# Masters in FINANCE

# THE INVESTMENT DECISION

## Corporate Investment Appraisal

Fall 2012

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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;
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).

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

# 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 RETURN ON CAPITAL (ROC)

"Before Tax" version:

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

"After tax" version:

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

## 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:

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

# 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 Equiy 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

FCFF = EBIT (1-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%

# 3. FCF EXAMPLE – FORECASTING EARNINGS

| 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 |

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# 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)

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



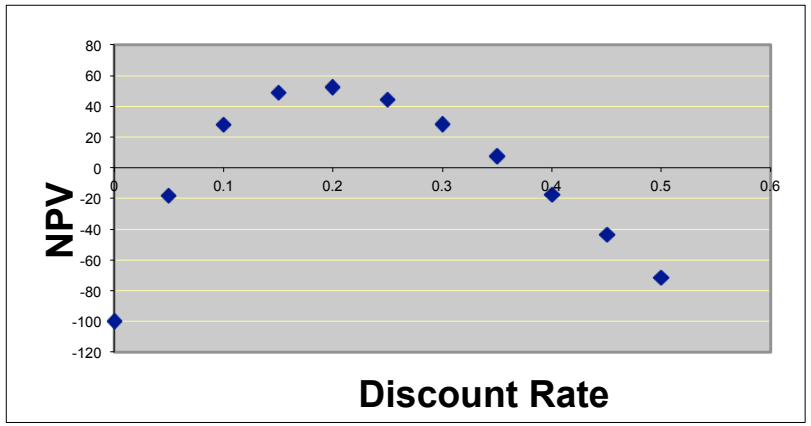
## Limitations of the IRR:

- 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% | | VAL | 27,8 |




- 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.

# 5. MUTUALLY EXCLUSIVE PROJECTS WITH DIFFERENT LIVES: PROJECT REPETITION

| 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:

$$\frac{NPV_A}{\frac{1}{0.12}\left[1-\frac{1}{1.12^3}\right]} = \frac{235.95}{2.4018} = 98.24$$

Project B:

$$< \quad \frac{NPV_B}{\frac{1}{0.12}\left(1-\frac{1}{1.12^2}\right)} = \frac{222.07}{1.6901} = 131.40$$

•Note: simply comparing the Equivalent Annuity is not sufficient unless discount rates are the same…

# 5.INFLATION TREATMENT: NOMINAL VERSUS 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.

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

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

# 6. ROBUSTNESS CHECKS: SENSITIVITYANALYSIS




- Definition: Sensitivity Analysis assesses how sensitive a project is – that is, its measure of perormance, 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.

# 6. ROBUSTNESS CHECKS: SCENARIO ANALYSIS




• 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? Usinf 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...