

# **FINANCE FOR NONFINANCE PROFESSIONALS**

Week 2: How to spend money

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# HOW TO SPEND MONEY

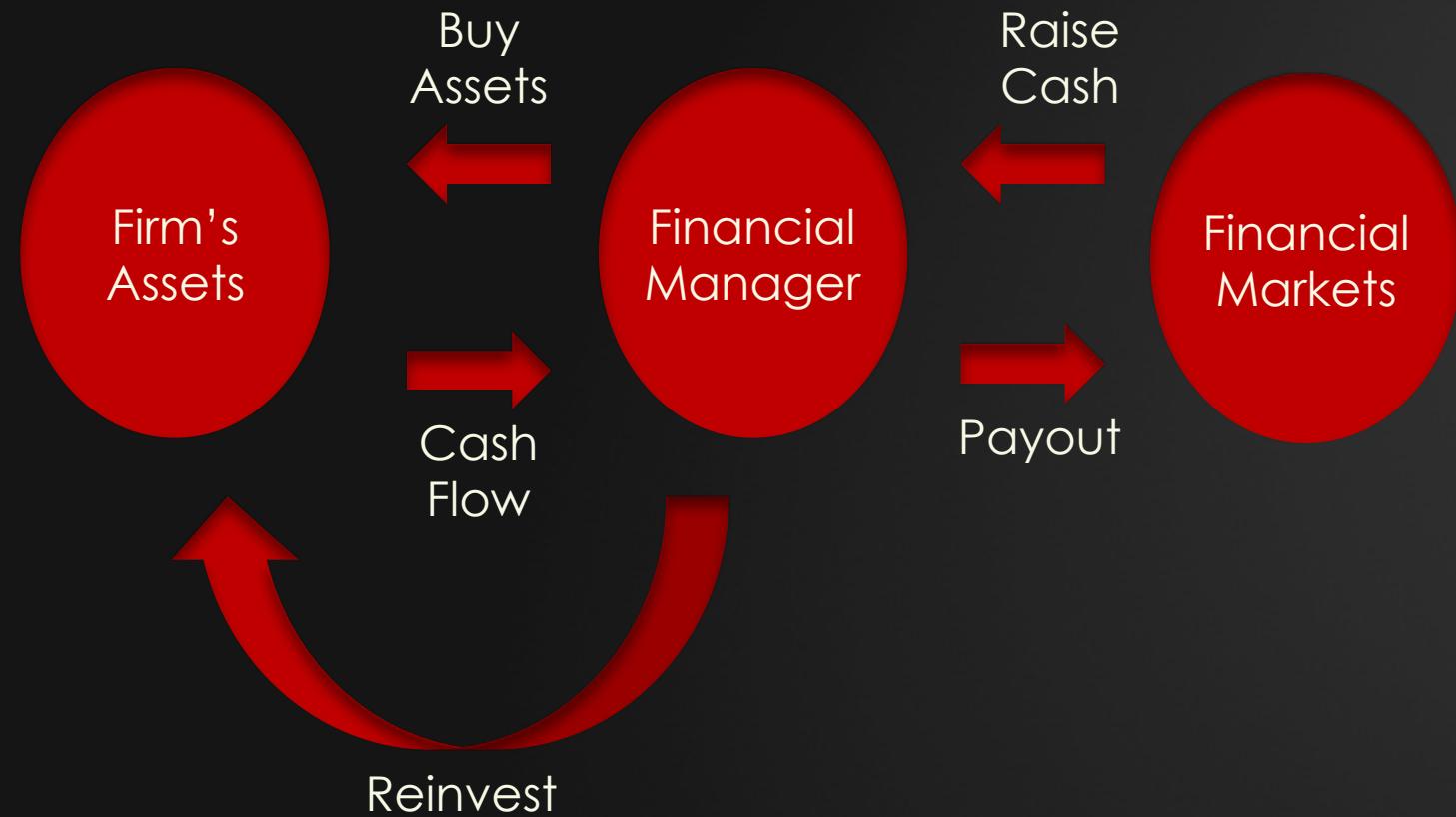
- ▶ Capital budgeting process
- ▶ Net Present Value (NPV)
- ▶ Payback period
- ▶ Accounting ratios
- ▶ Internal rate of return (IRR)
- ▶ Putting it all together

# **HOW TO SPEND MONEY (CAPITAL BUDGETING TOOLS)**

Overview of the  
Capital Budgeting Process

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# CAPITAL BUDGETING PROCESS



# CAPITAL BUDGETING

You have to pay for other peoples' money

Implicitly, you pay them r

How should we decide the how, when,  
and where of how to spend money?

# CAPITAL BUDGETING

Similar to an individual investor:

1. Timing
2. Risk
3. Opportunity Cost

Risk vs. Return over time

# CAPITAL BUDGETING

Best practices:

Arms-length

Objective

Transparent

# CAPITAL BUDGETING

- ▶ Accept or reject
- ▶ Best of a set
- ▶ Rank different projects

When are benefits > costs

Obvious but very tricky!

# CAPITAL BUDGETING

- ▶ Review tools
- ▶ Understand tradeoffs
- ▶ Metrics in perspective
- ▶ Sensitivity analysis
- ▶ Putting it all together

# HOW TO SPEND MONEY (CAPITAL BUDGETING TOOLS)

## Net Present Value

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# NET PRESENT VALUE (NPV)

Add up the PV of all future cash

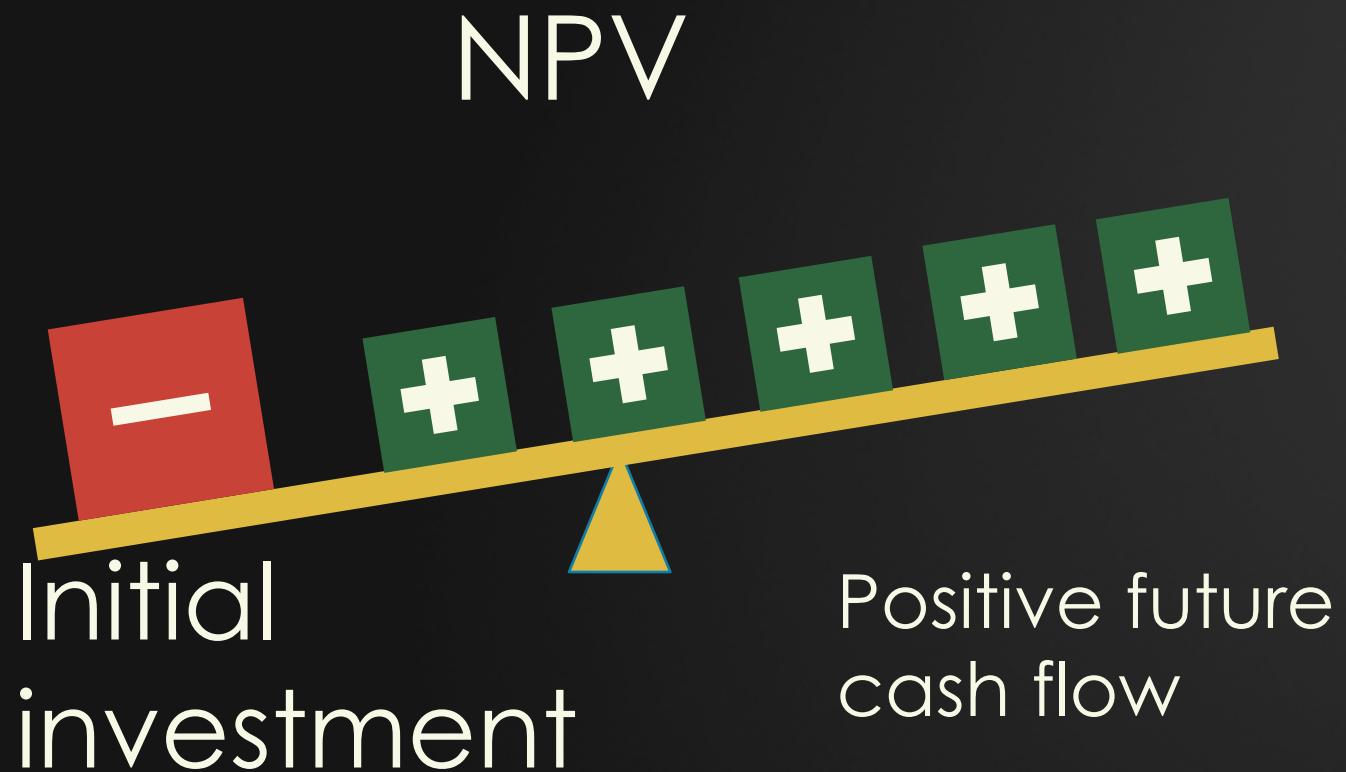
Compare with initial investment

Decision rule: Invest if  $NPV > 0$

# NET PRESENT VALUE (NPV)

NPV formula:

# NET PRESENT VALUE (NPV)



# NET PRESENT VALUE

Problem: Analyze the table of cash flows and compute the NPV if the discount rate is 10%?

Period	Cash Flow		Present Value
0	-\$1,500	→	-\$1,500
1	\$900		\$818.18
2	\$750		\$619.83
Total	\$150		-\$61.98

# NET PRESENT VALUE: MAIN DRIVERS

- ▶ Cash flow (more is better!)
- ▶ Timing (the sooner the better)
- ▶ Discount rate (lower the better)

# NET PRESENT VALUE: WRAP-UP

- ▶ Best capital budgeting tool
- ▶ Incorporates:
  - ▶ Timing
  - ▶ Opportunity cost
  - ▶ Risk
- ▶ Objective
- ▶ Arms-length
- ▶ Transparent

# HOW TO SPEND MONEY (CAPITAL BUDGETING TOOLS)

## Payback Period

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# PAYBACK PERIOD

How long it takes to earn back initial investment

## Decision rule

Invest if payback less than X

# PAYBACK PERIOD: EXAMPLE

Project	Cash Flow				Payback
	0	1	2	3	
X	-\$500	\$500	\$250	\$0	1
Y	-\$500	\$100	\$200	\$600	3
Z	-\$500	\$300	\$400	\$400	1.5

# PAYBACK PERIOD

The good:

Time is money!

Reflects the opportunity cost

---

The bad:

Neglects cash after the payback

Neglects timing

Neglects risk

Arbitrary cut off

# PAYBACK VS NPV

Project	Cash Flow				Payback	NPV (10%)
	0	1	2	3		
X	-\$500	\$500	\$250	\$0	1	\$161
Y	-\$500	\$100	\$200	\$600	3	\$207
Z	-\$500	\$300	\$400	\$400	1.5	\$404

# PAYBACK: WRAP-UP

- ▶ Often a weak capital budgeting tool
- ▶ Accept projects where Payback < X
- ▶ Measures time to recovery
- ▶ Arbitrary, no risk or timing, ad hoc

# HOW TO SPEND MONEY (CAPITAL BUDGETING TOOLS)

Accounting ratios

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# ACCOUNTING RATIOS

Measure the ratio of A/B

Decision rule:

Invest if the ratio > X

# PAYBACK PERIOD: ROIC

- ROIC = return on invested capital

## Decision rule

Invest if ROIC > X

# ROIC: EXAMPLE

	Year 0	Year 1	Year 2	Year 3
Book investment	450	300	150	0
Revenue		600	500	400
Cash outflows		300	250	200
Depreciation		150	150	150
Accounting Profit		150	100	50

# OTHER ACCOUNTING RATIOS

- ▶ Return on assets (ROA)
- ▶ Return on equity (ROE)
- ▶ Gross margin (Gross Profit/Sales)
- ▶ Profit margin (Net profit/Net Sales)
- ▶ Profitability index

# ACCOUNTING RATIOS

The good:

More money is better!

Reflects the use of capital

---

The bad:

Neglects timing

Includes accounting distortions

Neglects risk

Arbitrary cut off

# ACCOUNTING RATIOS: WRAP-UP

- ▶ Accept projects where Ratio < X
- ▶ Weak capital budgeting tool
- ▶ Arbitrary, no risk or timing, ad hoc
- ▶ Not focused on cash creation

# HOW TO SPEND MONEY (CAPITAL BUDGETING TOOLS)

## Internal Rate of Return

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# INTERNAL RATE OF RETURN

What discount rate makes  $NPV = 0$ ?

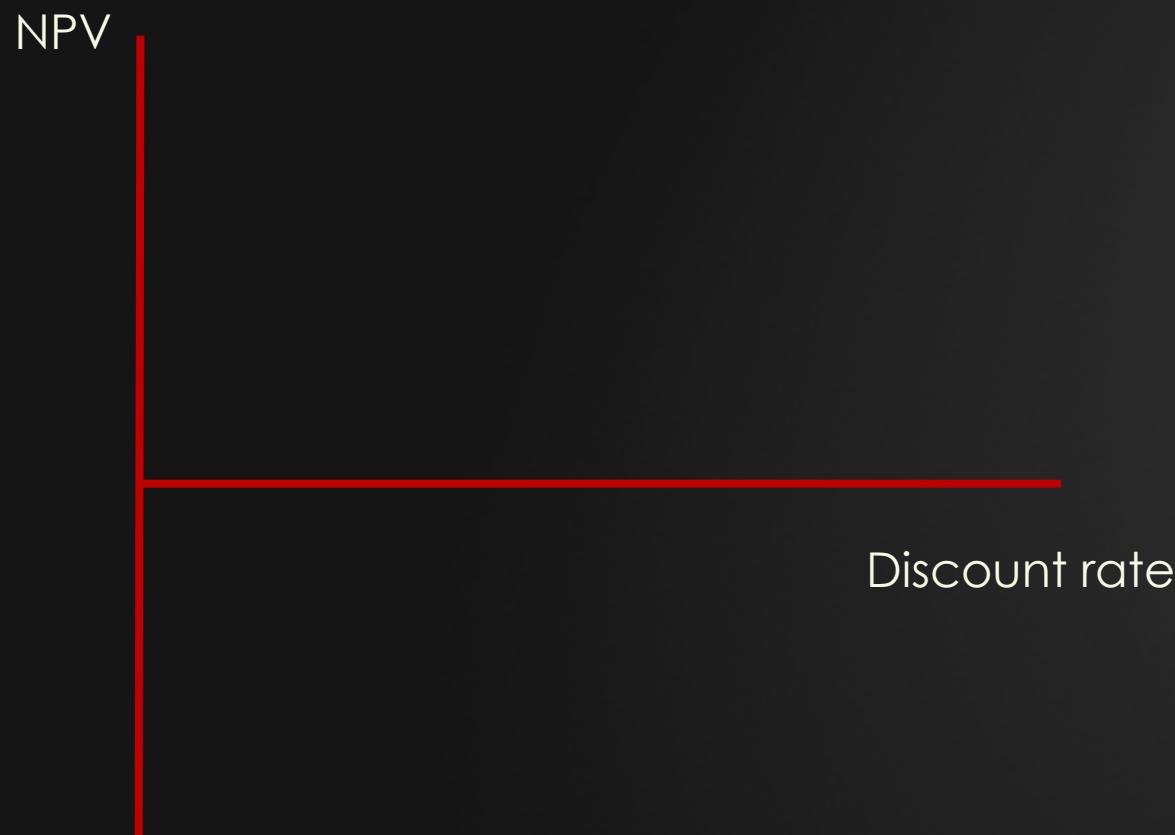
Decision rule: Invest if that rate  $> r$

# IRR

- ▶ Discounting more drives NPV down
- ▶ How hard can NPV get hit and stay  $> 0$
- ▶ This decision rule is similar to NPV

# IRR VS NPV FORMULA

# IRR: RELATION TO NPV RULE



# IRR: EXAMPLE (TRIAL AND ERROR)

Time	Cash Flow	Trial 1 (10%)	Trial 2 (20%)	Trial 3 (16%)
0	(9,364)	(9,364)	(9,364)	(9,364)
1	10,000	9,091	8,333	8,621
2	1,000	826	694	743
NPV	1,636	553	-336	0

# IRR EXAMPLE IN SPREADSHEET

The screenshot shows a Microsoft Excel spreadsheet titled "Book1 - Microsoft Excel". The spreadsheet is used to demonstrate how to calculate the Internal Rate of Return (IRR) for a given cash flow scenario.

**Row 1:** Computing IRR in Excel

**Row 2:** (empty)

**Row 3:** Time, Cash Flow, PV[Cash Flow]

**Row 4:** 0, -\$9,364, -\$9,364

**Row 5:** 1, \$10,000, \$9,091

**Row 6:** 2, \$1,000, \$826

**Row 7:** (empty)

**Row 8:** Disc. Rate, 10%

**Row 9:** NPV, \$553.36, =SUM(C4:C6)

**Row 10:** IRR, 16%, =IRR(B4:B6)

**Row 11:** (empty)

The formula bar at the top shows the formula `=+IRR(B4:B6)` entered into cell B10. The "IRR" function is used to calculate the internal rate of return based on the cash flows provided in cells B4 through B6.

Below the table, the status bar indicates "Ready".

	A	B	C	D	E	F
1	Computing IRR in Excel					
2						
3	Time	Cash Flow	PV[Cash Flow]			
4	0	-\$9,364	-\$9,364			
5	1	\$10,000	\$9,091			
6	2	\$1,000	\$826			
7						
8	Disc. Rate	10%				
9	NPV	\$553.36	=SUM(C4:C6)			
10	IRR	16%	=IRR(B4:B6)			
11						

# INTERNAL RATE OF RETURN

- ▶ Similar to NPV
- ▶ Scales NPV into a %
- ▶ More intuitive
- ▶ Accounts for timing, opportunity cost, and risk

# INTERNAL RATE OF RETURN: WRAP-UP

- ▶ Accept projects where  $\text{IRR} > r$
- ▶ Good capital budgeting tool
- ▶ Accounts for risk, timing, and opportunity
- ▶ Loses the scale

# HOW TO SPEND MONEY (CAPITAL BUDGETING TOOLS)

Wrinkles with IRR

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# WRINKLES WITH IRR

1. Loan-type flows
2. Scale problems
3. Timing problems
4. No IRR or multiple IRRs

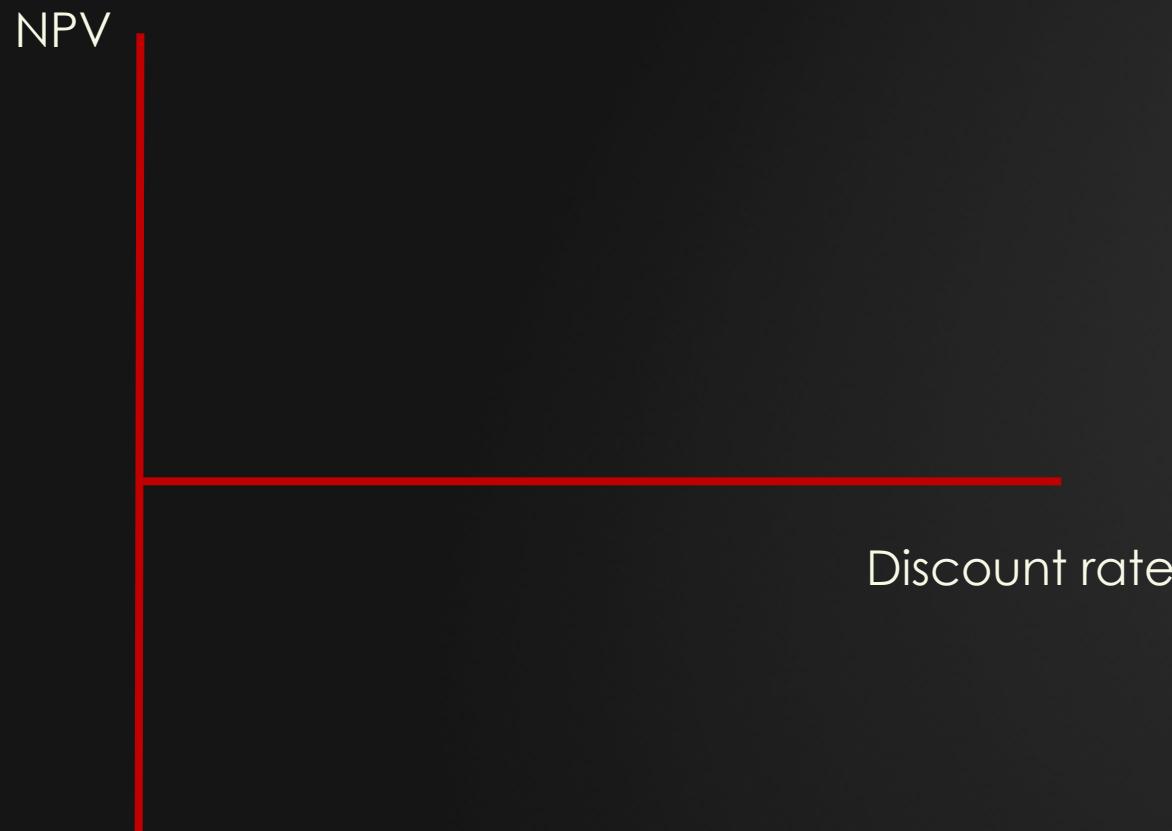
# IRR WITH LOAN-TYPE FLOWS

- ▶ When the cash flows are reversed
- ▶ Money in, then money out
- ▶ Any time the signs flip

# IRR WITH LOAN-TYPE FLOWS: EXAMPLE

Project	$CF_0$	$CF_1$	IRR	NPV at 10%
X	(400)	500	25%	54.54
Y	400	(500)	25%	(54.54)

# IRR WITH LOAN-TYPE FLOWS



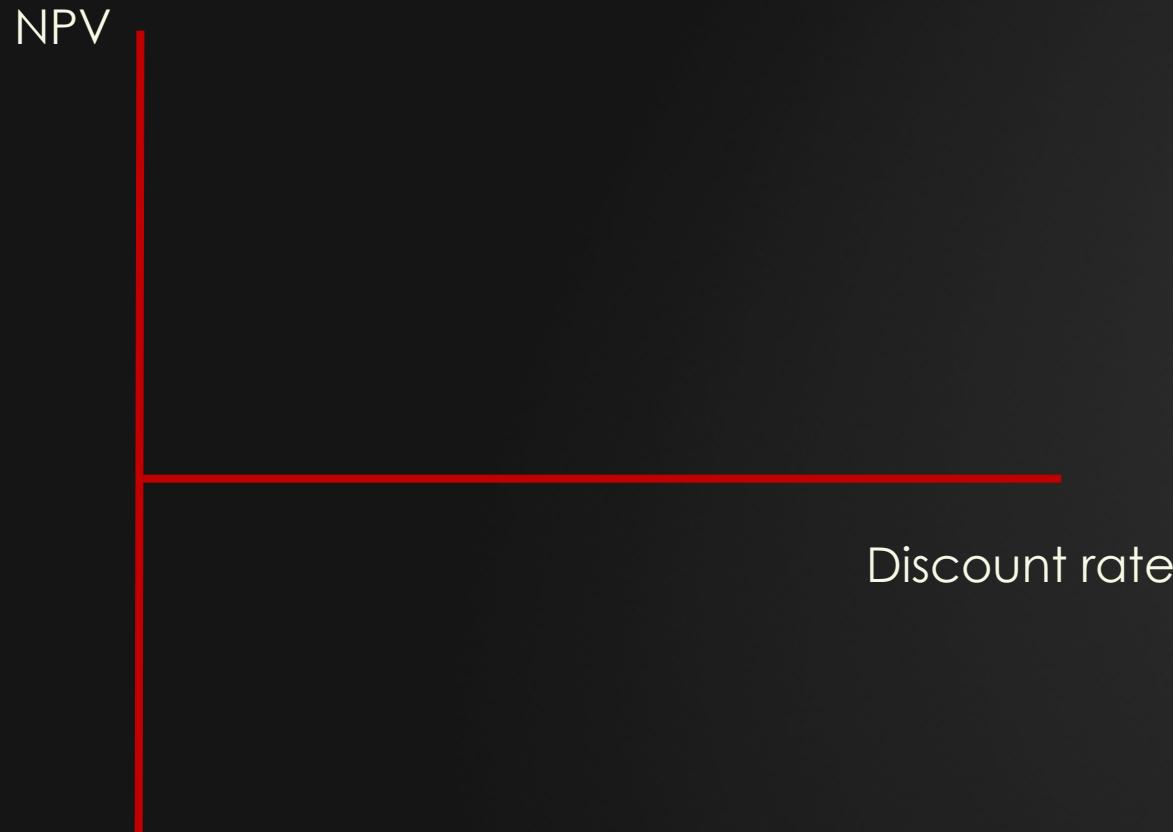
# COMPARING SCALE WITH IRR

- ▶ Hard to compare mutually exclusive projects
- ▶ Higher IRR might now imply higher NPV

# COMPARING SCALE WITH IRR

Project	$CF_0$	$CF_1$	IRR	NPV at 10%
X	-1	2	100%	0.82
Y	-100	120	20%	9.1

# COMPARING SCALE WITH IRR



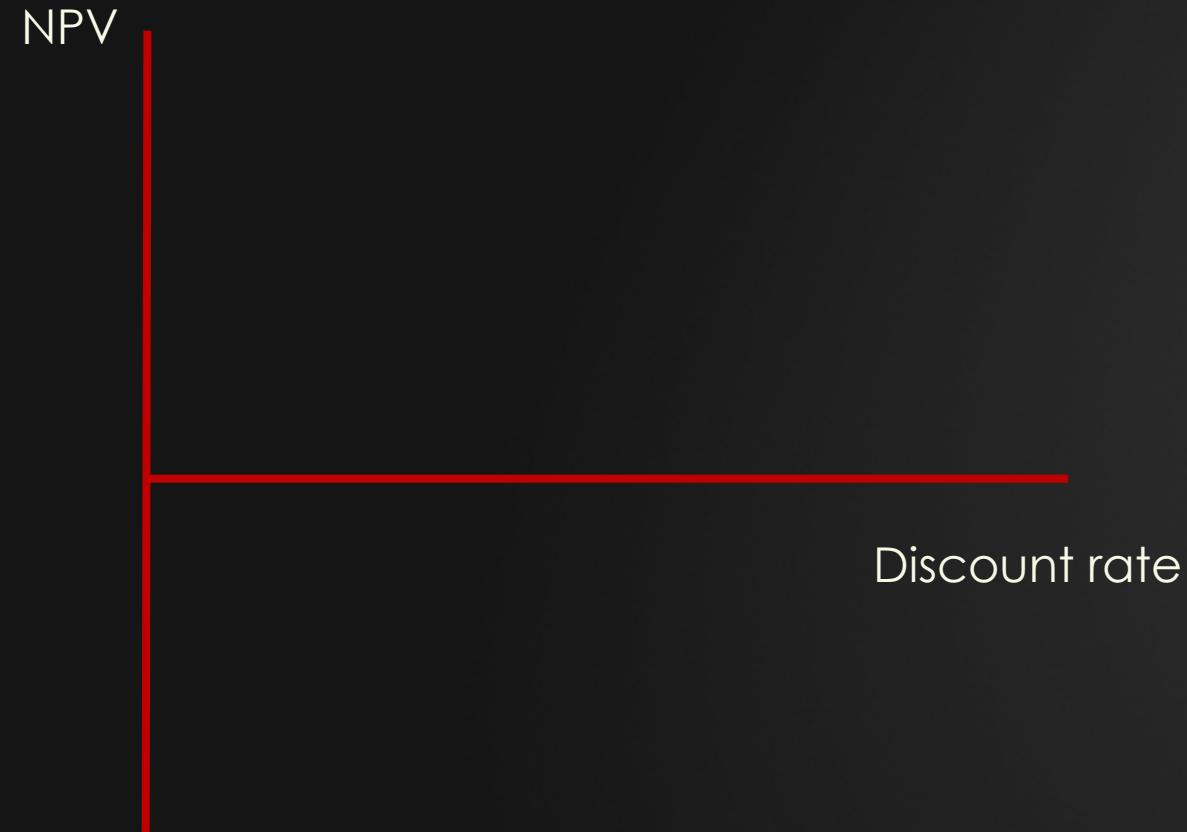
# MULTIPLE OR NO IRR

- ▶ There could be no rate that sets  $NPV = 0$
- ▶ Different rates might set  $NPV = 0$

# COMPARING SCALE WITH IRR

Project	$CF_0$	$CF_1$	$CF_3$	IRR
X	-100	235	136.5	[5%, 30%]
Y	-100	120	-50	--

# MULTIPLE OR NO IRR



# WRINKLES WITH IRR: WRAP-UP

- ▶ Be careful!
- ▶ Always check for sign changes
- ▶ Always check for multiples
- ▶ Always compare with NPV!

# HOW TO SPEND MONEY (CAPITAL BUDGETING TOOLS)

Using all the metrics together

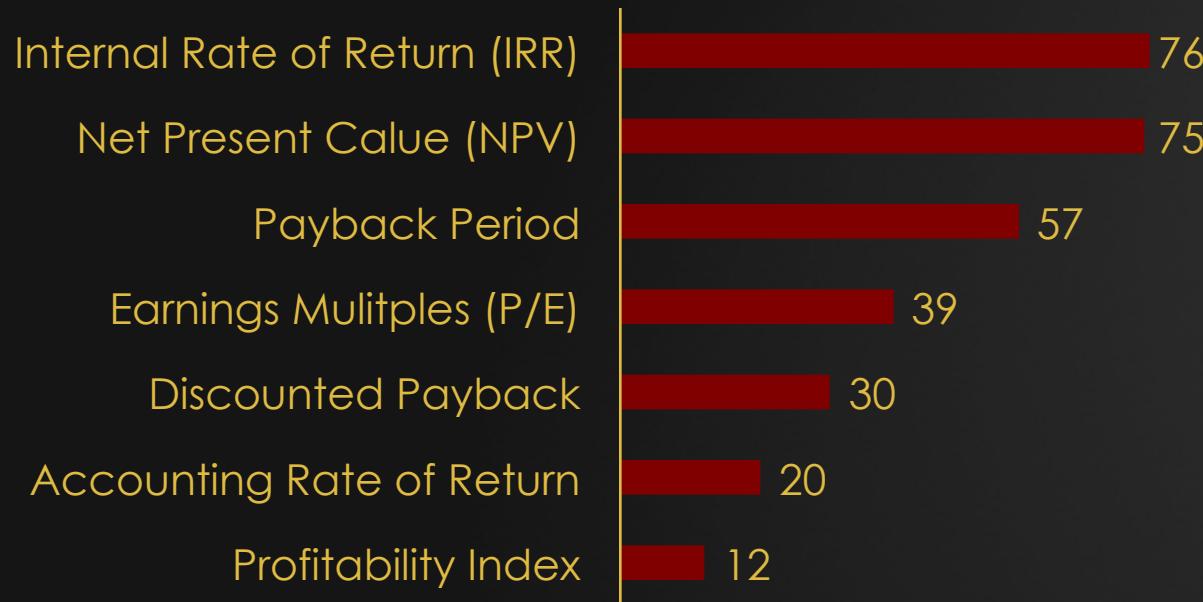
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# PUTTING ALL THE METRICS TOGETHER

Most CFOs rely on multiple metrics



Source: John Graham and Campbell Harvey, 2001

# PUTTING ALL THE METRICS TOGETHER

- ▶ NPV always first best approach
- ▶ IRR puts NPV in perspective
- ▶ Payback can be useful
- ▶ Ratios are informative and easy
- ▶ There should be a consistent theme

# HOW TO SPEND MONEY (CAPITAL BUDGETING TOOLS)

## Sensitivity analysis

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# THE MAIN CAPITAL BUDGETING TOOLS

1. NPV
2. IRR
3. Accounting Ratios
4. Payback

# CASH FLOW FORECASTING

- ▶ Everything depends on forecasts
- ▶ All forecasts are wrong!
- ▶ How sensitive are our decisions?
- ▶ What are the main value drivers?

# SCENARIO ANALYSIS

Time	Cash Flows (Expected)
0	-\$5,000
1	\$3,200
2	\$2,500
3	\$1,200
4	\$1,200
5	\$1,200
NPV (@15%)	\$1,745

# SCENARIO ANALYSIS

Time	Cash Flows		
	(Pessimistic)	(Expected)	(Optimistic)
0	-\$6,000	-\$5,000	-\$5,000
1	\$2,500	\$3,200	\$4,000
2	\$2,000	\$2,500	\$3,000
3	\$1,000	\$1,200	\$2,000
4	\$1,000	\$1,200	\$1,500
5	\$1,000	\$1,200	\$1,500
NPV (@15%)	-\$587	\$1,745	\$3,665

# SENSITIVITY ANALYSIS

- ▶ Expand scenarios
- ▶ Calculate sensitivities
- ▶ Spreadsheets make this easy

# SENSITIVITY ANALYSIS: WRAP UP

- ▶ Assumptions matter
- ▶ Forecasting is an art
- ▶ There is no 100% right answer
- ▶ Understand the limitations
- ▶ Good diagnostic tool

# HOW TO SPEND MONEY (CAPITAL BUDGETING TOOLS)

Spreadsheet Modeling

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# PUTTING ALL THE METRICS TOGETHER

- ▶ Spreadsheets are a powerful tool
- ▶ Organization and best practices
- ▶ Built-in excel functions
- ▶ General layout and review of tools