Masters in FINANCE

THE INVESTMENT DECISION

Corporate Investment Appraisal

Fall 2017

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BIBLIOGRAPHY

- In any of the standard Corporate Finance textbooks, the

  chapters on cash flows and capital budgeting.

OUTLINE

1. **Basic Concepts**: Present Value, Discounting, Compounding, Annuity, Perpetuity;

2. **Accounting Criteria for Investment Appraisal**: ROC, ROE; but first remember the Financial Statements: the Balance Sheet and the Income Statement;

3. **Cash Flows**: Definition of Free Cash Flow to the Firm (FCFF) and of Free Cash Flow to Equity (FCFE). Principles of Estimation;

4. **Financial (Cash-Flow-based) Criteria for Investment Appraisal:** Payback Period, Net Present Value (NPV), Internal Rate of Return (IRR), Profitability Index (Profitability Index), Modified Internal Rate of Return (MIRR), Incremental IRR;

5. **Special Cases**: Limited Budgets/Resources, Mutually Exclusive Projects with Different Lives, Nominal versus Real;

6. **Additional Analysis**: Sensitivity Analysis, Scenarios, Break-even.

1. BASIC CONCEPTS: PRESENT VALUE

Argument: €1 today is worth more than €1 tomorrow.

Concept: the Discount Rate translates current income into future income, and vice versa (r).

1. BASIC CONCEPTS: DISCOUNTING, COMPOUNDING

Discounting: to convert some value received in the future into its present value.

Compounding: to convert current income into its future value.

Today: t=0

Future Dates: t=1,2,3,4,…

$$PV_0 = \frac{CF_t}{(1+r)^t}$$

$$FV_t = CF_0(1+r)^t$$

1. BASIC CONCEPTS: ANNUITY, PERPETUITY

• Present Value of an Annuity X
beginning next period;

$$PV(X,n,r) = X \times \frac{1}{r}\left[1 - \frac{1}{(1+r)^n}\right]$$

• Present Value of a Growing Annuity
(growing at a constant rate);

$$PV(X,g,n,r) = X \times \frac{1}{r-g}\left[1 - \left(\frac{1+g}{1+r}\right)^n\right]$$

• Present Value of a Perpetuity starting
next period;

$$PV = \frac{X}{r}$$

• Present Value of a Growing Perpetuity
(at a constant rate).

$$PV = \frac{X}{r-g}$$

A snapshot in time of the firm's financial position

The Balance Sheet Identity:

$$Assets\ =\ Liabilities\ +\ Stockholders'\ Equity$$

Assets: What the company owns

Liabilities: What the company owes

Stockholder's Equity: The difference between the value of the firm's assets and liabilities

2. CRITERIA FOR INVESTMENT APPRAISAL: ACCOUNTING BASED BALANCE SHEET

Assets: Current Assets: Cash or expected to be turned into cash in the next year

   Long-Term Assets:

   Net Property, Plant, & Equipment
      Depreciation (and Accumulated Depreciation)
      Book Value = Acquisition cost – Accumulated depreciation
   Goodwill and intangible assets
      Amortization
   Other Long-Term Assets
      Example: Investments in Long-term Securities

Liabilities: Current Liabilities: Due to be paid within the next year

   Long-Term Liabilities

Net Working Capital = Current Assets – Current Liabilities

2. CRITERIA FOR INVESTMENT APPRAISAL: ACCOUNTING BASED
BALANCE SHEET EXAMPLE

GLOBAL CONGLOMERATE CORPORATION

Consolidated Balance Sheet
Year Ended December 31 (in $ million)

Assets	2012	2011
Current Assets		
Cash	21.2	19.5
Accounts receivable	18.5	13.2
Inventories	15.3	14.3
Other current assets	2.0	1.0
Total current assets	57.0	48.0
Long-Term Assets		
Land	22.2	20.7
Buildings	36.5	30.5
Equipment	39.7	33.2
Less accumulated depreciation	(18.7)	(17.5)
Net property, plant, and equipment	79.7	66.9
Goodwill and intangible assets	20.0	20.0
Other long-term assets	21.0	14.0
Total long-term assets	120.7	100.9
Total Assets	177.7	148.9

Liabilities and Stockholders' Equity	2012	2011
Current Liabilities		
Accounts payable	29.2	24.5
Notes payable/short-term debt	3.5	3.2
Current maturities of long-term debt	13.3	12.3
Other current liabilities	2.0	4.0
Total current liabilities	48.0	44.0
Long-Term Liabilities		
Long-term debt	99.9	76.3
Capital lease obligations	—	—
Total debt	99.9	76.3
Deferred taxes	7.6	7.4
Other long-term liabilities	—	—
Total long-term liabilities	107.5	83.7
Total Liabilities	155.5	127.7
Stockholders' Equity	22.2	21.2
Total Liabilities and Stockholders' Equity	177.7	148.9

2. CRITERIA FOR INVESTMENT APPRAISAL: ACCOUNTING BASED BALANCE SHEET

IMPORTANT TO KEEP IN MIND: Market Value Versus Book Value

Market Value of Equity (Market Capitalization)

Market Price per Share x Number of Shares Outstanding

- Cannot be negative
- Often differs substantially from book value

NOT TO FORGET:

Enterprise Value = Market Value of Equity + Debt − Cash

2. CRITERIA FOR INVESTMENT APPRAISAL: ACCOUNTING BASED INCOME STATEMENT

Recall the Income Statement (or P&L):

	Total Sales
-	Cost of Goods Sold
-	Selling, General and Administrative Expenses
-	Research & Development
-	Depreciation and Amortization
+	Other Income
=	Earnings Before Interest and Taxes (EBIT)
-	Interest Payments
=	Earnings Before Taxes
-	Income Taxes
=	Net Income

2. CRITERIA FOR INVESTMENT APPRAISAL: ACCOUNTING BASED INCOME STATEMENT EXAMPLE

GLOBAL CONGLOMERATE CORPORATION

Income Statement
Year Ended December 31 (in $ million)

	2012	2011
Total sales	186.7	176.1
Cost of sales	(153.4)	(147.3)
Gross Profit	33.3	28.8
Selling, general, and administrative expenses	(13.5)	(13.0)
Research and development	(8.2)	(7.6)
Depreciation and amortization	(1.2)	(1.1)
Operating Income	10.4	7.1
Other income	—	—
Earnings Before Interest and Taxes (EBIT)	10.4	7.1
Interest income (expense)	(7.7)	(4.6)
Pretax Income	2.7	2.5
Taxes	(0.7)	(0.6)
Net Income	2.0	1.9
Earnings per share:	$0.556	$0.528
Diluted earnings per share:	$0.526	$0.500

2. CRITERIA FOR INVESTMENT APPRAISAL: ACCOUNTING BASED RETURN ON CAPITAL (ROC)

"Before Tax" version:

$$ROC = \frac{EBIT}{Average\,Book\,Value\,of\,Invested\,Capital}$$

"After tax" version:

$$ROC = \frac{EBIT(1 - Tax\,Rate)}{Average\,Book\,Value\,of\,Invested\,Capital}$$

Example 1:

• I buy at t=0 an equipment for € 350 000. At t=1 the equipment has a residual value (after depreciation) of €280 000.

• I expect to generate EBIT of € 120 000 during the year. Disregarding taxes:

$$ROC = \frac{120000}{\left(\dfrac{350000 + 280000}{2}\right)} = 0.380952$$

2. CRITERIA FOR INVESTMENT APPRAISAL: ACCOUNTING BASED RETURN ON CAPITAL (ROC)

Example 2: Take the same example, but considering now EBIT projections for the whole life of the project.

t	0	1	2	3	4	5
BV Equip.	350000	280000	210000	140000	70000	0
Depreciation		70000	70000	70000	70000	70000
Average BV		315000	245000	175000	105000	35000
EBIT		120000	150000	110000	90000	50000
Annual ROC		0.3810	0.6122	0.6286	0.8571	1.4286

Average of the Annual ROCs= 0.7815

And based on the average EBIT and BV:

Average EBIT	104000
Average BV	175000
ROC	0.59429

2. CRITERIA FOR INVESTMENT APPRAISAL: ACCOUNTING BASED RETURN ON EQUITY (ROE)

$$ROE = \frac{\text{Net Income}}{\text{Average BV of the (partial) Investment made with equity}}$$

Example: Consider the previous example, assuming now that out of the €350 000 invested, €200 000 were equity. We have a projection of the Annual Net Income.

t	0	1	2	3	4	5		
BV Equipment	350000	280000	210000	140000	70000	0		
Depreciation		70000	70000	70000	70000	70000		
BV Equity Invested	200000	160000	120000	80000	40000	0	0.5714	Proportion of Equity
Average BV Equity Inv.		180000	140000	100000	60000	20000		
Net Income		60000	55000	40000	25000	15000		
Annual ROE		0.3333	0.3929	0.4000	0.4167	0.7500		

2. FROM ACCOUNTING NUMBERS TO CASH FLOWS

• These accounting measures (ROC, ROE) disregard the time value of money (no discounting); and

• Do not take into account the right timing of cash flows from the point of view of investors.

3. CASH FLOWS

- 2 Possible views:

  From the Perspective of Equity Only (Equity Approach)

  FCFE and Discount Rate = Cost of Equity;

  From the Perspective of the All Investors (Firm Approach)

  FCFF and Discount Rate = Average Cost of Capital.
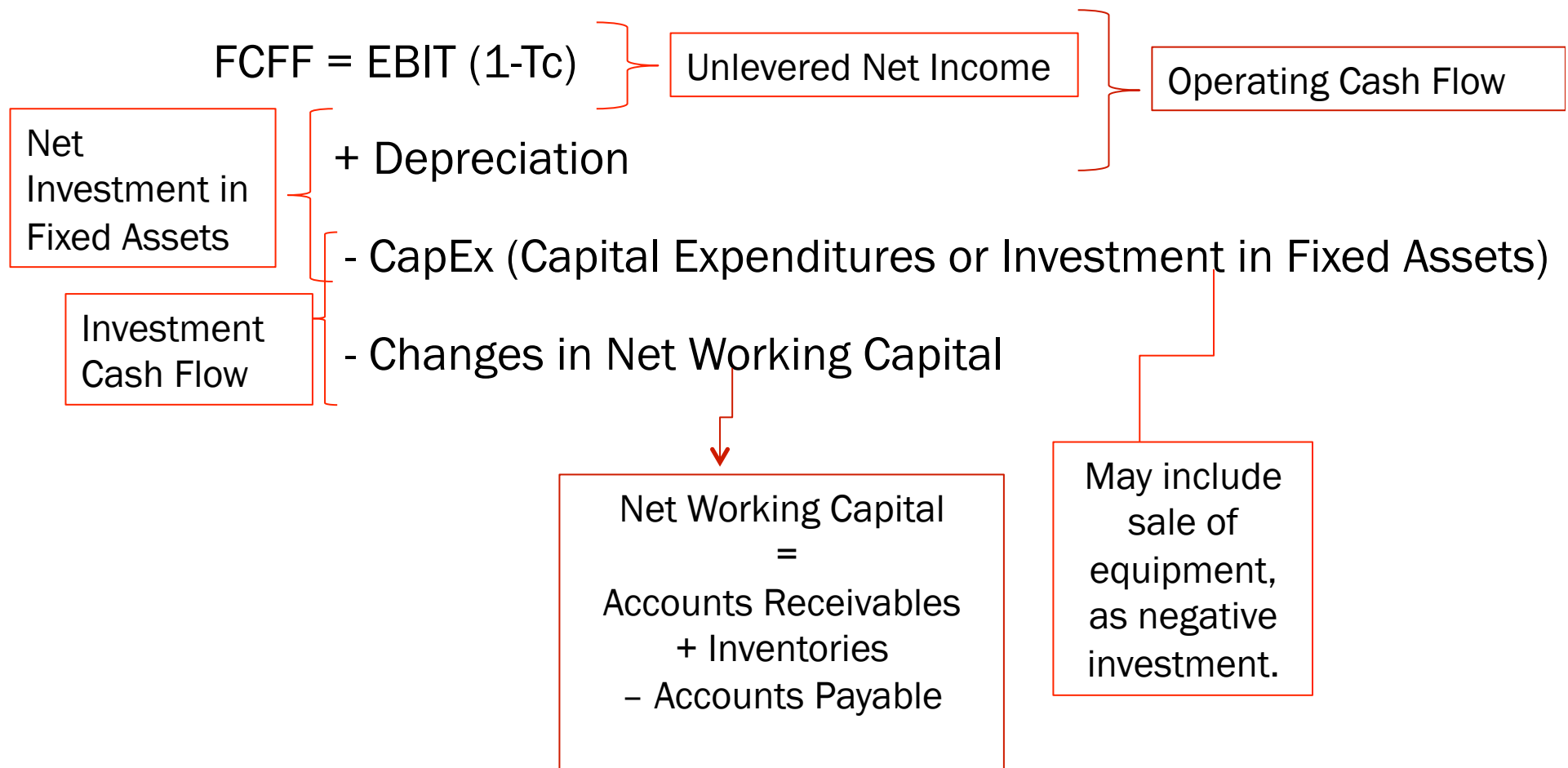
- A typical project has the following components:

  Investment in Fixed Assets;

  Operational Cash Flows;

  Residual Value.

3. FREE CASH FLOW TO THE FIRM

$$\text{FCFF} = \text{EBIT}\,(1\text{-Tc})$$

Unlevered Net Income

Operating Cash Flow

Net Investment in Fixed Assets

\+ Depreciation

\- CapEx (Capital Expenditures or Investment in Fixed Assets)

Investment Cash Flow

\- Changes in Net Working Capital

Net Working Capital
=
Accounts Receivables
+ Inventories
– Accounts Payable

May include sale of equipment, as negative investment.

3. FREE CASH FLOW TO EQUITY

FCFE = Net Income

+ Depreciation

- CapEx

- Changes in Net Working Capital

- Repayment of Debt

+ New Issues of Debt

3. PRINCIPLES OF CASH FLOW ESTIMATION

• Cash flows must:

- • consider the right **Timing**;

- • be **Incremental**;

- • take into account **Opportunity Costs;**

- • disregard **Sunk Costs**;

- • take into account **Side Effects**;

- • be **After Tax**.

3. FCF: EXAMPLE - DATA

Costs of marketing study (already spent): $250,000

Current market value of proposed factory site (which we own): $150,000; salvage value is $150,000 after taxes

Cost of machine: $100,000 (depreciated in 5-years); salvage value is $30,000 before taxes

Working capital is 10% of sales of the following year

Production (in units) per year during 5-year life of the machine: 5000, 8000, 12,000, 10,000, 6000

Price during first year is $20; price increases 2% per year thereafter

Production costs during first year are $10 per unit and increase 10% per year thereafter

Taxes are 30%

Earnings Forecasts	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Sales revenues		100,000	163,200	249,696	212,242	129,892
Operating costs		50,000	88,000	145,200	133,100	87,846
EBITDA		50,000	75,200	104,496	79,142	42,046
Depreciation		20,000	20,000	20,000	20,000	20,000
EBIT		30,000	55,200	84,496	59,142	22,046
Taxes		9,000	16,560	25,349	17,742	6,614
Unlevered Net Income		21,000	38,640	59,147	41,399	15,432
Operating cash flow		41,000	58,640	79,147	61,399	35,432

Investments	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Machine	100.000					
Factory (opportunity cost)	150.000					
Salvage value machine						21.000
Salvage value factory						150.000
CapEx	250.000	0	0	0	0	-171.000
Change in net working capital	10.000	6.320	8.650	-3.745	-8.235	-12.989
Cash flow of investments	-260.000	-6.320	-8.650	3.745	8.235	183.989

Cash flow of project:	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Cash flow of investments	-260.000	-6.320	-8.650	3.745	8.235	183.989
Operating cash flow	0	41.000	58.640	79.147	61.399	35.432
FCF	-260.000	34.680	49.990	82.893	69.634	219.421

4. CASH-FLOW BASED CRITERIA:
PAYBACK PERIOD

Moment in time when the initial investment is recovered.

Example 1: simple version (not discounted)

t	0	1	2	3	4
cash flow	-1000	250	330	500	610
Cumulative cash flow	-1000	-750	-420	80	690

$$\text{Payback Period} = 2 + \frac{420}{500} = 2.84 \text{ years}$$

Limitation: Not considering the time value of money.

4. CASH-FLOW BASED CRITERIA: PAYBACK PERIOD

Example 2: "discounted" version.

Consider a discount rate (cost of capital) r=11%:

t	0	1	2	3	4
cash flow	-1000	250	330	500	610
Discounted cash flow	-1000	225.2252	267.8354	365.5957	401.8259
Cumulative discounted cash flow	-1000	-774.775	-506.939	-141.344	260.4822

$$\text{Payback Period} = 3 + \frac{141.344}{401.826} = 3.351754 \text{ years}$$

Limitations:

- Ignores cash flows that take place after the payback period;
- Hard to apply/interpret with multiple investments over time.

4. CASH-FLOW BASED CRITERIA:
NET PRESENT VALUE (NPV)

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

Example: Consider the previous example, with discount rate r=11%.

t	0	1	2	3	4
cash flow	-1000	250	330	500	610
Discounted cash flow	-1000	225.225	267.835	365.595	401.825

$$NPV = -1000 + \frac{250}{(1+0.11)} + \frac{330}{(1.11)^2} + \frac{500}{1.11^3} + \frac{610}{1.11^4} =$$

$$-1000 + 225.2 + 267.8 + 365.6 + 401.8 = 260.4822$$

4. CASH-FLOW BASED CRITERIA:
NET PRESENT VALUE (NPV)

Properties of NPV:

Additivity;

Assumes reinvestment of intermediate cash flows at the "normal" discount rate r;

Accepts different discount rates over time ($r_{0,1}$; $r_{1,2}$; etc).

Limitations of NPV:

It's an Absolute measure, disregarding the scale of investment;

It's Indifferent to the timeframe of the projects.

Computation in Excel

=npv(r;initialcell:finalcell)

Note: discounts the first value (even if t=0); ignores empty cells.

4. CASH-FLOW BASED CRITERIA: PROFITABILITY INDEX (PI)

- It's a derivative of NPV, taking into account the scale of investment.

- There are several possible versions, examples of which:

  - NPV / Initial Investment;
  - PV(Future Cash flows) / Initial Investment;
  - PV(FCF+CapEx) / PV(CapEx).

- Example:

t	0	1	2	3	4	5	NPV	PI version 1	PI version 2
Proj A: CFt	-1000	300	400	500	650	700	857,57 €	0,8575669	1,8575669
Proj B: CFt	-10000	2000	2500	3000	4000	4000	1.353,98 €	0,1353981	1,1353981
r	0,1								

4. CASH-FLOW BASED CRITERIA: INTERNAL RATE OF RETURN (IRR)

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

Example: Consider the project seen before

t	0	1	2	3	4
cash flow	-1000	250	330	500	610

IRR	21%

Computation in excel:
=irr(initialcell:finalcell)

Limitations of the IRR:

• Impossible to compute in some cases;

• Lending versus Borrowing.

• Multiple IRRs in some cases;

Example:

t	0	1	2	3	4
cash flow	-1000	800	1000	1300	-2200

r=10%

IRR	6,60%

NPV	27,8

Discount Rate
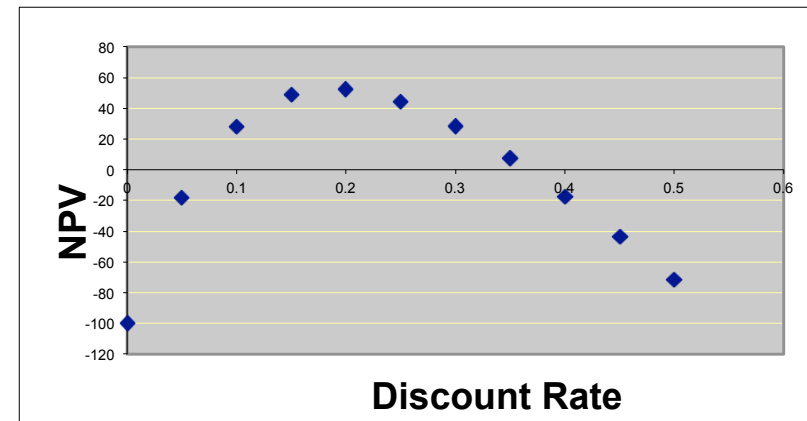
• Divergence from NPV in the ranking of projects in some cases;

Example:

t	0	1	2	3	NPV	IRR
Proj A: CFt	-10000	5000	4000	6100	1.383,25 €	22,92%
Proj B: CFt	-10000	3000	3500	9500	1.501,60 €	22,23%
r	0,15				B	A

4. CASH-FLOW BASED CRITERIA:
MODIFIED INTERNAL RATE OF RETURN (MIRR)

• The reason why the ranking of projects according to the IRR or the NPV can differ lies in the assumption made by the IRR rule, that intermediate cash flows are reinvested at the IRR itself (and not the "normal" discount rate). An alternative is to compute the Modified IRR. Consider the previous example (r=15%):

t	0	1	2	3
CFA	-10000	5000	4000	6100
CFB	-10000	3000	3500	9500
Future Value Cash Flow A		6613	4600	6100
Future Value Cash Flow B		3968	4025	9500

•First compute the future value of the projects, and then what is the annual return it corresponds to:

$$10,000(1+MIRR_A)^3 = 17,313$$
$$10,000(1+MIRR_B)^3 = 17,493$$

MIRR A	0.200751844
MIRR B	0.204898954

4. CASH-FLOW BASED CRITERIA:
INCREMENTAL INTERNAL RATE OF RETURN

• One could also analyze an incremental project and compare its Incremental

IRR to the discount rate (cost of capital). Using the same example:

t	0	1	2	3
CFA	-10000	5000	4000	6100
CFB	-10000	3000	3500	9500
CF (proj B-A)	0	-2000	-500	3400
IRR (B-A)	18%			

•Since IRR of doing B instead of A is 18%>15% (cost of capital), we conclude

B is a better project.

5. LIMITED RESOURCES

• In terms of investment decision, limited resources are an issue when the firm is unable (due to lack of resources) to invest in all its potential positive-NPV projects.

• In such cases, computing the Profitability Index may be a good indicator of the most efficient types of projects in terms of generating value per euro invested.

• However, choice of projects cannot be guided by the PI.

• Firms should list all positive-NPV projects, and form all possible "portfolios" of projects that do not go beyond the budget. Finally, firms should choose the combination of projects (among those that satisfy the constraints)   that maximizes total NPV.

5. MUTUALLY EXCLUSIVE PROJECTS WITH DIFFERENT LIVES

Example:

t	0	1	2	3	NPV
Proj A: CFt	-100	110	200	110	235,95 €
Proj B: CFt	-100	200	180		222,07 €
r	0,12				A

But suppose the projects can be repeated over time, with replacement of the equipment. If so, perhaps a fair comparison would be to repeat the projects until they do have the same life.

It might be hard to forecast cash flows for later periods. Some argue this is only reasonable to do in real terms (i.e., absent inflation), and assuming cash flows are always the same.

t	0	1	2	3	4	5	6
Proj A: CFt	-100	110	200	110			
				-100	110	200	110
2 * Equip A:	-100	110	200	10	110	200	110
NPV	403,89 €						

t	0	1	2	3	4	5	6
Proj B: CFt	-100	200	180				
			-100	200	180		
					-100	200	180
3*Equip B:	-100	200	80	200	80	200	180
NPV	540,22 €						**AFTER ALL: B**

5.MUTUALLY EXCLUSIVE PROJECTS WITH DIFFERENT LIVES: EQUIVALENT ANNUITY

• An alternative to the repetition of cash flows over time is computing the

equivalent annuity:

$$\text{Equivalent Annuity} = \frac{NPV}{\frac{1}{r}\left[1 - \frac{1}{(1+r)^n}\right]}$$

Project A: Project B:

$$\frac{NPV_A}{\frac{1}{0.12}\left[1 - \frac{1}{1.12^3}\right]} = \frac{235.95}{2.4018} = 98.24 \quad < \quad \frac{NPV_B}{\frac{1}{0.12}\left(1 - \frac{1}{1.12^2}\right)} = \frac{222.07}{1.6901} = 131.40$$

•Note: simply comparing the Equivalent Annuity is not sufficient unless

discount rates are the same...

5.INFLATION TREATMENT:

NOMINAL VERSUS REAL ANALYSIS

• If cash flows are nominal, the discount rate must also be nominal;

• If the cash flows are in real terms, the discount rate must also be real.

$$\text{Real Cash Flow} = \frac{\text{Nominal Cash Flow}_t}{\left(1 + \text{Expected Rate of Inflation}\right)}$$

$$1 + r_{REAL} = \frac{1 + r_{NOMINAL}}{1 + \text{Expected Rate of Inflation}}$$

- Definition: Sensitivity Analysis assesses how sensitive a project is – that is, its measure of performance, such as NPV or IRR – to a change in one of the inputs of the model. VERY USEFUL.

- Steps:
    1. Estimate the FCF for a base-case scenario with intial inputs, and compute NPV, etc.
    2. Change one by one main inputs and assess impact on NPV, IRR, etc.
    3. Identify which are the most relevant variables for the performance of the project, and which are the more uncertain.
    4. Summarize information in tables.

- How to do it? Using Excel: Data, What if Analysis, Data Table. Wait for Problem Set 4.

- Limitations:
    - We make changes to one variable at a time (at most two variables);
    - It's subjective.

• Definition: With Scenario Analysis we build different scenarios for the development of the project, in which any variable can change. We the assess the performance of the project (for example, its NPV) in each scenario. VERY USEFUL.

•Steps:

1. Estimate cash flows for the base case scenario, and assess quality of project (NPV, IRR, etc).

2. Identify main source of uncertainty/risk and build scenarios around it.

3. For each scenario consider new inputs and repeat estimation of cash flows, NPV, etc.

4. Summarize the information obtained from each scenario.

•How to do it? Using Excel: Data, What it Analysis, Scenario Manager. Wait for Problem Set 4.

• Limitations:

•No rules to build scenarios.

•Subjectivity.

6. ROBUSTNESS CHECKS:
BREAKEVEN ANALYSIS, ETC

• It can be interesting to assess to minimum number of units (or the minimum price, etc) that makes NPV=0. This is what we call break-even analysis in corporate finance. See example in Problem Set 4, and how to use Excel's Data, Goalseek.

• Some times we find statistical attempts to perform robustness tests based on simulation. Intuitively, one would assume that a crucial variable such as units sold would follow a normal distribution with Mean x and variance s, etc...