

How to Estimate the Profitability of an Investment Project?

TU-A1300 - Introduction to Industrial Engineering and Management

Jouko Karjalainen

Learning Objectives

- Explain the generic features of models supporting decision-making
- Understand the concept of Net Present Value (NPV) and related concepts of
 - Free Cash Flow (FCF)
 - Discounted Cash Flow (DCF) and Present Value (PV)
 - Opportunity Cost of Capital
 - NPV's relation to the value of the firm's business operations
- Be able to apply NPV in a straightforward case
 - Identify the challenges in estimating FCF
 - Understand the key concepts of Cost-Volume-Profit (CVP) analysis

A Planning Problem

- Large shopping center
 - 1 million visitors per month
 - 200 shops, 60 000 m²
- The Mystic Boutique
 - 100 m². Pays rent 7 000 €/month
 - Open 7 days a week
 - Wages of attendants 5 000 €/ month
 - Sales margin 50 % ($= 1 - \frac{\text{Purchase price}}{\text{Selling price}}$)
 - Initial investment 48 000 €
 - A three-year loan, 5 % interest rate
 - Estimated net sales 540 000 €/a

Revenue	540,000	100 %
Purchase costs	-270,000	50 %
Sales margin	270,000	50 %
Personnel costs	-60,000	-11 %
Rent	-84,000	-16 %
EBITDA	126,000	23 %
Depreciation	-16,000	-3 %
EBIT	110,000	20 %
Interest	-1,200	0 %
Profit before tax	108,800	20 %
Income tax (20%)	-21,760	-4 %
Net profit	87,040	16 %

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Which Is the Most Uncertain Element?

Can the Mystic Boutique capture enough paying customers from the huge mass of people spending time in or merely passing through the shopping center?

- How many visitors will find by The Mystic Boutique?
 - Is the location in mainstream or in shadows?
- How many visitors will visit the shop & buy something?
 - Is the product variety and pricing correct
- Sales target 540 k€/a
 - 45 k€/month or 1,5 k€/day
- Average daily sales
 - 10 paying customers, spending 150 € each
 - Or 6 spending 250 € each
- Shopping center level
 - 30 000 daily visitors per 200 shops
 - 150 potential customers per shop?

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Break-Even Point

- How successful is the shopping center as a whole?
- After opening 20 000 visitors per day
 - 60 % of the estimated
- Experts say it will take 2-3 years to reach the expectations

Revenue	324,000	100 %
Purchase costs	-162,000	50 %
Sales margin	162,000	50 %
Personnel costs	-60,000	-19 %
Rent	-84,000	-26 %
EBITDA	18,000	6 %
Depreciation	-16,000	-5 %
EBIT	2,000	1 %
Interest	-1,200	0 %
Profit before tax	0,800	0 %
Income tax (20%)	-0,160	0 %
Net profit	0,640	0 %

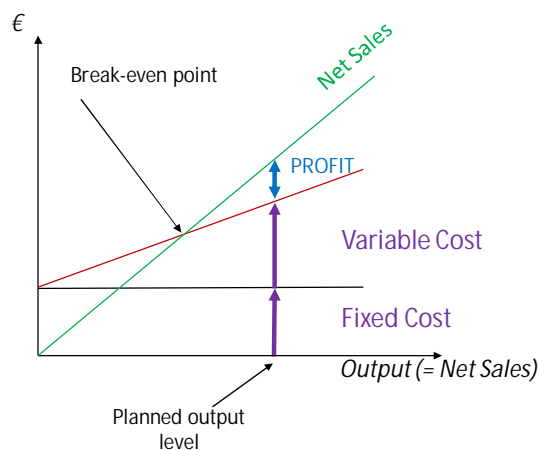
Annual revenue of 320 k€

► EBIT=0, Net profit= -1,2 k€

► Total cash flow= +14,8 k€

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Cost-Volume-Profit Analysis



$$\begin{aligned}
 & \text{Net Sales} && (\text{price} \cdot \text{quantity}) \\
 & - \text{Variable Cost} && (\text{unit cost} \cdot \text{quantity}) \\
 & \hline
 & = \text{Contribution margin} \\
 & - \text{Fixed Cost} \\
 & \hline
 & = \text{Profit (e.g. EBITDA)}
 \end{aligned}$$

$$CM_{[\%]} = \frac{\text{Net Sales} - \text{Variable Cost}}{\text{Net Sales}}$$

$$EBITDA = \text{Net Sales} \cdot CM_{[\%]} - \text{Fixed Cost}$$

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Short-Term Decisions

- If daily sales is 60 % of the predicted, The Mystic Boutique probably has a large inventory
 - How fast do products become obsolete?
 - Fashion products
 - Necessities
 - The aging inventory
 - What is the highest price we can get?
 - What is the lowest price we can tolerate?
- Space needs to be made for the next seasons products
 - The actual sales value will be less than the planned
 - The average contribution margin will be less than 50 %
 - Lowering price level of the remaining inventory
 - Eventually, selling below the purchase price may be the best option

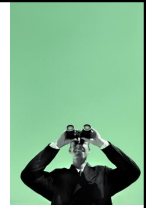
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Variable and Fixed Costs

- Variability depends on the time horizon and the predictability of the demand
- How fast can you acquire resources to match increasing demand?
 - The smallest amount that is economical to acquire
 - How to cope with unexpected peaks
- How fast can you adjust the costs to match decreasing demand?
 - Inventoriable goods that keep their value are variable even in the short run
 - Contracts affect how fast you can reduce costs
 - Work force
 - Rent
- In detail, variable costs do not always change linearly, and fixed costs are not completely fixed

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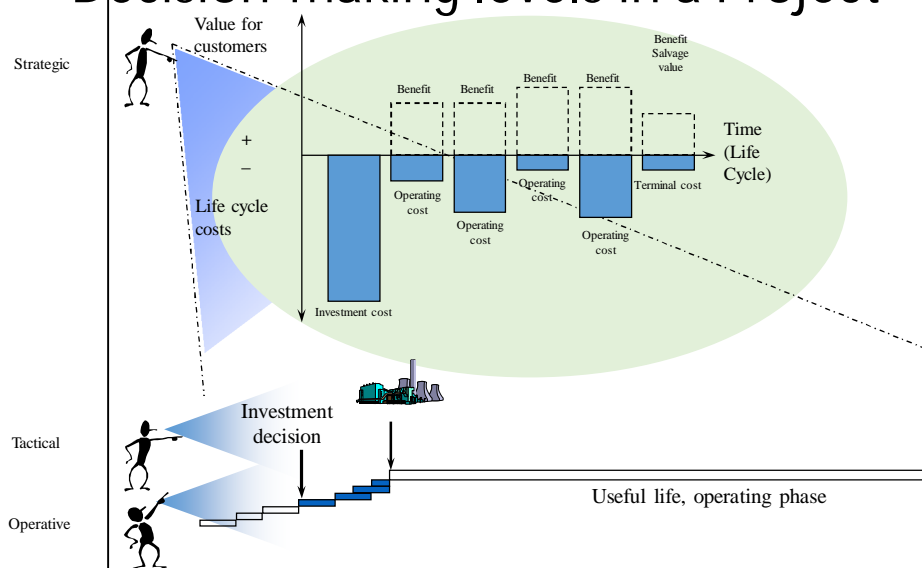
Identifying Future Benefits and Costs



- Incremental benefits caused by the decision
 - Customer segments, Revenue streams
 - How much channels take from the price-to-customer
- Incremental costs caused by the decision
 - Investment costs (Initial investment)
 - Recurrent costs (Variable or Fixed)
- Sunk costs must be ignored!
 - Past costs or costs caused by past decisions
 - Unavoidable because they cannot be changed no matter what action is taken now
- Consider indirect effects (project externalities)
 - Is there a cost for using existing resources
 - Does launching the new product affect the sales of old products

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Decision-making levels in a Project

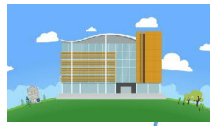


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Data Center as an Investment

Capacity

- 25 MW IT power
- 200 000 servers

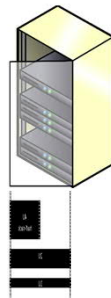


Investment cost 200 M€

- Building
- Infrastructure
- Connection

Revenue 40 M€/a

- Data center services

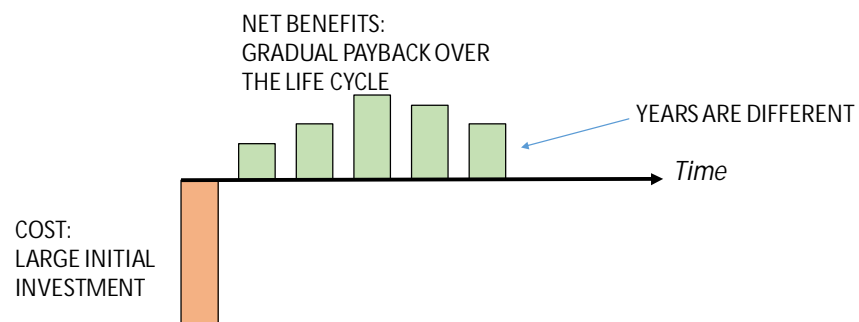


Operating cost 14 M€/a

- Energy
- Personnel
- Maintenance

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Cash Flows in Long-Term Decisions



COUNTING SIMPLY (SUM OF NET BENEFITS – INVESTMENT COST) OR THE
AVERAGE ANNUAL PROFIT MISSES THE TIME-VALUE OF MONEY
i.e., THE REQUIRED RETURN OF THE INVESTMENT
► DISCOUNTED CASH FLOW (DCF) TECHNIQUE

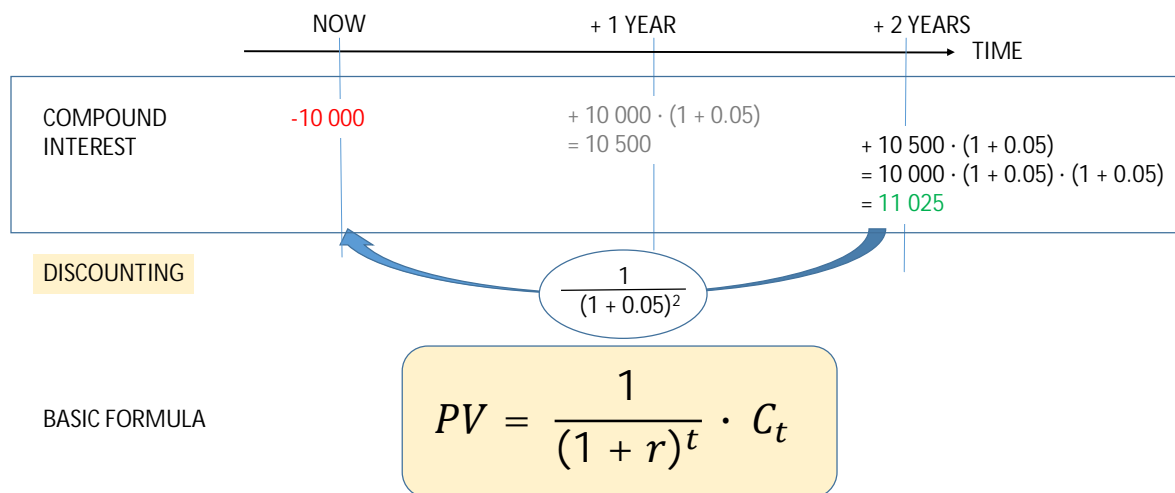
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Compare Alternatives for Investing Money

	INVEST NOW	RECEIVE + 1 YEAR	TIME
LEND MONEY	-10 000	$+10\,000$ $+ 500 = 10\,000 \cdot 5\%$ $+10\,500 = 10\,000 \cdot (1 + 0.05)$	
BUY AN IOU (I owe you 5000 in a year)	- X	$+ X$ $+ X \cdot 5\%$ $+ 5\,000 = X \cdot (1 + 0.05)$	$\leftrightarrow X = \frac{5\,000}{(1 + 0.05)}$
BUY SHARES	-10 000	+ ?	DIFFERENT RISK!

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Present Value (PV)



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Compare Streams of Cash Flow

Compound interest
 $r = 2\%$

now	+ 1 year	+ 2 years	+ 3 years	+ 4 years
1 000,00	1 020,00	1 040,40	1 061,21	1 082,43

Plan 1

Single payment

now	+ 1 year	+ 2 years	+ 3 years	+ 4 years
				1 082,43

$PV_{r=2\%} = 1000,00$

Plan 2

	now	+ 1 year	+ 2 years	+ 3 years	+ 4 years
Loan balance	1 000,00	750,00	500,00	250,00	0,00
Interest (2%)		20,00	15,00	10,00	5,00
Repayment		250,00	250,00	250,00	250,00
Total payments		270,00	265,00	260,00	255,00

$PV_{r=2\%} = ?$

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Loan vs. Part Payment

Plan 3

	now	+ 1 year	+ 2 years	+ 3 years	+ 4 years
Loan balance	1 000,00	1 000,00	1 000,00	500,00	0,00
Interest (2%)		20,00	20,00	20,00	10,00
Repayment		0,00	0,00	500,00	500,00
Total payments		20,00	20,00	520,00	510,00

$PV_{r=2\%} = ?$

Plan 4

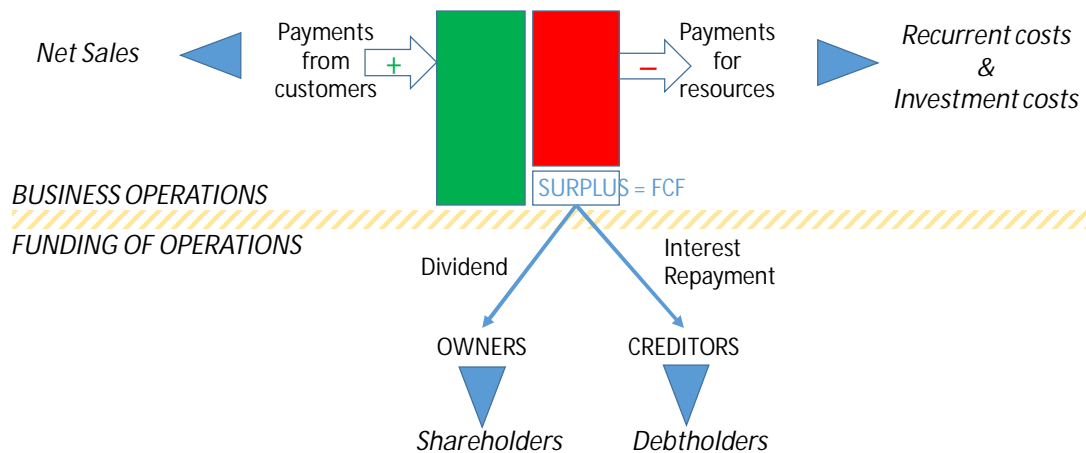
now	+ 1 year	+ 2 years	+ 3 years	+ 4 years
	200	100	400	400

$PV_{r=2\%} = ?$

Someone lends you money (invests 1000 in you) and expects to receive the positive cash flows that equal your payments (your negative cash flows)

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Free Cash Flow (FCF)



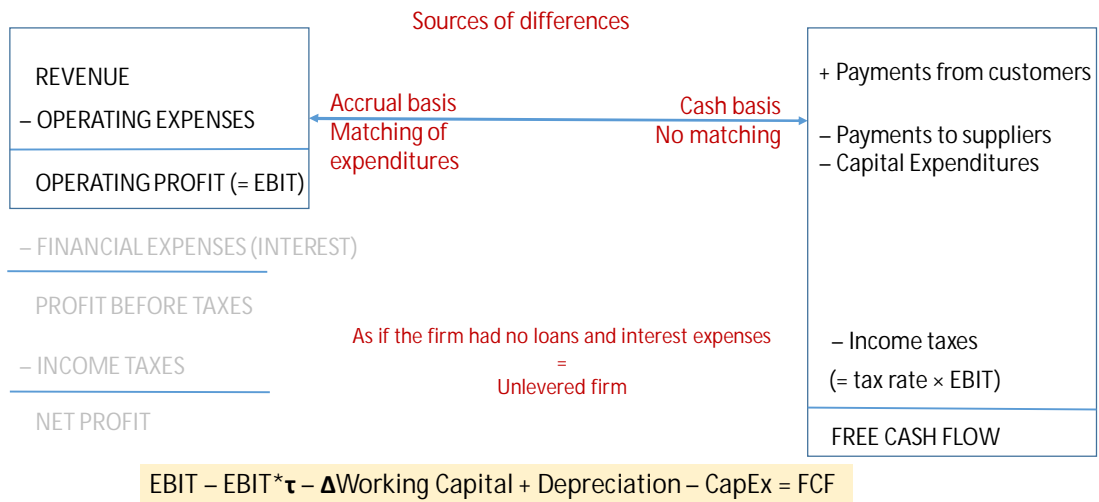
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The Statement of Cash Flows

- Cash from operating activities (CF_{ops})
 - Includes income taxes and interest paid
 - Cash from investing activities (CF_{inv})
 - Capital expenditures
 - Cash from financing activities (CF_{fin})
 - Dividend paid (Div)
 - Increase in shareholders' capital ($\Delta Shares$)
 - Increase in borrowing ($\Delta Debt$)
 - Change in cash ($\Delta Cash = CF_{ops} + CF_{inv} + CF_{fin}$)
 - $\Delta Cash = \text{Increase in cash} = \text{Cash in the end} - \text{Cash in the beginning}$
- } $\approx FCF$

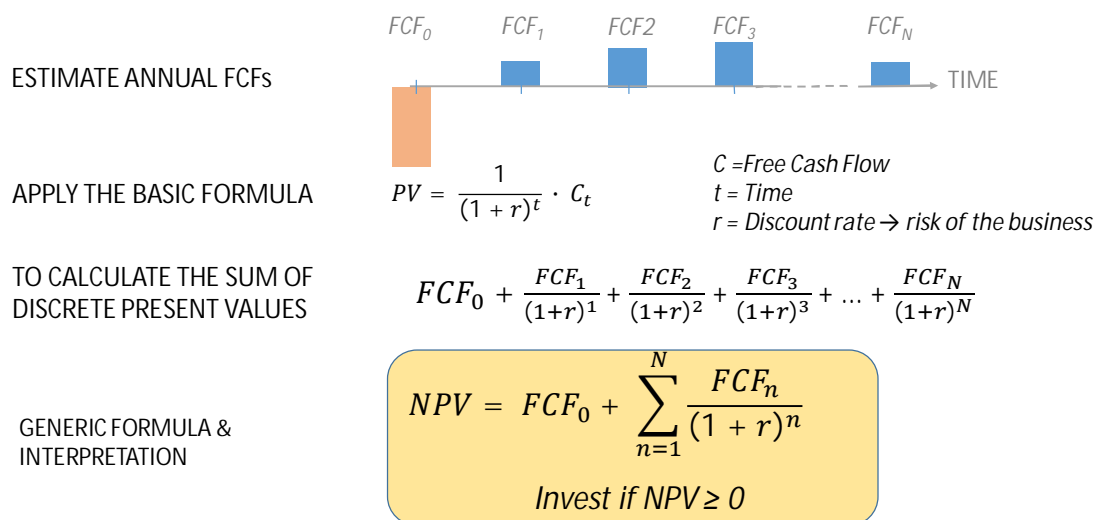
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Operating Profit versus Free Cash Flow



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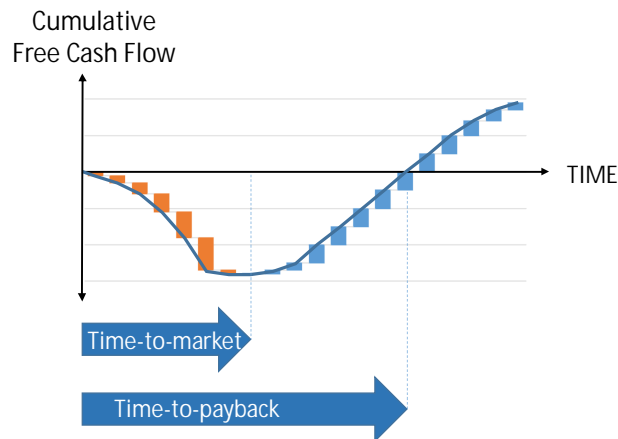
Net Present Value (NPV)



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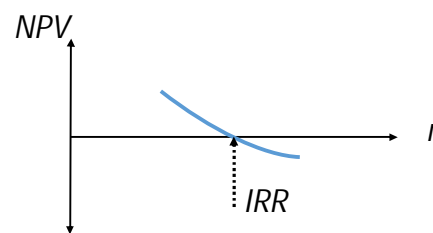
Other Indicators

The Payback Period



The Internal Rate of Return (IRR)

$$NPV = 0 = FCF_0 + \sum_{n=1}^N \frac{FCF_n}{(1 + IRR)^n}$$



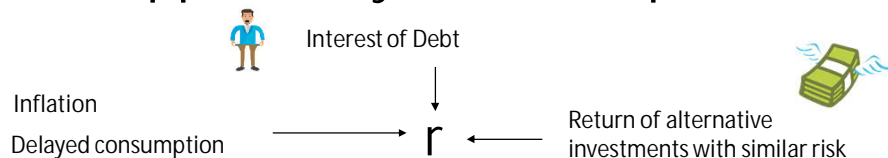
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Consider the Reliability of Numerical Estimates

- Initial rough estimates
 - Experience (qualitative, subjective), available past data (quantitative, subjective)
- Critical values (NPV=0 if ...)
 - IRR & others
- Reasonable range
 - Best case, worst case
- Internal logic / compatible estimates
 - Volume and available capacity, market share and marketing costs.

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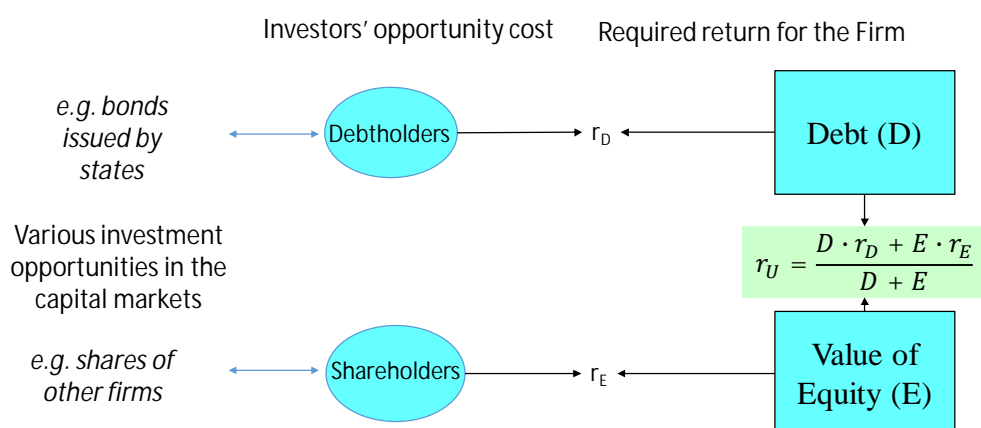
Opportunity Cost of Capital



- Interest rate of debt and the return of alternative investments affect your opportunity cost of capital
- The expected return depends on the risk of the investment. Risk means variation of return.
- Internal Rate of Return (IRR) should be compared to the opportunity cost of capital

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Cost of Capital for a Firm



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Debt Increases Your Risk

- You consider investing 10 000 € in a company (buy shares)
- In a year, the value of your shares can increase 30 % or decrease 20 %
- What happens if you need borrow the money to invest (one-year loan, 5 % interest)?
 - In the best case, your wealth increases from 0 to 2 500. You must sell 10,5/13 = 81 % of the shares to repay the loan + interest.
 - In the worst case, you must sell all the shares to cover part of the debt. Your wealth decreases from 0 to -2 500.
- If you have cash to invest, you don't have to sell in a year (but you may)
 - In the best case, your wealth increases from 10 000 to 13 000
 - In the worst case, your wealth decreases from 10 000 to 8 000

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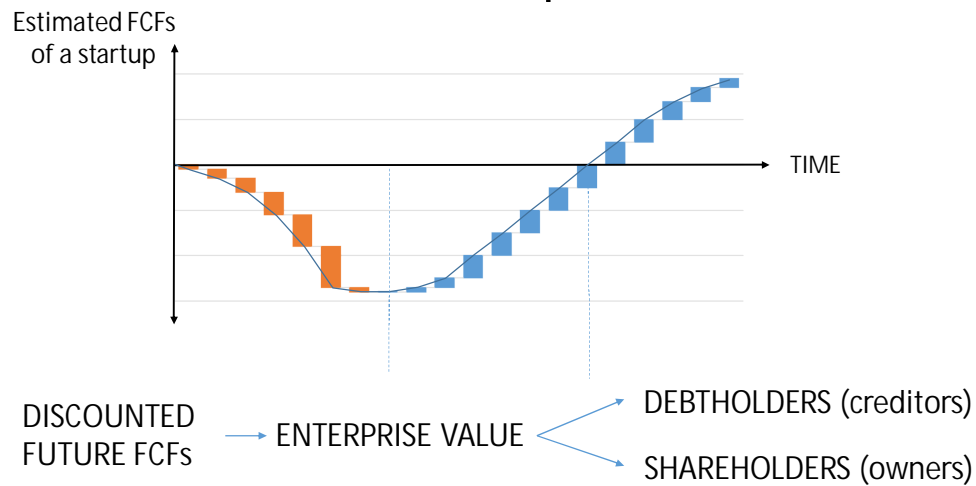
WACC

- A firm invests in risky business assets with required return of r_U . Leverage (proportion of debt) increases risk of the shareholders. Consequently, shareholders require higher return
 - Financial leverage $r_E = r_U + \frac{D}{E} (r_U - r_D)$
- Use the weighted average cost of capital (WACC) to discount free cash flows

$$r_{WACC} = r_U - \frac{D \cdot r_D \cdot (1 - \text{tax rate})}{D + E}$$

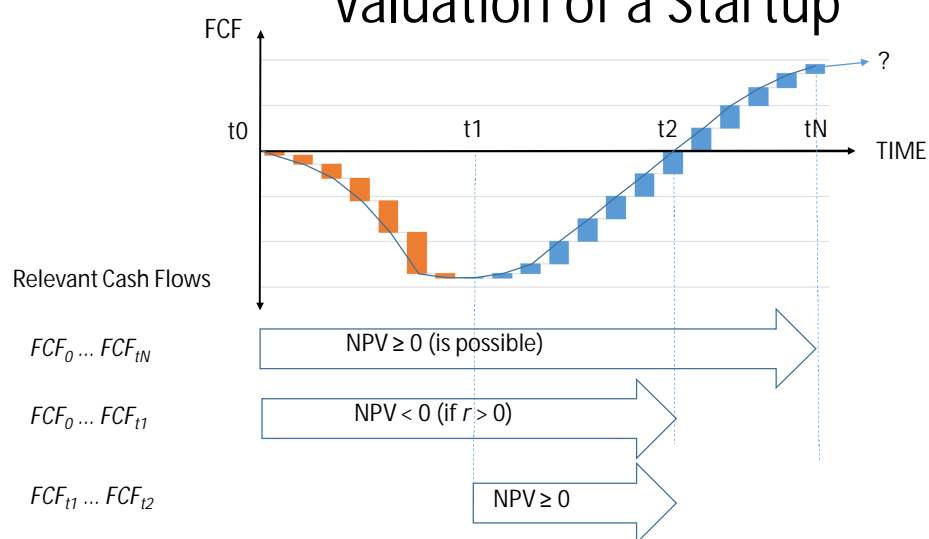
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NPV and Enterprise Value



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Valuation of a Startup



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