Industrial and investment analysis as a tool for regulation

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A primer on valuation

- Knowing what an asset is worth and what determines that value is a pre-requisite for intelligent **decision making**
- In choosing investments for a portfolio, in deciding on the appropriate price to pay or receive in a takeover and in making investment, financing and dividend choices when running a business.
- The premise of valuation is that we can make **reasonable estimates of value for most assets**, and that the same fundamental principles determine the values of all types of assets, real as well as financial.
- Some assets are easier to value than others, the details of valuation vary from asset to asset, and the uncertainty associated with value estimates is different for different assets, but the core principles remain the same.

Approaches to valuation

- In general terms, there are three approaches to valuation.
- The first, **discounted cash flow valuation**, relates the value of an asset to the present value of expected future cash flows on that asset.
- The second, **relative valuation**, estimates the value of an asset by looking at the pricing of 'comparable' assets relative to a common variable like earnings, cash flows, book value or sales.
- The third, contingent claim valuation, uses **option pricing** models to measure the value of assets that share option characteristics.

Discounted cash flow valuation

- In discounted cash flows valuation, **the value of an asset is the present value of the expected cash flows on the asset, discounted back at a rate that reflects the riskiness of these cash flows**
- The value of an asset is a function of the expected cash flows on that asset.
- Put simply, assets with high and predictable cash flows should have higher values than assets with low and volatile cash flows

$$\textbf{Value of assets} = CF_0 + E(CF_1)/(1+r) + E(CF_2)/(1+r)^2 + \ldots + E(CF_n)/(1+r)^n$$

where: **n** = Life of the asset; $\mathbf{E(CF_t)}$ = Expected cash flow in period t; **r** = Discount rate reflecting the riskiness of the estimated cash flows

Inputs to Discounted Cash Flow Methods

- There are three inputs that are required to value any asset in this model

1. The expected cash flow,
2. The timing of the cash flow and
3. The discount rate that is appropriate given the riskiness of these cash flows

Capital budgeting

- We are going to apply the discounted cash flow models to a particular type of valuation: capital budgeting
- A firm's business involves **capital investments (capital budgeting),** e.g. the acquisition of real assets. The objective is to increase the firm's current market value.
- Decision consists of valuing real assets, i.e. their cash flows.
- Let the cash flows of an investment (a project) be:

  $\{CF_0, CF_1, CF_2, CF_3, \ldots, CF_n\}$
- Its current market value is:

  $NPV = CF_0 + CF_1/(1+r)+CF_2/(1+r)^2+CF_3/(1+r)^3+\ldots+CF_n/(1+r)^n$

Where **NPV is net present value**

- NPV is the increase in the firm's market value by the project.

Net Present value (NPV) rule

- **Investment Criteria**:
- **For a single project**→ take it if and only if its NPV is positive.
- **For many independent projects**→ take all those with positive NPV.
- **For mutually exclusive projects**→ take the one with positive and highest NPV.

- In order to compute the NPV of a project, we need to know:

1. Cash flows
2. Discount rates

A primer on financial statements (balance sheets and profit and loss accounts)

- Much of the information that is used in valuation and corporate finance comes from financial statements.
- An understanding of the basic financial statements and some of the financial ratios that are used in analysis is therefore a necessary first step.
- Balance sheet is a Double- sided listing of the assets and the financing of these assets
- Assets (on the left-hand side) is given by fixed assets + current assets
- Financing (on the right-hand side) is given by Liabilities (current and long term) and Owners' Equity

Balance Sheet

Assets	Liabilities
	Equity: • Stock value (original amount paid for the capital stock of the firm) • Retained earnings
Fixed assets: • Leased property and equipment • Plant property, Equipment (at cost of acquisition) less Depreciation (loss of value due to aging) • Land • Goodwill (if assets were paid more than their market value)	**Long term liabilities:** • Obligations under leases • Long-term debts
Current assets: • Cash • Bank (money in the bank) • Accounts receivable (customers unpaid bills) • Inventories (raw material, Work In Progress, products)	**Current liabilities:** • Accounts payable (unpaid bills to suppliers) • Current portion of long-term debts • Short-term borrowings

The profit and loss account (income statement)

+ Sales (revenues)

- Cost of goods sold (raw materials, external services, salaries)

- Selling, general and administrative expenses

- Depreciation

- **Earnings before interest and taxes (EBIT)**

- Interests (bonds, loans, lease contracts)

- **Earnings before taxes (EBT)**

- Taxes

- **Earnings after taxes (EAT)**

Cash flows for capital budgeting

+ Cash inflows from sales - Cash outflows for operating expenditures

THEORETICAL CASH FLOWS FROM OPERATIONS

- Changes in net working capital - Taxes on operating income

NET CASH FLOWS FROM THE OPERATIONS

- Investments (payments for plant, equipment and software) + Residual value (just for the final period)

NET CASH FLOWS FOR CAPITAL BUDGETING

Cash flows for capital budgeting: operating inflows and outflows

- **Cash inflows** from sales are operating revenues directly associated to the project
- **Cash outflows** for operating expenditures are operating costs directly associated to the project

Cash flows for capital budgeting: working capital

- **Working capital** = **current assets** (inventory, cash and account receivable) **- current liabilities** (account payable, short-term debt).
- For capital budgeting we are interested in changes in working capital.
- Working capital may also be defined as: inventory + account receivable – account payable.
- Inventory: Cost of goods sold includes only the cost of items sold. When inventory is rising, the cost of goods sold understates cash outflows. When inventory is falling, cost of goods sold overstates cash outflows.
- Accounts Receivable: Accounting sales may reflect sales that have not been paid for. Accounting sales understate cash inflows if the company is receiving payment for sales in past periods.
- Accounts Payable: conceptually the reverse of Accounts Receivable

Cash flows for capital budgeting: taxes

- **Marginal corporate tax rate** is applied to EBIT (Earnings before interests and taxes), without taking into account that interest payments are tax deductible.
- Debt tax shields are recognized through the discount rate

Cash flows for capital budgeting: investments and residual value

- **Investments**: capital expenditures, i.e. costs associated to the purchase of plant, equipment, software, etc.
- **Residual value**: the residual value of the investment goods and the residual value of the working capital at the end of the project life.

Cash flows for capital budgeting: Example 1 Solar Inc.

SOLAR

Income budget for the periods t_1 - t_3

Sales	2000
Costs of goods sold	800
General expenses	100
Depreciation	700
Interests	200

At time t_0:

- Increase in the initial working capital 200
- Investments for the ongoing business (promotion and marketing) 1800

Tax rate: 25%

At the end of the third year, Solar recovers the entire working capital

Cash flows for capital budgeting: Example 1 Solar Inc.

Cash flows	t0	t1	t2	t3
Operating Inflows	0	+2000	+2000	+2000
Operating Outflows	0	-900	-900	-900
Change in Working capital	-200	0	0	0
Taxes	0	-100	-100	-100
Investments	-1800	0	0	0
Residual value	0	0	0	+200
Cash flow for capital budgeting	-2000	1000	1000	1200

Cash flows for capital budgeting: Example 2 Bell Electricity

- Bell electricity is a distributor of electricity. The firm is valuating a project on the maintenance of the distribution network characterized by two alternatives of investment:

a) to build a new line in substitution of the old structure;

b) to improve the maintenance of the old lines, introducing new cheaper selling contracts concerning the possibility of temporary interruption of the electric service.

The costs of the projects are reported in the next page. Time horizon (useful life for both projects): 10 years. Taxes are not considered

Cash flows for capital budgeting: Example 2 Bell Electricity

Projects	A	B
Investment in plant	1400	0
Residual value of the investment at t=10	+400	0
Change in working capital at t=0	+100	-100
Annual **change** in costs and revenues:		
Depreciation	+40	
Raw material	-30	
Wages	-55	+22
Interests	+70	+10
Revenues from service interruption		-30

Cash flows for capital budgeting: Example 2 Bell Electricity

Project A - Incremental Cash Flows	t0	t1-t9	t10
Change in Inflows	0	0	0
Change in outflows (cost saving)	0	+85	+85
Change in working capital	+100	0	0
Investments	-1400	0	0
Residual value	0	0	+400
Cash flow for capital budgeting	-1300	+85	+485

Cash flows for capital budgeting: Example 2 Bell Electricity

Project B - Incremental Cash Flows	t0	t1-t9	t10
Change in Inflows (lower revenues)	0	-30	-30
Change in outflows (higher costs)	0	-22	-22
Change in working capital	-100	0	0
Investments	0	0	0
Residual value	0	0	0
Cash flow for capital budgeting	-100	-52	-52

Discount rates

- **For the computation of the project's NPV we need to choose a discount rate**
- A project's discount rate (required rate of return or cost of capital) is the expected rate of return demanded by investors for the project
- Discount rate(s) in general depend on the timing and risk of the cash flow(s)
- Discount rate is usually different for different projects.

Estimation of the discount rate

- We introduce two way to estimate the discount rate of the project:

1. The **CAPM**: capital asset pricing model
2. The **WACC**: the weighted average cost of capital

CAPM

- We use the CAPM model to estimate the project discount rate $r_{project}$

$$r_{project} = r_f + \beta(r_M - r_f)$$

where

- r_f is the risk-free rate (usually long-term goverment bond rate of return).
- B is the sensitivity of the stock return to the market return. The Beta value is a coefficient that measures the systematic risk of a share. In principle the beta value of the project should be determined.
- r_m is the return of the market portfolio (estimated from historical data, nomally used numbers: 4.5-5.5%)

CAPM: Example

- Suez environnement is a French company supplying a set of environmental services (mainly water and waste management). It is considering to enter the energy market. The firm must evaluate the Net Present Value of the estimated cash flows from this new line of business.
- Which discount rate should it use for these NPV calculations?
- Suez should not use its own beta to discount its cash flows
- Suez shuold use the beta of a similar environmental company (e.g. Veolia)

CAPM: example

- The Beta value for Veolia is 1.93 (source: http://finance.yahoo.com)
- Risk free rate: 5%
- Market risk premium ($r_M - r_f$): 6%

$$r_{project} = r_f + \beta(r_M - r_f)$$

$$r_{project} = 0.05 + 1.93\ (0.06) = 16.6\%$$

WACC

- The expected cash flows can be discounted using the **weighted average cost of capital** (WACC).
- The tax advantage of debt financing is reflected in the WACC

$$WACC = S_e * k_e + S_d * k_d *(1-\tau)$$

Where:

- S_e is the share of equity on total amount invested in the project
- k_e is cost of equity
- S_d is the share of debt on total amount invested in the project
- k_d is pre-tax cost of debt
- τ is corporate tax rate
- $S_e + S_d = 1$

Putting things together: NPV computation - example 1

Income statement (000 Euro)	
Sales	600
Raw material cost	300
Wages (50% fixed cost)	180
Depreciation	30

Balance Sheet (000 Euro)			
Assets		Liabilities	
Current Assets	340	Current Liabilities	165
Fixed Assets	130	Equity	305
Total	470	Total	470

Tax rate: 40%
Cost of debt: 15%, Cost of equity: 15%

NPV computation – example 1

- The Dora firm wants to invest in a new software to manage the customers.
- The **investment** will be 50,000 euro and managers hope to increase the sales by 10% per year for a period of 10 years.
- Operating costs (outflows) should be divided into:
  - **Variable costs**, that change together with sales (by the same amount): raw material and (50% of) wages
  - **Fixed costs**, that do not vary with revenues: wages (50%)
- The additional required **working capital** will be 15,000 euro at the end of the year 1 and it will stay constant for the next years.
- The **time horizon is 10 years** and the final value of the investment and working capital is zero.
- Should Dora invest or not?

NPV computation – example 1

	t0	t1	t2-t10
Inflows	0	+660	+660
Outflows: variable costs	0	-429	-429
Outflows: fixed costs	0	-90	-90
Depreciation (only for tax computation)	*0*	*-35*	*-35*
Taxes	0	-42.4	-42.4
Change in working capital	0	+15	0
Investment	-50	0	0
Residual value	0	0	0
Cash flow for capital budgeting	-50	113.6	98.6

NPV computation – example 1

- **As discount rate we use the WACC:**

$$WACC = S_e * k_e + S_d * k_d *(1-\tau)$$

Where:

- S_e is the share of equity (from the balance sheet): 305/470 = 0.65
- k_e is cost of equity = 0.15
- S_d is the share of debt (from the balance sheet): 165 / 470 = 0.35
- k_d is pre-tax cost of debt = 0.15
- τ is corporate tax rate = 0.4
- WACC = 13%

NPV computation – example 1

- The Net Present Value is the sum of the discounted cash flows:

$$NPV = CF_0 + CF_1/(1+r)+CF_2/(1+r)^2+CF_3/(1+r)^3+\ldots+CF_{10}/(1+r)^{10}$$

Where: CF is cash flow for capital budgeting, r is the discount rate.

$$NPV = -50 + 113.6/(1.13) + 98.6(1.13)^2 + \ldots+98.6(1.13)^{10} = 498$$

- NPV is positive:
  - We recovered the initial capital of 50,000
  - We recovered 13% over the capital per ten years
  - We produced a value of 498 for the shareholders

Alternatives to the Net Present Value

- In practice investment rules other than NPV are often used:

1. **Payback period**
2. **Internal rate of return**
3. **Profitability index**

- Firms use these rules because they were used historically and they may have worked (in combination with common sense) in the particular cases encountered by these firms.
- These rules sometimes give the same answer as NPV, but in general they do not. We should be aware of their shortcomings and use NPV whenever possible
- The bottom line is: **NPV rule dominates the alternative rules**

Payback Period

- Payback period is the minimum length of time **s** such that the sum of net cash flows from a project becomes positive.

$$CF_1+CF_2+CF_3+\ldots+CF_S \geq -CF_0 = I_0$$

- **Decision Criterion Using Payback Period**:
- **For independent projects**→ Accept if *s* is less than or equal to some fixed threshold t*.
- **For mutually exclusive projects**→ Among all the projects having $s \leq t^*$, accept the one that has the minimum payback period.

Payback period: example

- Consider the two independent projects with the following cash flows (in thousands Euro)
- Decision: accept project 2

	CF0	CF1	CF2	CF3	CF4	CF5	CF6	PbP
Project 1	-100	20	40	30	10	40	60	s=4
Project 2	-100	10	10	80	5	10	10	s=3

Payback period: drawbacks

- Payback period rule ignores cash flows after the payback period.
- It ignores discounting.
- In the example above, suppose that the appropriate discount rate is a constant 10% per period.
- Then: NPV1 = 39.315, NPV2 = -7.270
- But we accepted project 2 and not project 1.

Taking into account appropriate discounting, we have the **discounted payback period**, which is the minimum *s* so that:

$$CF_1/(1+r)+CF_2/(1+r)^2+CF_3/(1+r)^3+\ldots+CF_S/(1+r)^s \geq -CF_0 = I_0$$

- Where r is the discount rate. However we still ignore the cash flows after the discounted payback period.

Internal Rate of Return

- A project's internal rate of return (IRR) is the number that satisfies

$$0 = CF_0 + CF_1/(1+IRR) + CF_2/(1+IRR)^2 + \ldots + CF_n/(1+IRR)^n$$

- <u>**Decision Criterion Using IRR**</u>:
- **For independent projects→** Accept a project if its IRR is greater than some fixed IRR*, the threshold rate.
- **For mutually exclusive projects→** Among the projects having IRR's greater than IRR*, accept one with the highest IRR

Internal Rate of Return: Example

- Consider the two independent projects with the following cash flows (in thousands Euro)
- IRR1 = 21% ; IRR2 = 7%
- Decision: accept project 1 (same decision as NPV)

	CF0	CF1	CF2	CF3	CF4	CF5	CF6
Project 1	-100	20	40	30	10	40	60
Project 2	-100	10	10	80	5	10	10

Internal Rate of Return and Net Present Value

- IRR rule leads to the same decisions as NPV if

1. Cash outflow occurs only at time 0
2. Only one project is under consideration
3. Opportunity cost of capital is the same for all periods
4. Threshold rate is set equal to opportunity cost of capital

Internal Rate of Return: drawbacks

- **Non-existence of IRR.** Example: No IRR exists for these two projects

	CF0	CF1	CF2
Project 1	-105	250	-150
Project 2	105	-250	150

- **Multiple IRRs.** Example: IRR1=7%, IRR2= 4%, 7%, 10%

	CF0	CF1	CF2	CF3
Project 1	-500,000	1,575,000	-1,653,750	578,815
Project 2	-500,000	1,605,000	-1,716,900	612,040

Profitability Index

- **Profitability index** (PI) is the ratio of the present value (PV) of future cash flows and the initial cost of a project (CF_0 or I_0)

$$\mathbf{PI = PV / -CF_0 = PV / I_0}$$

- **Decision criterion using PI:**
- **For independent projects→** Accept all projects with PI greater than one (this is identical to the NPV rule)
- **For mutually exclusive projects→** Among the projects with PI greater than one, accept the one with the highest PI

Profitability Index and Net Present Value

- PI gives the same answer as NPV when:

1. There is only one cash outflow, which is at time 0
2. Only one project is under consideration.

- PI scales projects by their initial investments. The scaling can lead to wrong answers in comparing mutually exclusive projects

	CF0	CF1	IRR	NPV (r=10%)	PI (r=10%)
Project 1	-1000	2000	100%	818.10	1.82
Project 2	-2000	3600	80%	1272.73	1.64

Some hints on tariff setting: regulatory principles

- **Tariff setting is expected to comply with some regulatory principles:**

1. **Sustainability:** guarantee of recovery of all regulated costs
2. **Equity or Non Discrimination** in the allocation of costs to consumers
3. **Economic efficiency: Productive** (produce the good or service at minimum cost meeting prescribed quality standards) and **Allocative efficiency** (promote efficiency in consumption of the good in the short and long run)
4. **Transparency:** in the methodology, so that all employed criteria and procedures are made public
5. **Simplicity**: in the methodology and its implementation
6. **Additivity:** End user tariffs must be the outcome of adding all applicable cost concepts

The revenue requirement method

- In virtually all contexts, public utilities have a common fundamental financial structure and a common framework for setting prices. This common framework is what we call the utility's overall ***revenue requirement***
- **The general revenue, which the companies are allowed to receive through tariffs, is called *revenue requirement*.**
- It should be sufficient to cover all costs required for reliable, safe and uninterrupted operation of the companies and to receive a reasonable profit on invested capital.
- In order to determine what price a utility will be allowed to charge, regulators must first compute the total cost of service, that is, the revenue requirement.
- Regulators then compute the price (or rate) necessary to collect that amount, based on assumed sales levels.

The revenue requirement method

- Here are the two basic formulae used in traditional regulation:

Revenue Requirement = (Expenses + Return + Taxes)

Unit price (Rate) = Revenue Requirement / Units Sold

- **Example:** An electricity firm is characterized by:

	Mil. Euro
Expenses	100
Equity	200
Allowed rate of return on equity	10%
Allowed return	20
Taxes	5
Total Revenue Requirement	125
Units sold (kWh)	1000
Price (Euro/kWh)	0.125

The revenue requirement method

- With the revenue requirement regulation the firm can increase its profits:
- By **reducing expenses**: an incentive to operate efficiently. However, there is a floor below which expenses simply cannot be reduced without adversely affecting the level of service (some regulators have established service quality indices that penalize utilities that achieve lower-than-expected customer service quality).
- By **increasing the Units Sold**: as this will increase revenues and therefore profits. This is the heart of the throughput incentive that utilities traditionally face.

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