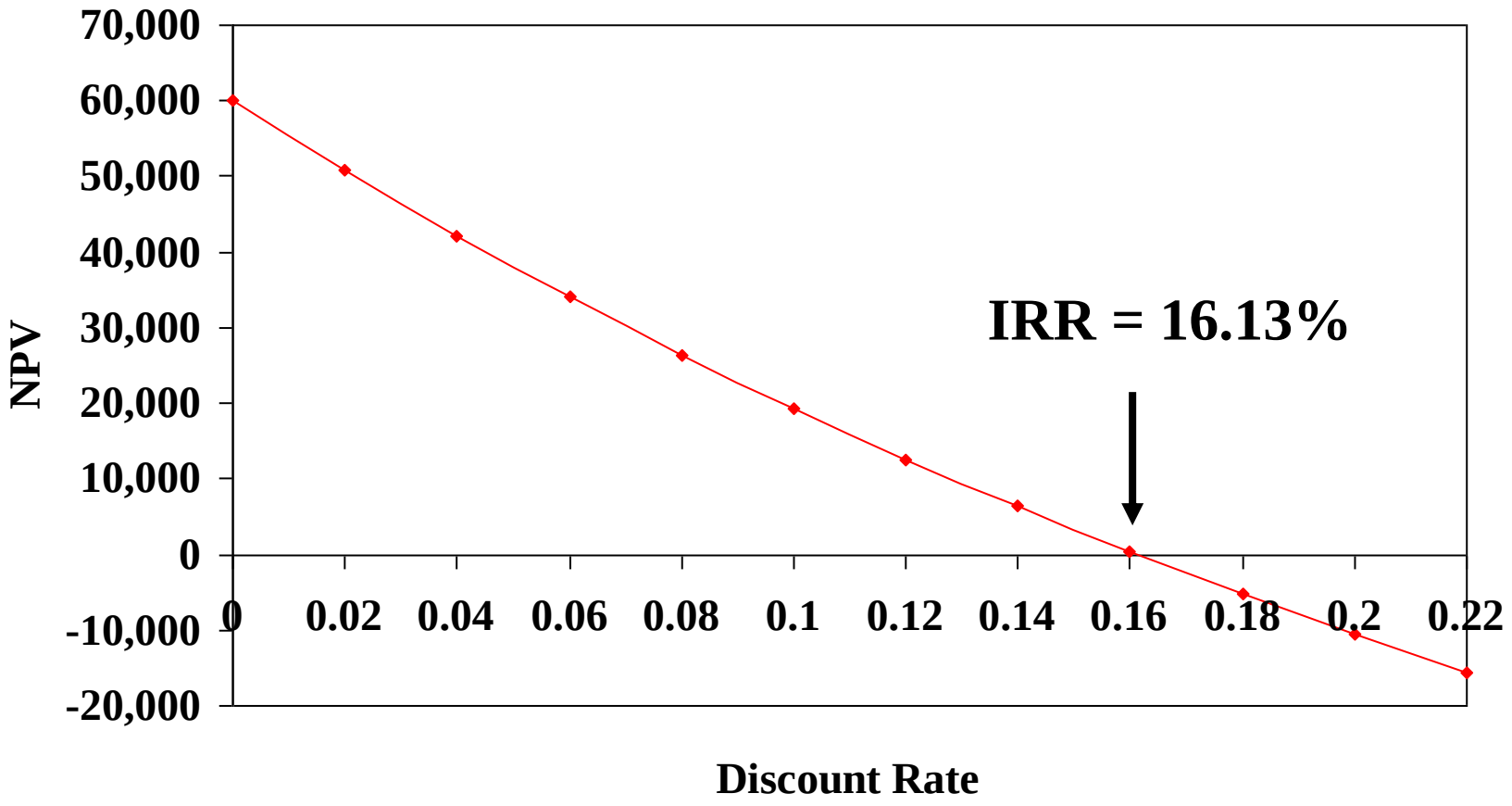
Calculating IRR with Excel

- Start with the cash flows as you did to solve for NPV
- Use the IRR function
  - Enter the range of cash flows, beginning with the initial cash flow (Cash flow 0)
  - You can enter a guess, but it is not necessary
  - The default format is a whole percent

Calculating IRR with Excel

	A	B	C
1	**IRR**		
2	**Year**	**CF**	
3	**0**	**(165,000.00)**	
4	**1**	**63,120.00**	
5	**2**	**70,800.00**	
6	**3**	**91,080.00**	
7			
8	**EXCEL**	**=IRR(B3:B6)**	**16.13%**

NPV Profile For The Project



Decision Criteria Test
IRR

- Does the IRR rule:
  - Account for the time value of money?
  - Account for the risk of the cash flows?
  - Provide an indication about the increase in value?
  - Permit project ranking?
- Should we consider the IRR rule for our primary decision criteria?

IRR - Advantages

- Preferred by executives
  - Intuitively appealing
  - Easy to communicate the value of a project
- If the IRR is high enough, may not need to estimate a required return
- Considers all cash flows
- Considers time value of money
- Provides indication of risk

IRR - Disadvantages

- Can produce multiple answers
- Cannot rank mutually exclusive projects
- Reinvestment assumption flawed

Summary of Decisions for the Project

Summary	
Net Present Value	***Accept***
Payback Period	***???***
Internal Rate of Return	***Accept***

NPV vs. IRR

- NPV and IRR will generally give the same decision
- Exceptions
  - **Non-conventional cash flows**
    - Cash flow sign changes more than once
  - **Mutually exclusive projects**
    - Initial investments are substantially different
    - Timing of cash flows is substantially different
    - Will not reliably rank projects

IRR & Non-Conventional Cash Flows

- "Non-conventional"
  - Cash flows change sign more than once
  - Most common:
    - Initial cost (negative CF)
    - A stream of positive CFs
    - For example, nuclear power plant or strip mine.
  - More than one IRR ….
  - Which one do you use to make your decision?

Non-Conventional Cash Flows

- Suppose an investment will cost $90,000 initially and will generate the following cash flows:
  - Year 1: 132,000
  - Year 2: 100,000
  - Year 3: -150,000
- The required return is 15%.
- Should we accept or reject the project?

Non-Conventional Cash Flows

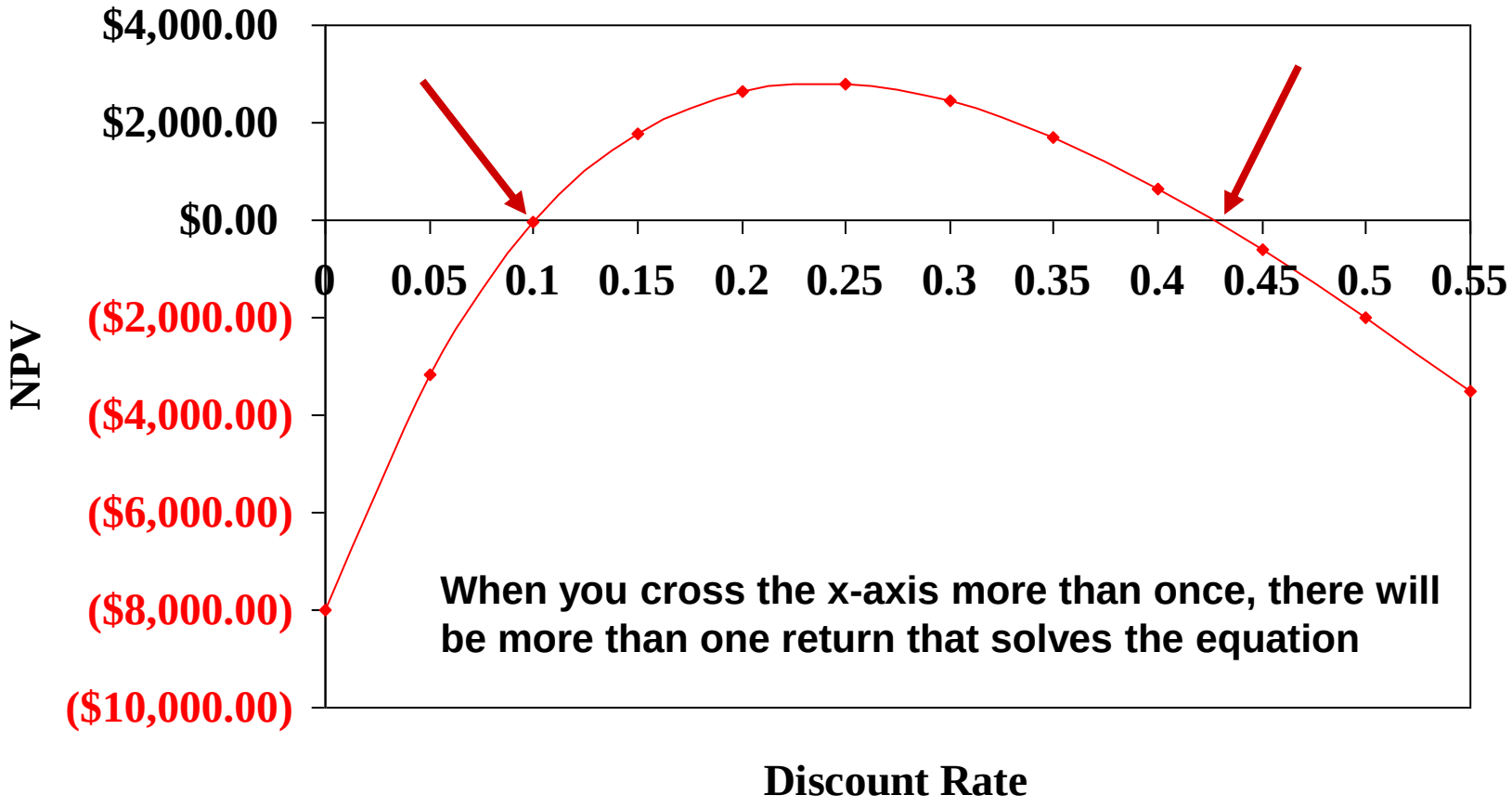
Summary of Decision Rules

- NPV > 0 at 15% required return, so you should ***Accept***
- IRR =10.11% (using a financial calculator), which would tell you to ***Reject***
- Recognize the non-conventional cash flows and look at the NPV profile

I =	15%	
YR	CF	
0	-$90,000	
1	$132,000	
2	$100,000	
3	-$150,000	
NPV	$1,769.54	> 0
IRR-1	10.11%	< 15%
IRR-2	42.66%	> 15%

NPV Profile

IRR = 10.11% and 42.66%



Independent versus Mutually Exclusive Projects

- Independent
  - The cash flows of one project are unaffected by the acceptance of the other.
- Mutually Exclusive
  - The acceptance of one project precludes accepting the other.

Reinvestment Rate Assumption

- IRR assumes reinvestment at IRR
- NPV assumes reinvestment at the firm's weighted average cost of capital (opportunity cost of capital)
  - More realistic
  - NPV method is best
- NPV should be used to choose between mutually exclusive projects

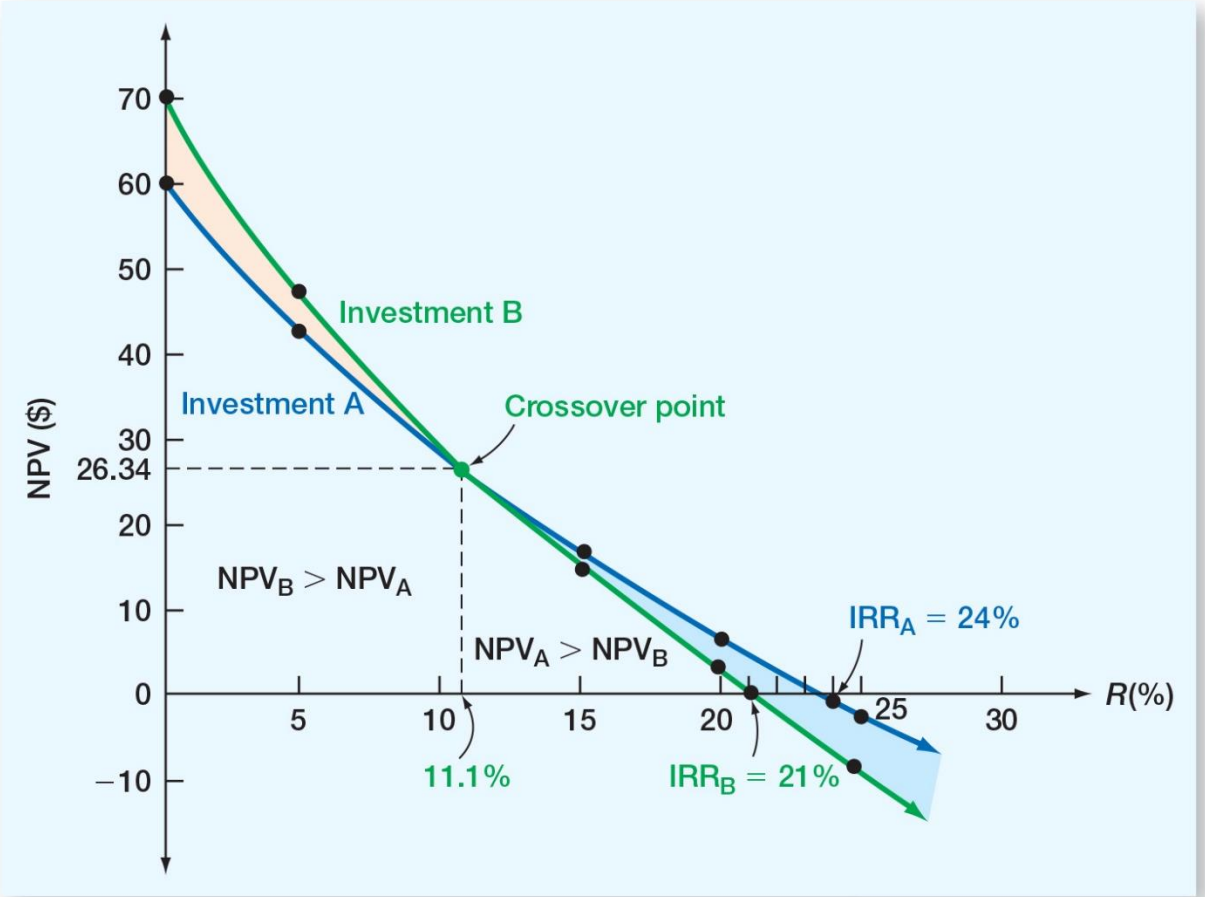
Example of Mutually Exclusive Projects

Period	Project A	Project B
0	-500	-400
1	325	325
2	325	200
IRR	19.43%	**22.17%**
NPV	**64.05**	60.74

The required return for both projects is 10%.

Which project should you accept and why?

Example 2 -Graph



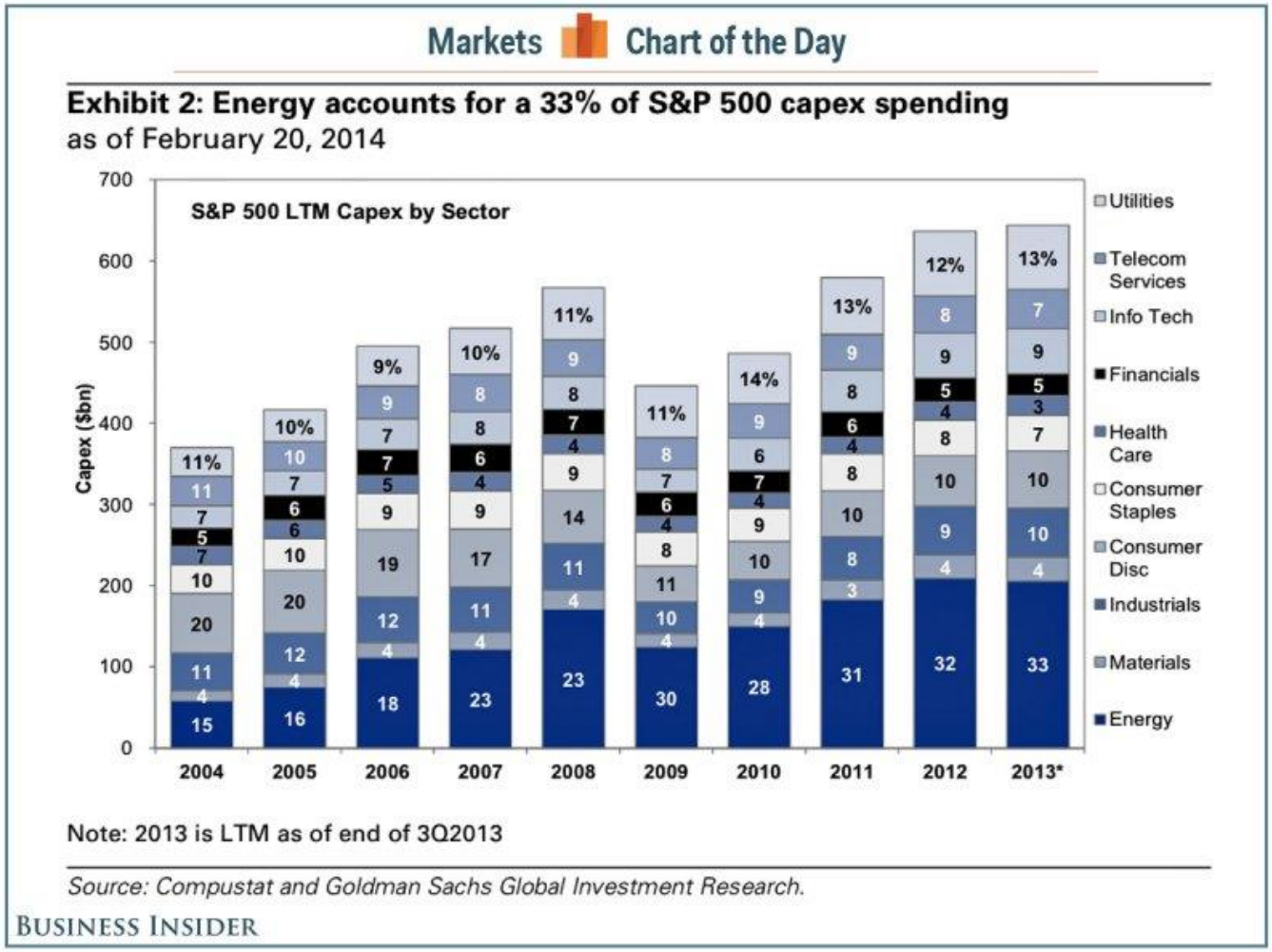
Conflicts Between NPV and IRR

- NPV directly measures the increase in value to the firm
- Whenever there is a conflict between NPV and another decision rule, ***always*** use NPV
- IRR is unreliable in the following situations:
  - Non-conventional cash flows
  - Mutually exclusive projects

Other capital budgeting tools (we will ignore these, know that they exist)

- Modified Internal Rate of Return (MIRR)
- Average Accounting Return
- Discounted Payback
- Profitability Index

Capital budgeting importance



In practice

TABLE 9.6 Capital Budgeting Techniques in Practice

A. Historical Comparison of the Primary Use of Various Capital Budgeting Techniques

	1959	1964	1970	1975	1977	1979	1981
Payback period	34%	24%	12%	15%	9%	10%	5.0%
Average accounting return (AAR)	34	30	26	10	25	14	10.7
Internal rate of return (IRR)	19	38	57	37	54	60	65.3
Net present value (NPV)	—	—	—	26	10	14	16.5
IRR or NPV	19	38	57	63	64	74	81.8

B. Percentage of CFOs Who Always or Almost Always Used a Given Technique in 1999

Capital Budgeting Technique	Percentage Always or Almost Always Using	Average Score [Scale is 4 (always) to 0 (never)]		
		Overall	Large Firms	Small Firms
Internal rate of return	76%	3.09	3.41	2.87
Net present value	75	3.08	3.42	2.83
Payback period	57	2.53	2.25	2.72
Discounted payback period	29	1.56	1.55	1.58
Accounting rate of return	20	1.34	1.25	1.41
Profitability index	12	.83	.75	.88

SOURCES: J.R. Graham and C.R. Harvey, "The Theory and Practice of Corporate Finance: Evidence from the Field," *Journal of Financial Economics,* May–June 2001, pp. 187–243; J.S. Moore and A.K. Reichert, "An Analysis of the Financial Management Techniques Currently Employed by Large U.S. Corporations," *Journal of Business Finance and Accounting,* Winter 1983, pp. 623–45; M.T. Stanley and S.R. Block, "A Survey of Multinational Capital Budgeting," *The Financial Review,* March 1984, pp. 36–51.

Capital Budgeting In Practice

- Consider all investment criteria when making decisions
- NPV and IRR are the most commonly used primary investment criteria
- Payback is a commonly used secondary investment criteria
- All provide valuable information

NPV Summary

Net present value =

- Difference between market value (PV of inflows) and cost
- Accept if NPV > 0
- No serious flaws
  - Does require an appropriate discount rate
- Preferred decision criterion

IRR Summary

Internal rate of return =

- Discount rate that makes NPV = 0
- Accept if IRR > required return
- Same decision as NPV with conventional cash flows
- Does not require a discount rate
- Unreliable with:
  - Non-conventional cash flows
  - Mutually exclusive projects
- MIRR = better alternative

Payback Summary

Payback period =

- Length of time until initial investment is recovered
- Accept if payback < some specified target
- Doesn't account for time value of money
- Ignores cash flows after payback
- Arbitrary cutoff period
- Asks the wrong question

Why is IRR popular in practice?

- People like rates instead of dollars.

Ex.

"Remodeling the clerical wing has a 20% return"

Vs.

"At a 10% discount rate, the net present value is $4,000."

Quick Quiz

- Consider an investment that costs $100,000 and has a cash inflow of $25,000 every year for 5 years. The required return is 9% and required payback is 4 years.
  - What is the payback period?
  - What is the NPV?
  - What is the IRR?
  - Should we accept the project?
- What decision rule should be the primary decision method?
- When is the IRR rule unreliable?

Quick Quiz Solution

Quick Quiz **Chapter 8**

r =		9%
Req. PB =		4 yrs

t	CF	Cumulatve CFs	DCF	Cumulative DCFs
0	(100,000.00)	(100,000.00)	(100,000.00)	(100,000.00)
1	25,000.00	(75,000.00)	22,935.78	(77,064.22)
2	25,000.00	(50,000.00)	21,042.00	(56,022.22)
3	25,000.00	(25,000.00)	19,304.59	(36,717.63)
4	25,000.00	0.00	17,710.63	(19,007.00)
5	25,000.00	25,000.00	16,248.28	(2,758.72)
			(2,758.72)	

Payback =	4 years	
NPV =	($2,758.72)	=NPV(E3,C9:C13)+C8
IRR =	7.93%	=IRR(C8:C13)

Practice Problems

1. Benny's is considering adding a new product to its lineup. This product is expected to generate sales for four years after which time the product will be discontinued. What is the project's net present value if the firm wants to earn a 14 percent rate of return?

Year	Cash Flow
0	-$62,000
1	16,500
2	23,800
3	27,100
4	23,300

Practice Problems

2. What is the IRR?

Year	Cash Flow
0	-$62,000
1	16,500
2	23,800
3	27,100
4	23,300

Practice Problems

3. What is the Payback?

Year	Cash Flow
0	-$62,000
1	16,500
2	23,800
3	27,100
4	23,300

Car lease vs buy example