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Investment valuation methods: the Italian case

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INDICE

PREMISE

The starting point of the thesis is investment: this can be defined as an operation in which financial means or resources are used in order to acquire goods or services that produce an economic return in the short, medium or long term.

After introducing the various types of investments, an excursus will be made on the methods of evaluating investments, thus entering the heart of corporate finance.

Before investing his resources, every entrepreneur should analyze in a quantitative and rational way whether the investment will bring a return. Very often, this decision is based on personal experience, which is usually based on subjective variables.

Among the various criteria for evaluating an investment are:

1. The Average Accounting Profitability Rate
2. The Recovery Period
3. Discounted Economic Result
4. The Internal Rate of Return
5. The Discounted Return Index.

From an investment perspective, it is also useful to consider the so-called macroeconomic variables in fact this aspect will be explored in depth by emphasizing the influence of these factors in the economy. Subsequently, the "financing principle" will be introduced, i.e., after verifying the profitability of the investment, the question will be which resources to invest. This principle analyzes the company's financial structure and obliges it to look for a structure capable of guaranteeing balance and value creation in the long term.

A central part of the thesis will be the introduction of a case-study: Italian firms.

After downloading the data relating to 100 Italian listed companies, an econometric analysis was introduced with the aim of studying the significant and determining variables of the total invested capital.

The model in question will allow the analyst to make future forecasts in such a way as to help investors and entrepreneurs make the most appropriate decisions in the business environment.

The final step is to use econometrics to estimate the cash flows generated by the dependent variable in order to calculate the NPV and show how the chapters of the thesis are closely related to each other.

CHAPTER I: EVALUATION OF INVESTMENTS

1.1 What is an investment?

An investment can be defined as a monetary outlay (1963), i.e. employing a certain amount of money in projects from which an economic return is expected to be achieved; in other words, investing is equivalent to allocating financial resources to durable goods or economic activities at time 0 with the expectation of obtaining a gain at time 1.

Investments can be classified into two categories (1958):

- Fixed assets;
- current assets.

Fixed assets can be described as assets that do not exhaust their usefulness in a single financial year, remain in the company assets in a lasting way and are divided into intangible assets (factors of production without physical consistency, e.g. installation and expansion costs, research, development and advertising costs...), tangible fixed assets (factors of production with physical consistency, e.g. land and buildings, plant and machinery, equipment...) financial fixed assets, consisting of receivables with a maturity of more than one year (e.g. equity investments, medium/long-term financing receivables, derivative financial instruments, etc.).

Current assets are all those assets that are intended for sale or consumption, collection or commitment in a short time, in other words not intended to remain for a long period in the assets of company X. Within the current assets there are:

- warehouse stocks, short-term investments aimed at processing, consumption or exchange within 1 year;
- deferred cash, receivables of any kind that are expected to be settled by the end of the following year;
- immediate liquidity, bank deposits and all investments similar to money.

Investments can also be explicit, i.e. projects that clearly show net cash outflows and incomes, or implicit, when the investment is not directly associated with cash flows (1984); investments are alternatives if the realization of one investment makes the realization of the other impossible; while they are constrained when an investment needs to be undertaken in order to complete the other project. Competing investments, on the other hand, are two or more investments that cannot be made at the same time, despite the economic convenience and the fact that they are not alternatives, due to the unavailability of the necessary resources.

Independent investments are two or more projects that have uncorrelated inflows and outflows.

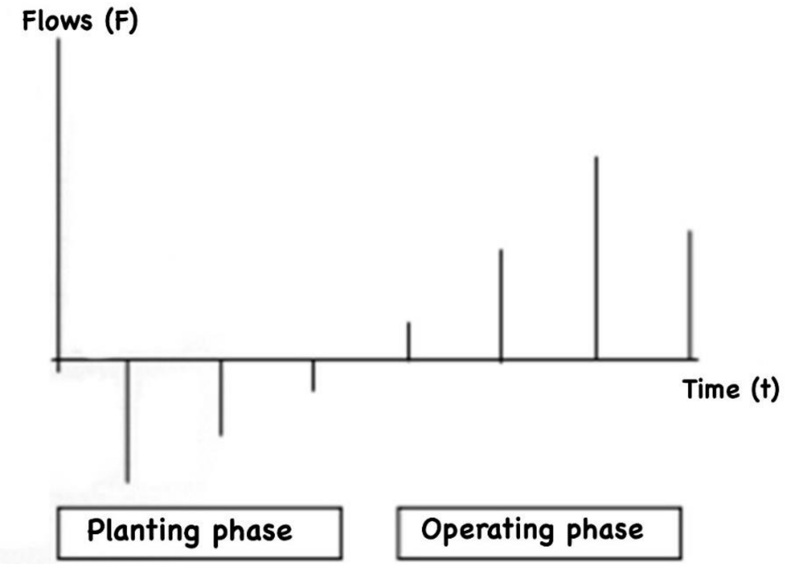
Sequential projects are characterized by the fact that the realization of one project is followed by the need to complete another in order to obtain the expected benefits of the original project.
Further classification can be made on the basis of the effects that the investments bring (2014):

- cost effects: the objective of these projects is to increase efficiency and cost-effectiveness;
- effects on revenues: an attempt is made to improve the product from a qualitative point of view in order to increase the selling price;
- effects on working capital: all those investments that aim at better warehouse management;
- joint effects: the effect produced by these projects falls on costs, revenues and working capital.

Regardless of the type of investment a person decides to undertake, investment's life can be broken down into two phases:

1) The first is the "planting phase": in simple words, the contractor pays for the project without any return; this phase is usually characterized by negative flows caused by the monetary outlay made to support the new idea.
2) The second phase is called the "operating phase" (2023): it coincides with the period in which the initiative begins to produce profits. In this context, it is useful to introduce the concept of performance or yield.

Figure 1: Graphical representation of the flows characterizing the planting phase and the operating phase



Source: Finanza d'Azienda M. Dallocchio – A. Salvi, EGEA 2004, Chapter 13

Yield can be defined as the actual gain from the allocation of financial resources.
To better understand, see the following example.
Luke decides to open a wallet today and pays it 150,000 euros. This sum invested will make him pocket 170,000 euros tomorrow: the initial investment of 100,000 euros produced a return of 20,000 euros.
From a very technical point of view, this performance is referred to by the acronym ROI.
According with DuPont’s scheme (1950), return on investment is the rate of return on a company's total investments. It is the rate of profitability that allows investors to evaluate the success of an investment in principle.
It is also used to find out how many times a business's revenues cover its costs. It is helpful in choosing the right strategy to use in an investment.

ROI: Operating Income / Total Assets Balance Sheet (1)

1.2 The criteria for the financial evaluation of investments

The evaluation of investments consists of the economic and financial planning activity that is carried out in order to verify the impact in terms of profitability of the new project.
In other words, this analysis is used to judge the validity of an investment and consists of three analysis profiles (2002):

I. The economic profile: it provides a ratio between the resources absorbed and the resources freed up in order to calculate a synthetic cost indicator that expresses the convenience of the project: this is called economic feasibility.
It is important to emphasize that for a proper economic analysis, it is necessary to consider the incremental cash flows of the investment and the cost of capital.
II. The financial profile: the so-called financial feasibility is verified, i.e. the compatibility of the investment with the company's income and expenditure profile. A cost-effective investment may not necessarily be financially viable.
III. The profile of economic and financial communication: the set of information collected and rationally assembled that is transmitted to anyone who has an interest in it (shareholders and stakeholders). A viable and cost-effective project may be abandoned on the basis of the considerations of external analysts as a result of the negative effects of budgetary indicators.

There are several methods of evaluating investments, but what they all have in common is the fact that a criterion to be labeled as valid must consider three elements:

-the size of the cash flows,

- the temporal distribution of flows,

-the financial value of time (2014).

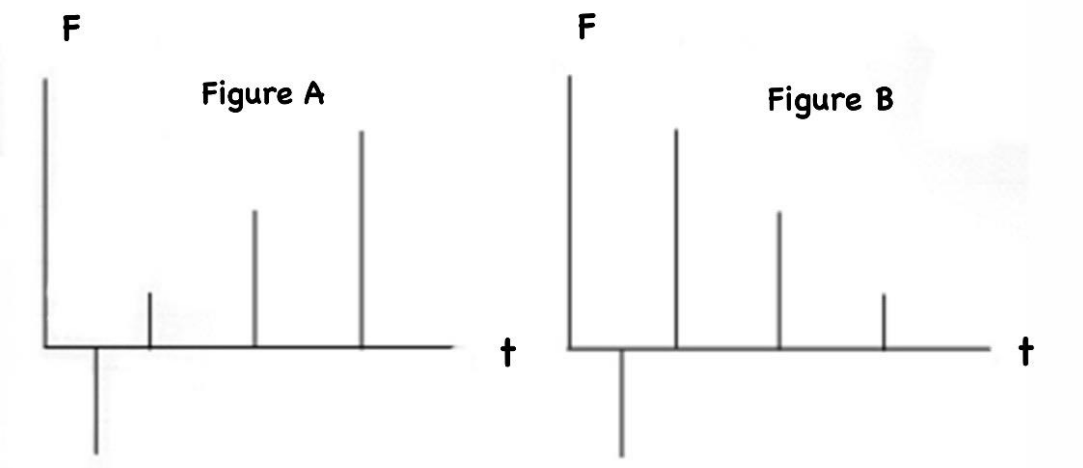
With regard to the first aspect, an investment is advantageous if the resources released, i.e. the cash flows generated, exceed the amount of resources absorbed.

E.g. sustained investment = -150, return flow = +250, positive difference = +100.

The second component poses two main questions to the investor, namely what is the time horizon to be considered for an adequate evaluation and what should be the duration of the periods in which to divide the observations.

The answer to these questions depends on factors such as your industry or the type of investment. It should be noted that two investments with equal cash flows in absolute size but different time distribution are not the same.

Figure 2: Investments with different time distributions

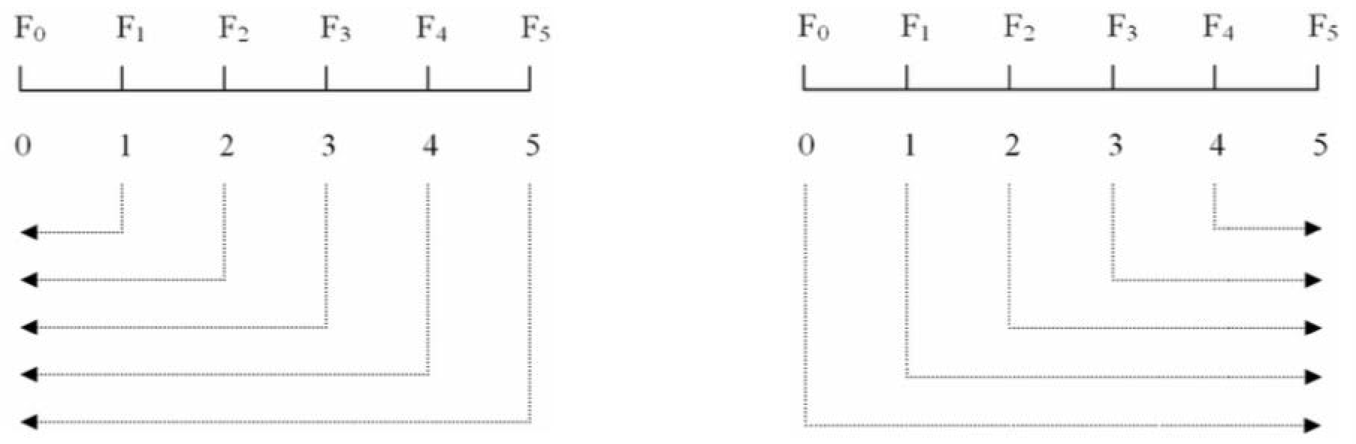


Source: Finanza d'Azienda M. Dallocchio – A. Salvi, EGEA 2004, Chapter 13

What the time distribution reflects is the financial value of time: traders prefer the immediate availability of a sum of money rather than a postponed one, and this stems from the fact that any shift in cash flows over time involves incurring a cost or receiving an income. If the flows occur with different maturities, i.e. at different time periods, their value cannot be compared.

In order to compare them, it is necessary to trace the flows back to a common moment according to the logic of discounting or capitalization.

Figure 3: Discounting and capitalization of flows



Source: Finanza d'Azienda M. Dallocchio – A. Salvi, EGEA 2004 , Chapter 13

The first graph corresponds to the logic of discounting: future flows are converted into present flows and this allows the present value of future cash inflows and outflows to be calculated.
The second graph shows the logic of capitalization: we try to know the future value (or amount) at maturity t, in this case t=5, of the flows invested in previous periods.
To calculate the present value, thanks to the contribution of I. Fisher (precursor of the idea that the value of an investment depended on discounted future cash flows, 1930) the formula used is:

$$PV = \sum_{t=1}^{N} \frac{F_{(t)}}{(1+k)^{t}} \quad (2)$$

where: F(t) is the cash flows,
n is the number of periods in which the flows are produced,
k is the cost of capital.

Example: Rick runs a dairy and he is considering whether or not to buy a machine that would allow him to reduce time and effort and that has a cost of 500 euros (corresponds to the initial investment). However, talking to other cheesemakers, it turns out that this machine has an average lifespan of 3 years and that the purchase will allow Rick to obtain an extra 300 euros in the first year, 200 in the second and 100 in the third.
The alternative to buying the instrument is to invest in stocks that yield 5% per annum.

Using formula (2) the present value is = 500 (1.05^-1) + 300 (1.05^-2) + 100 (1.05^-3) = 834.6826.
To calculate the net present value, a concept that will be explored later, the initial investment is subtracted from the PV: 834.6826 – 500 = 334, 6826.
Since the NPV is positive, it seems convenient to buy the machine.
To find the future or upright value of a series of cash flows, use instead:

$$VF = \sum_{t=1}^{n} F_{(t)} (1+k)^{n-t} \qquad (3)$$

where: F(t) is the cash flows,
n represents the number of periods in which the cash flows are produced;
k is the cost of capital.
These concepts are critical to understanding the various analysis criteria for evaluating an investment.

1.2.1 Average accounting rate of return

The first criterion to investigate, resulting from the study of various financial professionals, is the Average Accounting Profitability Rate (AAR), which can be defined as the ratio between the average incremental profitability produced during the periods taken into consideration and the amount of the average investment to be incurred (2006):

ARR = average net income/ average value of investment (4)

Alternatives used in place of incremental average net income can be (2015):
-average incremental operating income,
-incremental weighted average operating income,
-incremental weighted average net income.
The weighting is carried out by giving a more significant weight to the first years, since the forecasts are more easily reliable.
As far as the denominator is concerned, we can have:
-average incremental investment in fixed capital,
-average incremental investment in fixed capital, increased by incremental working capital,
-the absolute value of the outlay to be incurred for the implementation of the investment.

However, the most common wording is:

ARR = average net income/ (1/2 FC + WC) (5)

This formula assumes that the fixed capital is harmonized on a straight-line basis with a realizable value of zero. WC represents working capital and, unlike fixed capital, does not depreciate over time. The ARR, if not compared with a second rate, does not express an opinion on the convenience of the investment. Although the use of ARR is widespread, this criterion has some limitations (2001):

-does not consider cash flows,

-numerator and denominator are average values for which the distribution of income and expenditure is not considered,

-the financial value of the time is not taken into account,

-numerator and denominator are inhomogeneous.

ARR Calculation Example

Consider 5 periods:

	0	1	2	3	4	5	Media
1) Aver. net income	0	300	600	800	900	720	664
2) Incremental WC	0	200	500	480	480	500	432
3) Depreciation	0	1200	1200	1200	1200	1200	1200
4) Net increm. FC	4800	4300	3600	2100	1200	0	2666,667
5) Tot. Capital = 2) + 4)	4800	4500	4100	2580	1680	500	3026,667
6) Weighting coeffic.		30%	27%	20%	17%	10%	
Unweighted ARR	0,21938326						
Weighted aver. net inc.	637						
Weighted ARR	0,21046256						

To calculate the unweighted AAR, “Media” of average net income was divided by the average of the Total Capital: 664/3026.6667. To find the weighted AAR, the weighted average rate of return was first calculated by multiplying the average net income of each period by the various weighting coefficients (300 x 0.3 + 600 x 0.27 + 800 x 0.2 + 900 x 0.17 + 720 x 0.1), and then the weighted average net income found was divided by the average of the Total capital: 637/3026,6667.

1.2.2 Recovery Period

The payback period is defined as the ratio of an initial investment (I0) to the income value:

PP (or PRI) = Investment / income value (6)

This value expresses the number of periods necessary for the positive flows of the investment to compensate for the expenses incurred: $t \to min\left(\sum_{i=1}^{t} FCFO_i \geq I_0\right)$

In this context, it is necessary to identify the so-called cut-off: only if the time required to obtain a return is less than the cut-off it will be advisable to support the project.

Payback period is particularly easy to calculate, however, it is believed that this criterion is not widely used as it has significant limitations (2014, 2023)

First of all, the risk and time factor are not considered, as well as the medium-long term flows, and moreover no information is provided regarding the profitability of the projects. From a practical point of view, this criterion can be used to evaluate low-risk or unimportant projects or when there is doubt about the reliability of measurements such as flows or WACCs.

The correct application of this index is obtained by considering the temporal distribution of cash flows and solving the following equation:

$$\sum_{t=1}^{PRI} F_{(t)} - F_0 = 0 \quad (7)$$

Example of Recovery Period Calculation

Years	Cash flows	Cumulative cash flows
0	-8000	-8000
1	1000	-7000
2	3000	-4000
3	3500	-500
4	2000	1500
5	3000	4500

The amount invested will be recovered between the third and fourth year.

To overcome some of the intrinsic limitations of the payback period criterion, the discounted payback period can be used, i.e. the shorter time it takes for the investment to generate positive discounted cash flows that cover the investment initially incurred:

$$t \to min\left(\sum_{t=1}^{N} \frac{FCFO_t}{(1+WACC)^t} \geq I_0\right)$$

Although some lagoons remain, such as the fact that medium-long term flows are not considered and the permanence of the arbitrariness of the cut-off, the time and risk factors are considered. From the point of view of practical application, DPP is used in contexts characterized by uncertain and insignificant cash flows in the long term.

The equation to be used to calculate the criterion is:

$$\sum_{t=1}^{PRI} F_{(t)}(1+k)^{-t} - F_0 = 0 \tag{8}$$

Example of calculation of the discounted recovery period

Years	Cash flows	Cumulative cash flows	Discounted flows	Disc. Cumul. Flows
0	-8000	-8000	-8000	-8000
1	1000	-7000	909,0909091	-7090,909091
2	3000	-4000	2479,338843	-4611,570248
3	3500	-500	2629,601803	-1981,968445
4	4000	3500	2732,053821	750,0853767
5	3000	7500	1862,763969	2612,849346

In this example, the discount rate is assumed to be 10%. The recovery period is t = 4.

1.2.3 Discounted economic result (or net present value)

The REA (VAN) or NPV represents the incremental wealth generated by an investment and is expressed as if it were immediately available. This criterion is defined as the algebraic sum of all the discounted cash flows produced by the project:

$$REA = \sum_{t=1}^{n} \frac{F_t}{(1+k)^t} - F_0 \tag{9}$$

The formula (9) can be more generalized with the following:

$$REA = \sum_{t=0}^{n} \frac{F_t}{(1+k)^t} \tag{10}$$

The decision-making criterion that drives a person to undertake an investment is the fact that it must have positive NPV. A positive NPV attests to the project's ability to generate flows of sufficient size to repay the initial outlays and leave excess resources to be allocated to other uses.

The flows generated must be discounted by the cost of capital: as this increase, the economic convenience of the project decreases.

From a practical point of view, this method is preferred over others when dealing with large projects, low volatility cash flows, or reliable WACC estimates (2023).

Example of NPV calculation

Consider a project with an initial outlay of €150,000 and a steady flow of €50,000 over the next 4 years. The WACC is 10%. The question that arises is whether it is worthwhile to undertake the investment. To solve this problem, the formula that will be used is as follows:

$$VAN = -I_0 + VA = -I_0 + \sum_{t=1}^{N} \frac{FCFO_t}{(1+WACC)^t} \quad (10)$$

where k is expressed in terms of the weighted average cost of capital.

	0	1	2	3	4
Undiscounted flows	-150000	50000	50000	50000	50000
Discounted flows	-150000	45454,54545	41322,31405	37565,74	34150,67
VAN = -I0 + VA	8493,272317				

A positive answer is obtained from the table as the NPV of the project is greater than zero.

NPV is one of the most widely used investment valuation methods and this diffusion is due to the main strengths that characterize this criterion and can be summarized as follows (2001):

-it considers the risk and time factor (and in particular the time value of money),

-NPV considers medium- to long-term flows,

-consideration of the size of the project,

-it does not take into account subjective evaluations such as personal preferences,

-it has the additive property, i.e. NPV (project A + project B) = NPV (project A) + NPV (project B).

Another aspect that characterizes REA is the possibility of ignoring some identical flows for two different projects if difficulties were encountered in the calculation of these flows: ignoring these flows would be feasible given the nullity of the effect on the differential transaction.

Generally, we can say that REA (A) - REA (B) = REA (A - B): if the REA of the differential operation turns out to be greater than zero, we would choose a over b.

Despite the many advantages listed, it is necessary to emphasize that the NPV does not consider the so-called rationing of capital as well as future opportunities.

To understand the first aspect, we have to consider two investment projects with the same WACC equal to 7%.

	Initial investment I0	Cash flow 1	Cash flow 2	VAN
Project a	-100000	80000	80000	44641,45
Project b	-1000000	800000	800000	446414,5

Considering only the NPV criterion, the most convenient choice would seem to be project b, having a higher NPV than a; however, in the case of capital rationing, the firm may not be able to sustain such a high investment as in case b. The selection between the two projects should be made considering both elements.

As far as future opportunities are concerned, a different argument must be made: consider a project a and a project b preparatory to the achievement of a project c. In both investments, there is a WACC = 10%.

	Invest. 0	Cash flow 1	Cash flow 2	Cash flow 3	Cash flow 4	VAN
Project a	-200000	80000	80000	80000	80000	53589,24
Project b	-200000	150000	30000	30000	30000	4186,872
Project c (resulting from b)		-150000	180000	180000	180000	343303,1

The NPV considers project a to be more advantageous than project b: however, this is because the prerequisite nature of investment b is not considered to be c.

If the future opportunity offered by project c were taken into consideration, one would choose to undertake the b because: NPV (b + c) > NPV (a).

In this context, talking about future opportunities is the same as talking about real options (Stewart Myers, a professor of finance at MIT Sloan School of Management, proposed the idea of applying the theory of real options to the valuation of investments): these are rights that allow you to assess the flexibility associated with the implementation of investment projects and to achieve an advantage deriving from an opportunity in an environment where uncertainty prevails.

Among the real options, the most well-known are:

- the option of expansion,
- the standby option,
- the option to leave.

The expansion option consists of the possibility that is given to the entrepreneur to make additional investments (it has been partially introduced in the last table seen above).

Assume that you want to invest in a project and, depending on the result you expect to achieve, you will decide whether to undertake a second project, which is therefore consequent to the first.

WACC = 10%. It should be noted that the optimistic and pessimistic scenarios are equally likely.

	Invest. 0	Cash flow 1	Cash flow 2	Cash flow 3	Cash flow 4	VAN	VA
Project b optimistic sc.	-200000	100000	30000	30000	30000	-41267,7	158732,3
Project b pessimistic sc.	-200000	150000	35000	35000	35000	15490,75	215490,7
Project c (resulting from b)		-150000	180000	180000	180000		270575,8

Without the option, the NPV will be: -200000 + (158732.2 x 0.5 + 215490.7 x 0.5) = -12888.5 euros.

With the option the NPV will be: -200000 + (158732.2 x 0.5 + 2750575 x 0.5) = 14653.99 euros.

The following formula is used to calculate the value of the real option:

$$\text{Value of a real option} = \text{NPV with option} - \text{NPV without option} \tag{11}$$

In this example, this value is given by 14653.99 – (-12888.5) = 27542.49 euros

The waiting (or deferring) option refers to the decision to delay the start of a project in order to obtain a possible higher return later, for example by exploiting resources and information that were not initially possessed.

Also in this second case we are faced with two different projects for which an initial disbursement of 300000 euros paid at different times is required. WACC = 10%.

	Invest. 0	Cash flow 1/ invest. 0	Cash flow 2 / CF 1	Cash flow 3/ CF 2	Cash flow 3	VAN (0)
Project d whithout waiting	-300000	130000	160000	90000		18031,56
Project d with waiting op. sc.		-300000	150000	180000	100000	54777,68
Project d with waiting p. sc.		-300000	130000	140000	90000	1366,027

Without the option, the project is worth €18031.56.

With the waiting option, the project is worth: (54777.68 x 0.5 + 1366.027 x 0.5) = 28071.85 euros.

The value of the option is: 28071.85 – 18031.56 = 10040.29 euros.

The last case to be analyzed is that of abandonment options that allow the person who owns them to abandon the project in progress if this proves to be an inconvenience.

A WACC of 10% is estimated.

	Invest. 0	Cash flow 1	Cash flow 2	Cash flow 3	Cash flow 4	VAN	VA
Project e optimistic sc.	-30000	18000	8000	6000	5000	898,1627	30898,16
Project e pessimistic sc.	-30000	13000	3000	-12000	-10000	-31548,4	-1548,39
Dismantling of the project e	-30000	26000				-6363,64	23636,36

The NPV without option is: -30000 + (30898.16 x 0.5 – 1548.39 x 0.5) = -15325.11 euros.

With the option, the NPV turns out to be:

-30000 + [30898.16 x 0.5 + (23636.36 + 13000/1.1) x 0.5] = 3176.35 euros.

The value of the abandonment option is: 3176.35 – (-15325.11) = 18501.46 euros.

It should be noted that especially for small companies, the real options are inapplicable (1993):
-the expansion and waiting options are based on prospective flows that are distant in time and difficult to determine,
- the probability of occurrence of events cannot always be determined with the use of theoretical models,
-difficulty in comparing two projects (often they are new projects and with flows that are not similar to those of the company as a whole).
Despite the inapplicability in some contexts, these options remain very useful because they allow investors to combine technicality with an elastic and managerial approach.

To conclude the analysis of this valuation method, we want to introduce a further disadvantage of this criterion: the NPV does not separate the value of the investment from that of the loan. This is precisely why the Adjusted Present Value (VAM or APV) was introduced.
This method is used to determine the value of a project of an indebted firm which is equal to the sum of the value of the project of a non-indebted firm and the net present value of the secondary effects of financing.

The most recursive formula is as follows:

$$VAM = -Io + VA = -Io + \sum_{1}^{N} \frac{FCFO_t}{(1+ro)^t} \quad (12)$$

Again, you'll choose projects that have a modified present value greater than zero.

1.2.4 The internal rate of return

The internal rate of return or implicit rate (IRR or TIR) is the discount rate that makes the present value of an investment null or, in other words, makes the values of the positive and negative flows of a project identical. To mention speaking of the IRR is once again I. Fisher who was one of the first economists to explore the relationship between interest rates and investment decisions (2024).
IRR represents the maximum cost of collection that a project can bear without losing its economic convenience.

$$IRR = r \rightarrow NPV = -Io + \sum_{1}^{N} \frac{FCFO_t}{(1+r\ )^t} = 0 \quad (13)$$

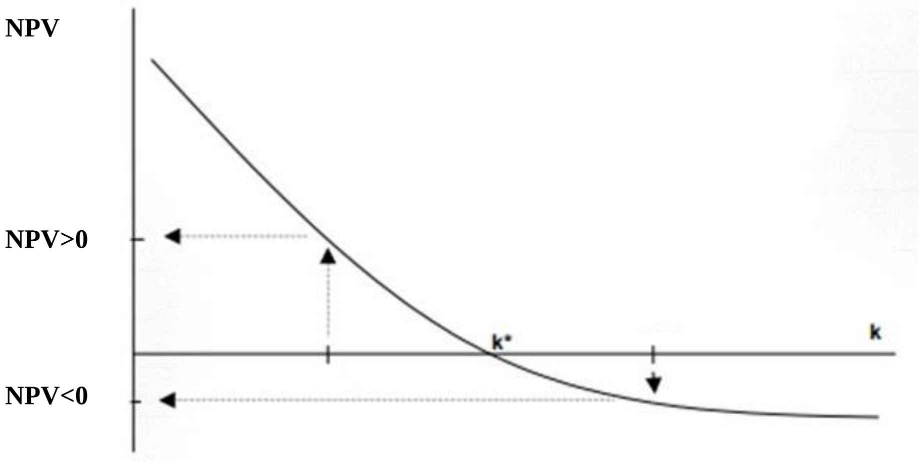
Like all investment valuation methods, IRR has strengths and weaknesses.

Among the former, the consideration of the risk and time factor, long-term flows and the fact that the IRR is a synthetic measure are highlighted; however:

- the size of the project is not considered,
- this method cannot be adopted in the case of projects with alternating flows,
- the location of the flows over time is not considered.

From a practical point of view, IRR is widely used to compare similar projects and in the case of financing projects.

Figure 4: Graphical representation of the internal rate of return



The figure above shows the trend of the NPV as a function of the interest rate: k* represents the IRR. How do you see if:

-NPV(k*) > 0: the investment is worthwhile,

-NPV(k*) < 0: the investment is not worthwhile,

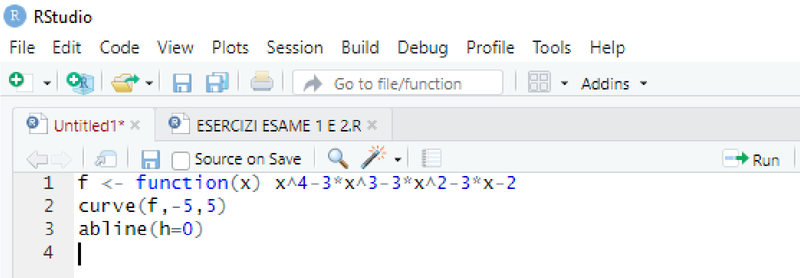
-NPV(k*) = 0: it doesn't matter whether to undertake the investment or not.

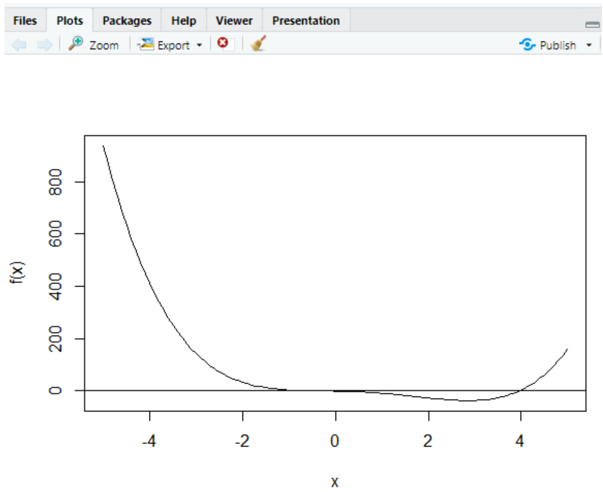
It should be noted that in formula 13 it is assumed that there is only one negative flow (I0), nothing changes if the initial flows were more than one.

The problem arises if the negative flows were to be interposed with the positive ones, since this would imply multiple solutions.

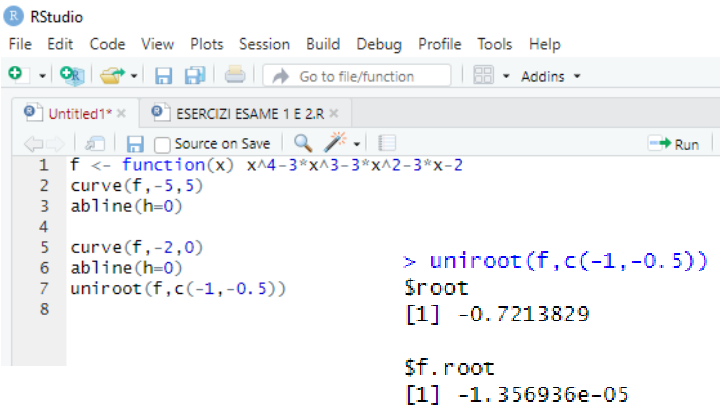
A quick way to check if there are more intersections between the curve that describes the trend of the NPV and the x-axis (k), therefore more values that cancel the REA, is to use the calculation of the zeros of the function (Isaac Newton, 17^{th} Century) on the program R.

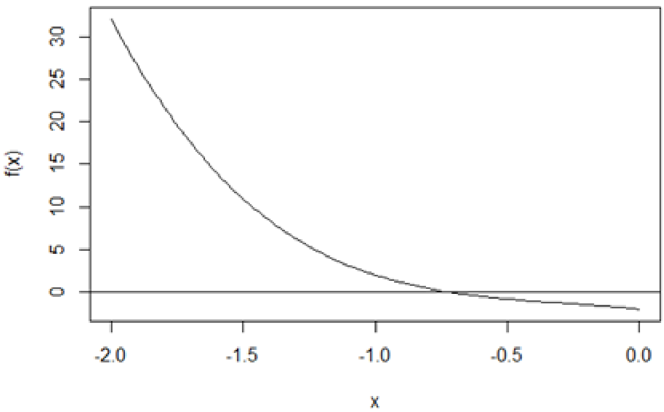
The first step is to define the function of interest, draw the graph using the "curve" command (the values -5 and 5 have been randomly selected) and draw a horizontal line, parallel to the X axis, passing through zero.



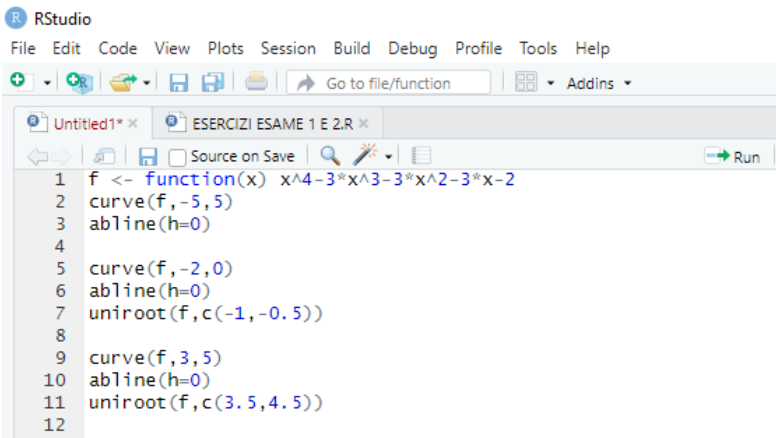


Next, to see the graph more closely, you'll use the curve function again: since a possible zero of the function seems to be between -2 and 0, we will focus on those values. After identifying the range using "uniroot" you find the first number that cancels f (i.e. -0.7213829)



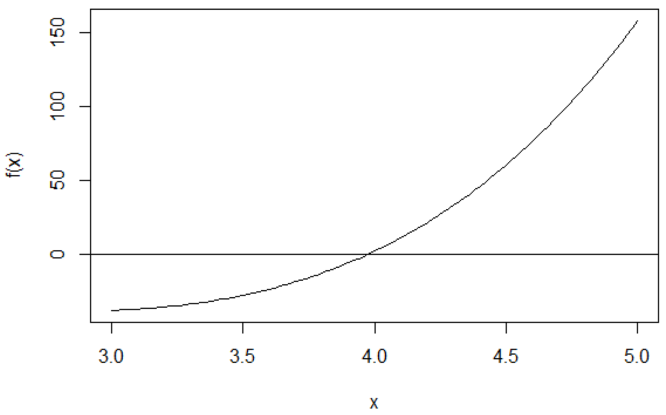


To find the second zero we will use the same procedure as seen above but focusing on a different range: the zero in question would seem to fall between the values between 3 and 5.



```
> uniroot(f,c(3.5,4.5))
$root
[1] 3.976083

$f.root
[1] -0.0004923372
```



The question that arises after figuring out how to find zeros is how to use IRR as a decision criterion. If there are more than one investment options (a and b), investors will choose the one with the highest rate: if IRR(a) > IRR(b) → a > b, investment a.

In the case of financing, the lowest rate will be chosen as the goal is to minimize costs.

1.2.5 Profitability Index

The profitability index measures the efficiency of the investment and is expressed through the ratio between the discounted output produced by the investment and the value of the resources absorbed in the initial investment; in other words, PI (or IR) sets out the relationship between the present value of the positive flows generated by the investment and the present value of the expenditures necessary for the implementation of the project.

$$PI = \text{Present value} / \text{initial investment} \qquad (14)$$

The PI indicates how many monetary units can be released for each unit invested.

This index is used to evaluate large projects and projects with low volatile cash flows, and reliable estimates of the WACC.

IR has some weaknesses such as not considering future opportunities and not considering capital rationing. On the other hand, the strengths can be summarized as follows (2002):

- risk factor and time considered,
- medium-long flows considered,
- possibility to take advantage of the additive property,
- very strict criterion.

If you want to compare two projects using the profitability ratio, preference will be given to the investment that has an PI > 1. If there are more investments, the one with the highest profitability ratio is preferred. It is important to underline that a project with REA greater than zero must have an PI greater than one.

PI Calculation Example

The question arises as to whether it is worthwhile to undertake an investment that involves an initial outlay of 170000 euros and a constant flow of 60000 for the following 4 periods.

Estimated WACC 10%.

	Invest. 0	Cash flow 1	Cash flow 2	Cash flow 3	Cash flow 4	VAN	VA
Project f	-170000	60000	60000	60000	60000	20191,93	190191,9
IR = VA/INV. 0 = 1,119							

Since the index gives a value greater than 1, the project is cost-effective.

IR is very useful especially when we are faced with competing operations, i.e. in conditions of lack of financial resources that do not allow the implementation of all the projects that would be convenient having a positive REA.

	REA	IR
Project a	3000	1,4
Project b	1700	1,2
Project c	3500	1,3
Project d	1500	1,8

On the basis of the REA criterion, investment c would seem to be more convenient, but the IR advises not to ignore project d.

1.3 The criteria for the financial evaluation of investments in the context of scarcity of resources

Investment decisions in the context of scarcity of resources invite consideration of elements other than a situation of financial stability. This aspect is underlined in the book "Financial Strategies for Distressed Companies" in which the authors analyze the financial strategies to be adopted while maintaining financial balance. First of all, the capital rationing situation has 2 consequences:

- the financial value of time can no longer be represented by the cost of capital alone: if the investment generates positive flows, these are reinvested at a rate r higher than the cost of capital;
- in the evaluation of the investment, the re-use of flows must be considered.

To sum up, in a context characterized by the absence of financial constraints $r = k$, while if there were constraints $r > k$.

The starting point is to calculate the amount obtained from the flows generated by the investment and reused and then it will be discounted to time zero, i.e. to the period of implementation of the project.

A further difference is the fact that two projects cannot be compared exclusively on the basis of the additional wealth generated (if the projects have different durations, the one with a shorter duration allows investments in other projects) so it is necessary to introduce the concept of equalization operations. The aim of these operations is to allow the comparison of projects with unequal amounts and effects that are generated over different periods of time. The criteria that are used are:
-the adjusted discounted economic result (RAR),
-the adjusted implicit rate (IRR);
-the adjusted discounted yield ratio (IRAR).

1.3.1 Adjusted discounted economic result

The RAR, like the following indexes, is not a new concept but the result of the contribution of more scholars over the years (Arthur E. Attema, Werner B. F. Brouwer and Karl Claxton). This criterion differs from the classic REA because in this case the resources obtained from the initial investment are reinvested, so there is the possibility of making investments at a return higher than the cost of capital.

$$RAR = \left[\sum_{t=1}^{n} F_t \times (1+r)^{n-t} \right] \times (1+k)^{-n} - F_0 \tag{15}$$

Example RAR calculation

The cost of capital is estimated to be 15% while the re-employment rate r is 20%.

Years	Cash flows	Capitalization factors	Capitalized flows	Discounting factor
0	-10000		-10000	
1	1300	2,0736	2695,68	0,497176735
2	3500	1,728	6048	
3	4000	1,44	5760	
4	4500	1,2	5400	
5	3200	1	3200	
Tot capitalized flows = 23103,68				
RAR = Tot cap. flows x Disc. Fact. - I0	1486,612196			

The investment is convenient having a positive RAR of 1486.6122.

1.3.2 The adjusted implied rate

The wording of the IRR is as follows:

$$(1+\mathrm{TIR})^{-n} \left[\sum_{t=1}^{n} F_t (1+r)^{n-t} \right] - F_0 = 0 \tag{16}$$

This rate is very useful in the presence of financial constraints and with the same initial outlay because it allows investors to construct an order of time preference in the realization of investments. In the event that the disbursements are different, another criterion must be used, namely the adjusted discounted yield ratio. All investments with TIR > k will be accepted.

1.3.3 The adjusted discounted yield ratio

IRAR is calculated:

$$IRAR = \frac{\left[\sum_{t=1}^{n} F_t \times (1+r)^{n-t} \right] \times (1+k)^{-n}}{F_0} \tag{17}$$

This index is used to determine the best choice between competing investments in the event that the initial outlay is different.

The link between RAR and IRAR will be analyzed below. Consider 5 different projects and a capital to be invested of 1000: for the realization of all the projects you would need a capital of 1500 so you have to decide which of the proposed projects are the best.

	F(0)	IRAR	RAR
Project a	300	1,37	110
Project b	350	1,32	127
Project c	200	1,28	80
Project d	370	1,25	95
Project e	280	1,19	102

On the basis of IRAR, there would be a tendency to invest in the first 3 projects using 85% of the available resources. However, project c has a lower RAR than projects d and e.

Combining formulas 15 and 17 in a system shows that:

$$RAR = F(0) \times (IRAR - 1) \tag{18}$$

This equation is that of a hyperbola of the type RAR = XY where (IRAR – 1) = X and F(0) = Y.

From a practical point of view and to take up the example above, we want to emphasize that:

-if competing investments have the same initial outlay, IRAR is the best criterion to consider,

-If competing investments have different initial outlays, IRAR can also be used, but the best way to decide which projects to invest in is linear programming.

1.4 Elements influencing the valuation of investments

Uncertainty

To complete the analysis of traditional investment valuation methods, it is essential to delve into some concepts, including uncertainty. When you evaluate a project, you make predictions and, like any calculated estimate, they are affected by possible uncertainty. The calculation of the indices and criteria set out above should therefore be accompanied by an analysis that studies their effects.

To do this, it can be used:

- sensitivity analysis (developed from the bases cast by H. Markowitz for his Portafolio Theory),
- risk analysis (George Dionne contributed significantly to the definition of modern risk management practices),
- scenario analysis (Herman Kahn and Pierre Wack).

Sensitivity analysis is useful for understanding how changes in key parameters can affect an investor's financial performance. It consists of five phases (2004):

1) Identification of key parameters: this first phase aims to identify key parameters such as revenue growth rate, operating costs, discount rate, product or service price, which can bring significant changes to the results achieved by the project.
2) Definition of variations: once the key parameters have been identified, the possible variations for each parameter are defined. For example, it is calculated how a 10% change in revenue affects the NPV of the project, or how a 1% change in the discount rate affects the IRR.
3) Impact assessment: using financial models, the impacts of changes in key parameters on investment performance are assessed.
4) Interpretation of the results: it is important to interpret the results to understand the implications of changes in key parameters. If, for example, the project is sensitive to changes in operating costs, it will be important to carefully control and manage these costs during the implementation of the project.
5) Risk management and decision planning: on the results obtained from the sensitivity analysis, it is possible to develop risk management strategies and plan more specific investment decisions such as the implementation of measures to mitigate the risk associated with a particularly sensitive parameter, or to focus efforts on those parameters that have the greatest impact on the overall value of the project.

Sensitivity analysis is normally done by considering the variation of only one variable at a time. Variables for which a change of 1% in their value implies a change of at least 1% in IRR or at least 5 percentage points in NPV are considered to be particularly critical.

Risk analysis (2002) is a fundamental aspect of investment evaluation because it allows you to understand the potential risks associated with an investment project; it is a more complex analysis than the previous one as it requires estimating at least two parameters in the simplest case:

- the probability of occurrence of an event (Pi),
- the impact of this event on the outcome (Ei).

The first step of this analysis is to identify the risks, in this context all the potential causes that can significantly impact the deviations from the target (the expected return) are identified.

In the second step, mostly using quantitative and qualitative techniques, the probability of each risk and the associated potential financial losses are estimated.

The purpose of this step is to determine the probability distribution of a variable X affected by uncertainty. This procedure can be performed with a simulation model: the most widely used approach is Monte Carlo simulation (John von Neumann, Stanislaw Ulam, 1946). The simulation in question can consider multiple variables at the same time. If you opt for a pragmatic approach, the steps are as follows:

– sensitivity analysis to determine the most significant x-variables: the sensitivity of the investment to changes in the risk environment is assessed,
– identification of the plausible range of variation for each x,
– identification of the probability distribution for those values,
– elimination of incompatible conditions,
– execution of the simulation.

To better understand the assessment of the potential impacts that may occur, a scenario analysis is carried out: an optimistic, a realistic and a pessimistic scenario is assumed with the aim of helping investors understand changes in financial results in different circumstances.

Next comes risk mitigation and risk-return ratio: in light of the identified risks and mitigation strategies, investors need to assess whether the potential return on the investment adequately compensates for the risks taken.

Last but not least is the phase of continuous monitoring and management of risks (2013): given the variability of the context in which we operate and the fact that risks are changeable, it is necessary to continuously monitor the latter in order to readjust possible strategies.

Scenario analysis is based on the construction of different scenarios characterized by the values of critical variables.

In other words, this analysis is the process of predicting the expected value of a performance indicator: through the calculation of the probability of occurrence and the possible impact generated, a strategic plan is developed that allows the manager to simulate business responses to the occurrence of certain events.

Non-financial risks

The return on an investment is directly proportional to the financial risks a person wants to take: it is important to be aware of the need to balance the desire to achieve high results with the need to protect your capital from unforeseen events and fluctuations.

That said, very often people simply focus on this first category of risks, not considering the non-financial ones that can have a significant impact not only on the company's performance but also on its reputation. These risks can include environmental, social, and governance (ESG) issues, as well as reputational and legal risks. It is important to assess and integrate these risks into investment decisions in such a way as to reduce exposure to any adverse consequences.

-**Environmental risks**: issues such as pollution, floods, droughts, unsustainable use of natural resources, and climate change have become commonplace and can have significant impacts on business operations and their long-term sustainability (the BCE and the World Economic Forum publish annual reports and guides on the management of these risks). Investments in sectors with a high environmental impact could be subject to risks from stricter regulations, legal penalties or reputational damage.

-**Social risks**: these concern problems related to relations with local communities and human rights. Investments in companies involved in disputes related to workers' rights, occupational safety or human rights violations can result in sanctions and negative consequences in terms of image.

-**Governance risks**: these risks are reflected if the investor decides to undertake projects with companies with weak governance structures.

Encountering businesses where there are cases of fraud and corruption can also lead to the need to take legal action and loss of trust in the company.

-**Reputational risks**: reputation is a fundamental intangible asset for any company. Investments in industries or companies with a compromised reputation can result in loss of customers, licenses, or contracts, with significant financial consequences.

To effectively integrate non-financial risks into investment valuation, specific approaches and tools, such as ESG (Environmental, Social, Governance, James Gifford, 2004) analysis, must be adopted to assess and monitor these risks throughout the investment lifecycle.

The qualitative aspect

Financial data are not enough to adequately evaluate an investment opportunity, in fact, qualitative aspects must also be considered, such as the strategic importance of a project for the company or its relevance in the field of sustainability (Robert S. Kaplan, Balanced Scorecard).

These aspects provide a broader perspective and can influence the profitability and sustainability of the investment over the long term.

-**Strategic importance**: an investor may decide to undertake a project despite the fact that the financial data indicates a not particularly large return for reasons related to the achievement of strategic objectives, such as expansion into new markets, portfolio diversification or technological innovation: strategic importance could justify the allocation of resources regardless of expected return.

-**Sustainability relevance**: companies that are able to integrate ESG criteria into their operations tend to be more resilient and competitive in the long term. Therefore, investing sustainably, assessing the environmental, social and governance impact of an investment can provide guidance on long-term value creation.

To integrate qualitative aspects into investment valuation, it is necessary to adopt analytical approaches that consider a wider range of factors beyond simple financial data, such as multi-criteria analysis. These approaches allow investors to compare investment opportunities more comprehensively and accurately, considering both risks and associated qualitative opportunities.

Macroeconomic variables

Macroeconomic variables can influence the variation of investments in different ways and for this reason they must be understood and taken into account in order to acquire information to assess the economic and financial context in which companies operate (John Maynard Keynes, “The General Theory of Employment, Interest, and Money”). These include:

1. **Economic growth**: this is one of the most important variables for investors, in fact, being faced with strong economic growth is equivalent to being in an environment characterized by favorable investment opportunities: companies tend to benefit from greater demand for their products and services. Conversely, weak economic growth can limit opportunities for growth and profitability for firms.

2. **Inflation**: general increase in the prices of goods and services, it can have a significant impact on investment. A moderate inflation rate can be good for the economy, boosting consumer spending and business investment. However, excessive inflation can erode purchasing power, reducing companies' profit margins and pushing up interest rates.

3. **Interest rates**: interest rates are one of the main drivers of financial markets. Changes in interest rates affect the financing costs of businesses, the yield on bonds and the profitability of real estate investments. Rising interest rates tend to have a negative impact on equity markets, as higher rates can reduce the profitability of businesses and make equity investments less attractive than bonds. Conversely, a cut in interest rates can stimulate economic activity and support stock markets.

4. **Labor market**: elements such as the unemployment rate and wages can influence consumer spending and the profitability of businesses. A strong labor market, with low unemployment and wage increases, can foster economic growth and consumption.

On the other hand, a weak labor market can limit consumer spending and overall economic growth.

5. **Fiscal and monetary policy**: these policies set by governments and central banks can significantly influence the performance of the economy:

An accommodative monetary policy, with low interest rates and central bank purchases of financial assets, can support economic growth and stock markets. Conversely, restrictive policies, such as interest rate hikes or reductions in government spending, can dampen economic activity and reduce investor confidence.

1.5 The financing principle

Until now, the focus has been on analyzing the profitability of an investment and on the introduction of tools that help investors compare projects and choose the most convenient option. In this section, the focus will be on which resources to use to support the investment of interest to the entrepreneur.

While the investment principle imposes a mandatory constraint on investors, i.e. that the expected rate of return of the project must be higher than the minimum rate of return accepted in relation to the riskiness of the project, the financing principle (Aswath Damodaran) aims to identify the correct balance between the use of own funds and third-party funds: in other words, the aim is to define the right ratio between risk capital and debt capital. The financing principle therefore refers to the way in which companies obtain the necessary funds to finance their investment projects.

This principle is crucial for understanding how companies plan and manage their financial structure. As mentioned above, there are two types of funding that are most frequently used:

- Equity: composed of the funds provided by the shareholders or owners of the company. Equity can come from founders' initial investments, capital increases, or reinvestment of profits generated by the business.

- Debt Capital: this refers to funds obtained through loans or bonds. These loans are made by financial institutions such as banks, non-bank financial institutions, or bondholder investors. Debt principal must be repaid within a set period of time and generally involves interest payments.
However, it is also possible to have hybrid types of financing, i.e. a mix of the first two: a concrete example can be found in convertible bonds.
Finally, by using their profits, companies can finance new investments by reinvesting them.
The financing principle involves choosing the most appropriate sources of financing to meet the needs of the company in terms of amount, cost, and time structure.

CHAPTER II: AN ECONOMETRIC MODEL FOR ITALIAN LISTED COMPANIES

As mentioned in the first chapter the context in which companies operate is characterized by instability due to the multitude of internal and external variables that make the environment changeable and that influence the actions of economic subjects.

To investigate its main features and the consequent implications from the business point of view, it can be used the PESTLE analysis (Francis J. Aguilar, the first version dates back to 1967) which investigates the political, economic, social, technological, legal and ecological environment in which the company operates and to the SWOT analysis (Albert Humphrey, 1960-1970) which instead analyzes elements such as competitors, suppliers, customers that affect in particular the definition of the organization and the strategic choices adopted by the manager.

The ideal scenario, as studied by Léon Walras (1834-1910), would be that of perfect competition, i.e. a market in which everyone has the same information about the financial instruments traded: however, the reality of the facts, as demonstrated since the 40s, is the non-homogeneity of the products and the impossibility of having infinite operators operating on the market. Friedrick von Hayek emphasizes the fact that the information in the hands of economic operators is imperfect. The area in which companies are active is therefore imbued with uncertainty and riskiness that is reflected in costs, demand and profitability.

Each company is therefore called upon to carry out a process of optimization and analysis in order to identify which projects to invest in given the need to rationalize resources.

Choosing to undertake one investment over another is not a trivial choice (2008): it is first necessary to adequately evaluate the project in terms of objectives, time and costs, calculate the financial return and carry out a series of analyses aimed at identifying risks, market trends, technologies and necessary means, task benefits, sustainable and social impact, and financial aspects.

The aim of this chapter is to introduce an econometric model in order to study the determinants of investments in Italian listed companies. Econometrics can be seen as an additional investment evaluation tool. First of all is necessary to define the dependent variable that will explain the model, identified in the value of the total invested capital. The second step will be given by the identification of the independent variables (in this content it has been decided to focus on financial and macroeconomic variables). An attempt will be made to demonstrate which of these are significant in the context of investments and the relationship between the latter and the methods of evaluating investments. In other words, the goal is to underline how the variables identified in the econometric model can directly influence the financial forecasts used to calculate indices (e.g. demand for an asset) or the degree of risk and uncertainty (e.g. interest rates).

The chapter will conclude with an analysis of the trend of the total invested capital of one company chosen among those of the sample, highlighting how global events are a further variable to consider.

2.1 Empirical models and methodology

The model that has been decided to be used to pursue the identification of the determinants influencing the investments of Italian firms is that of linear regression (Francis Galton, 1889).
In principle, the model consists of a system of equations, linear in parameters, which describes the interaction between two groups of variables.
The most basic model is the one defined by the simple regression function:

$$Y_i = \beta_0 + \beta_1 X_i + u_i$$

where:

- i represents the number of observations, $i = 1,....,n$;
- Y_i is called a dependent variable;
- X_i is the independent regressor or variable;
- $\beta_0 + \beta_1 X$ is the regression line;
- β_0 is the intercept of the regression line or known term;
- β_1 is the angular coefficient of the regression line;
- u_i is the statistical error, it is also called the noise factor and collects the effects of all the variables that could influence Y except for the regressor.

For each sample observation, we try to find a linear relationship between Y and the deterministic variables X. In the simple regression model, β_1 reflects the variation that the variable Y presents at a unit variation of X.
In the case covered by the thesis, it is considered to be not very explanatory and somewhat reductive to trace the analysis of investments to the study of a single potentially influencing factor for which it was decided to adopt a multiple regression model.
The general equation of the model is as follows:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + ... + \beta_p X_{pi} + u_i$$

where:

- i represents the number of observations, $i = 1, ... , n$;
- Y_i is the dependent variable;
- X_{pi} are the various regressors with $p = 1, ... , n$;
- β_0 is the intercept of the regression line or known term;

- $\beta 1$ is the inclination of Y with respect to X1 keeping the variables X2, X3,..., Xp constant;
- $\beta 2$ is the inclination of Y with respect to X2 keeping the variables X1, X3,..., Xp constant;
- $\beta 3$ is the inclination of Y with respect to X3 keeping the variables X1, X2,..., Xp constant;
- βp is the inclination of Y with respect to Xp keeping the variables X1, X2, X3,..., Xp-1 constant;
- ui is the statistical error, it is also called the noise factor and collects the effects of all the variables that could influence Y except for the regressor.

A linear relationship between the dependent variable and the explanatory variables is also assumed in this context. For the Italian case, the model was constituted as follows:

- Dependent variable**:** Total invested capital (measured in millions of euros).

- Independent variables**:**

· Fixed assets and long-term investments (measured in millions of euros);

· Return on asset (ROA);

· Return on common equity (ROE);

· EBIT (measured in millions of euros);

· EBITDA (measured in millions of euros);

· Sales revenue turnover (measured in millions of euros);

· Current market cup;

· Number of employees;

· Balance sheet total assets;

· Balance sheet total liabilities;

· Total debt to total asset ratio (for a more in-depth description of the variables, see the following table).

The resulting equation is:

$$\textit{Total invested capital} = \beta 0 + \beta 1 \cdot \textit{Fixed assets and lt investments} + \beta 2 \cdot \textit{ROA} + \beta 3 \cdot \textit{ROE} + \beta 4 \cdot \textit{EBIT} + \beta 5 \cdot \textit{EBITDA} + \beta 6 \cdot \textit{Sales rev turnover} + \beta 7 \cdot \textit{Cur mkt cap} + \beta 8 \cdot \textit{Num of employees} + \beta 9 \cdot \textit{Bs total assets} + \beta 10 \cdot \textit{Bs total liabilities} + \beta 11 \cdot \textit{Tot debt to tot asset} + u.$$

From an interpretative point of view, as for the generalization of the econometric model seen above, $\beta 0$ represents the known term, i.e. the total invested capital when all independent variables are equal to zero; the coefficients βi ($i = 1,...,11$) instead describe the marginal effect of each independent variable on the group's investments, keeping all the other variables constant.

βi therefore quantifies how much the total invested capital would change if the corresponding independent variable increased by one unit, while all the other variables remain unchanged.

Type	Variable	Description
Dependent variable	Total invested capital	Total *invested capital* is calculated as the sum of Total equity, Total debt and Non-operating cash. It is the investment that is made by shareholders and debtholders within a company and with the aim of purchasing fixed assets and covering daily operating expenses. It is one of the resources to be used to undertake new opportunities such as hypothetical expansions.
Independent variable	Fixed assets and long-term investments	*Fixed assets* are long-term assets intended to be used by a company in the production of goods or services (e.g. machinery, buildings, trucks...) and are characterized by being physically touchable. Long-term investments are non-current-assets with a duration of at least 3 years (e.g. bond funds, dividend stocks, real estate...).
	Return on assets (ROA)	ROA is a balance sheet index that measures the overall profitability of an activity: it is calculated by relating the operating result to total assets. To be faced with an efficient company, it is necessary that this index is at least higher than the interest rate paid on debt capital.
	Return on common equity (ROE)	ROE is an index of return on equity and is calculated by making the ratio between the net income generated in a year and equity. If the ROE is greater than zero, the company is creating wealth.
	Earnings before interest and taxes (EBIT)	*EBIT* is the measure of operating profit before borrowing and taxes that is widely used in calculating cash flows. It is defined as the difference between the value of production and cost of goods sold, operating costs and non-monetary costs.
	Earnings before interest, taxes, depreciation and amortization	*EBITDA* is a profitability indicator used to express an opinion on the profits generated by ordinary operations. It is calculated as the difference between the production value and the cost of services, raw material, personnel and financing. Widely used in comparisons between companies operating in the same sector.
	Sales revenue turnover	Sales *revenue turnover* is the revenue of a company deriving from its normal activities.
	Current market cup	*Current market cup* is the measure of the total value of a company's outstanding shares. It is calculated by multiplying the total number of shares by the current price of a single share. Very useful for investors to get information about the size of the company.
	Number of employees	The *number of employees* indicates how many people work within the company. This is strongly correlated with the size of the company.
	Balance sheet total asset	*BS total asset* is a balance sheet item that indicates the total value of assets.
	Balance sheet total liabilities	BS total liabilities is a balance sheet item that expresses the total value of liabilities.
	Total debt to total asset ratio	The *total debt to total asset ratio* measures the ratio between the total debts and the total assets of a company. This ratio expresses how a company has decided to borrow to finance its assets.

2.2 Data

The data used for the purpose of this analysis were downloaded from Bloomberg considering a 12-year time frame (30/12/2011-30/12/2022) and observations on an annual basis.

Starting from a sample of about 500 Italian companies, 100 were selected on the basis of the completeness of the information available.

The data were downloaded to excel and divided into 15 columns defined as follows:

- column 1 (A): name of the Italian company,
- column 2 (B): reference year,
- column 3 (C): company identification number (ID = 1, ..., 100),
- column 4 (D): total invested capital (dependent variable),
- column 5 (E): fixed assets and long-term investment (independent variable 1),
- column 6 (F): ROA (independent variable 2),
- column 7 (G): ROE (independent variable 3),
- column 8 (H): EBIT (independent variable 4),
- column 9 (I): EBITDA (independent variable 5),
- column 10 (J): sales revenue turnover (independent variable 6),
- column 11 (K): current market cap (independent variable 7),
- column 12 (L): number of employees (independent variable 8),
- column 13 (M): balance sheet assets (independent variable 9),
- column 14 (N): balance sheet liabilities (independent variable 10),
- column 15 (O): total asset to total debt ratio (independent variable 11).

Example of ENEL IM Equity excel data positioning

A	B	C	D	E	F	G	H
COMPANY	YEAR	ID	**TOTAL_INVESTED_CAPITAL**	**FIXED_ASSETS_AND_LT_INVESTMENTS**	**RETURN_ON_ASSET**	**RETURN_COM_EQY**	**EBIT**
ENEL IM Equity	30/12/2011	1	122490	82273	2,6534	12,3216	11258
ENEL IM Equity	31/12/2012	1	123772	85775	2,4305	10,7334	11278
ENEL IM Equity	31/12/2013	1	118335	86414	1,9258	9,0217	9740
ENEL IM Equity	31/12/2014	1	109868	76725	1,3398	6,8752	7685
ENEL IM Equity	31/12/2015	1	110491	80281	1,6226	7,6512	8921
ENEL IM Equity	31/12/2016	1	110669	79016	2,4284	10,8595	9792
ENEL IM Equity	31/12/2017	1	112877	85927	1,2908	7,0019	6878
ENEL IM Equity	31/12/2018	1	106081	83980	1,5588	8,8924	8455
ENEL IM Equity	31/12/2019	1	119003	90367	1,722	11,0007	7680
ENEL IM Equity	31/12/2020	1	119003	90367	1,722	11,0007	7680
ENEL IM Equity	31/12/2021	1	137637	96974	0,7882	5,7694	11193
ENEL IM Equity	30/12/2022	1	137637	96974	0,7882	5,7694	11193

I	J	K	L	M	N	O
EBITDA	SALES_REV_TURN	CUR_MKT_CAP	NUM_OF_EMPLOYEES	BS_TOT_ASSE	BS_TOT_LIAB	TOT_DEBT_TO_TOT_ASSET
16768	73377	35168,5568	78313	168562	114696	37,5559
17110	79514	29564,1557	75360	169891	115591	36,8024
16036	75427	29846,2565	71394	163865	111033	35,5006
15297	73076	36597,8671	67914	161179	109428	32,7996
15276	68604	42578,0545	62080	155596	103021	33,6487
15653	72664	52155,0684	62900	155641	103480	33,5946
16560	77366	71898,761	68253	171426	124488	36,3154
15618	63642	84139,4437	66717	163453	121096	36,4961
16371	84104	71634,4269	66279	206940	164598	35,0739
16371	84104	51138,4001	66279	206940	164598	35,0739
20002	135653	51138,4001	65124	219874	177794	41,0558
20002	135653	68421,756	65124	219874	177794	41,0558

To avoid running into possible outliers with consequent alteration of the econometric model, the potential presence of missing values and the existence of uniqueness among the data was verified: in other words, the variables characterizing the model must be sourced from reliable funds, must be defined in the same terms and must be complete.

Given that measures such as total invested capital, fixed assets, EBIT, EBITDA, sales revenue turnover, current market cup, number of employees, total assets and total liabilities are expressed in absolute terms as opposed to the other variables present, a logarithmic transformation of the data was carried out.

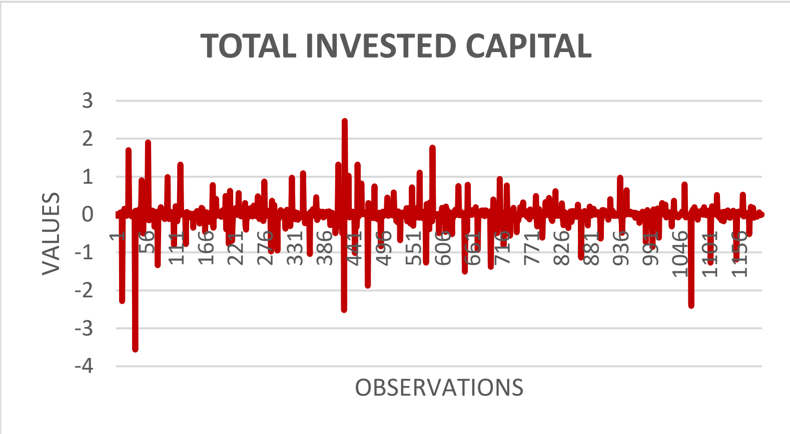
Logarithmic transformation (2016) is a technique useful not only to make data more symmetrical but also used to stabilize variance and improve the linearity of relationships between variables.

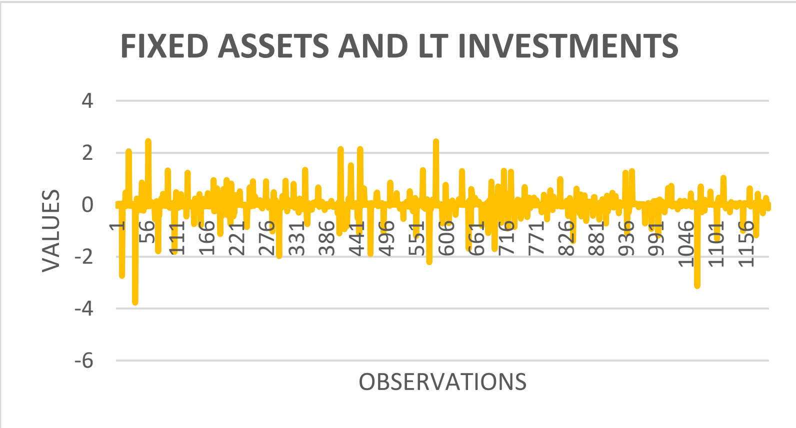
To carry out the transformation, it is sufficient to simply calculate the natural logarithm of the values assumed by the variable of our interest: suppose that the variable to be transformed is the total invested capital (X). The transformation will take place by calculating the logarithm of each observation xi so that yi (transformed variable) = (log (xi)).

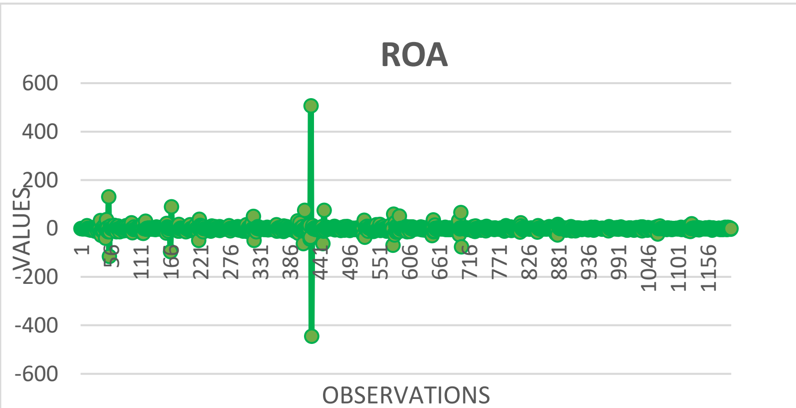
After making all the observed values greater than zero, you can proceed with the logarithmic transformation on the new values obtained.

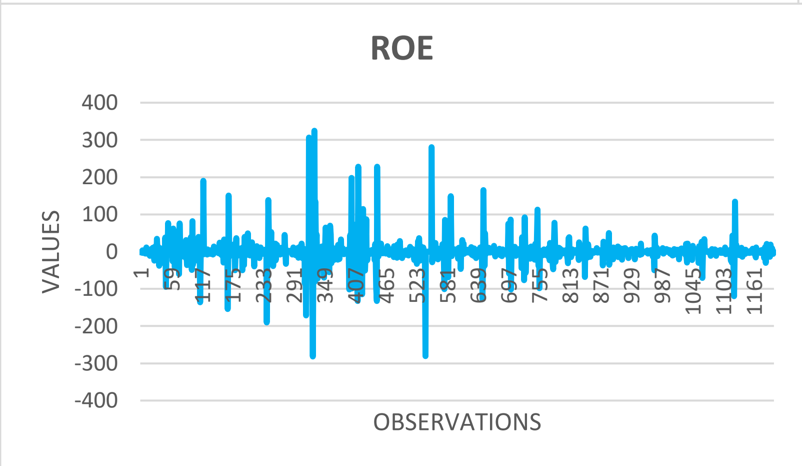
Before proceeding with the analysis, it is crucial to check the stationarity of the time series and check for autocorrelation in the data. Stationarity can be understood as homogeneity of the probabilistic structure of the stochastic process with respect to time t: in simpler words, if a random process is stationary, its statistical properties such as mean and variance remain unchanged over time. The existence of trends or seasonality in time series, a possible consequence of non-stationarity, can invalidate the results obtained by econometric models. The most intuitive way to test the stationarity hypothesis is to visualize the data by plotting the graph of the time series of the total invested capital and other dependent variables. The graphs below were obtained by calculating the difference between the observations (observation year t – observation t-1) and was created using the "insert" and "line chart" functions of excel.

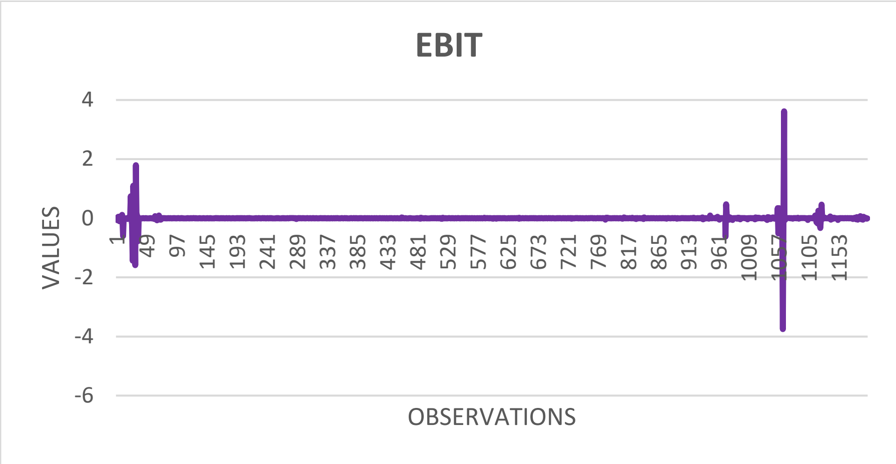
In order to effectively view the distribution of variables, given the multitude of observed values, it was decided to subdivide the regressors to analyze their trend over time more closely.

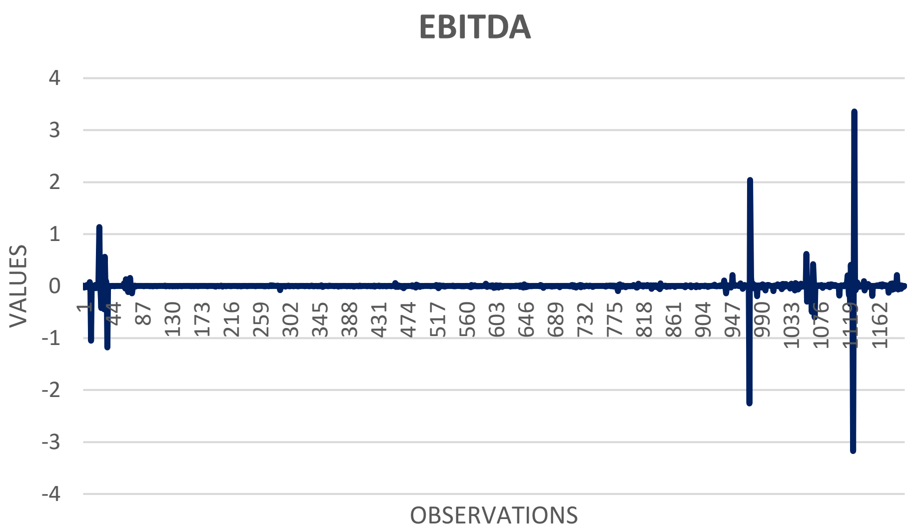


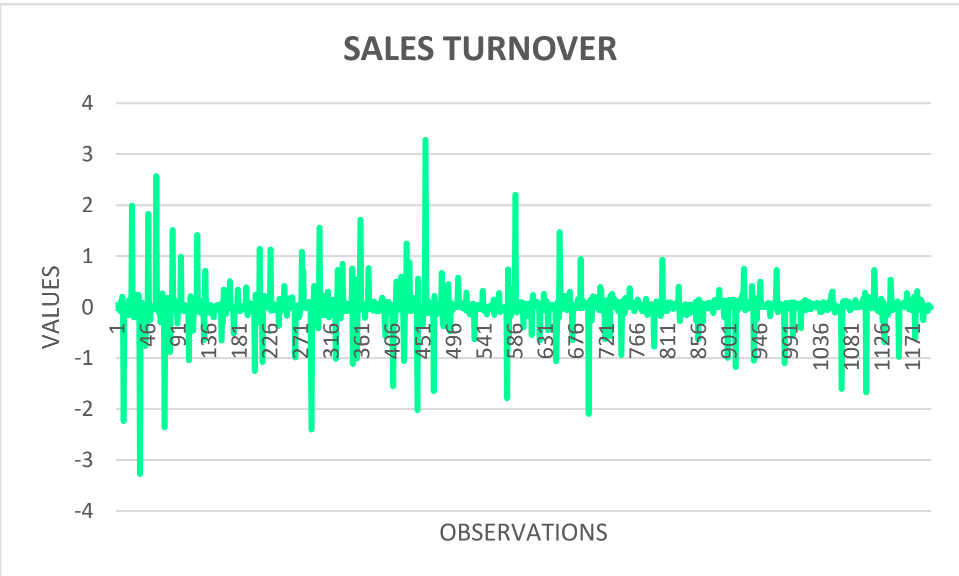


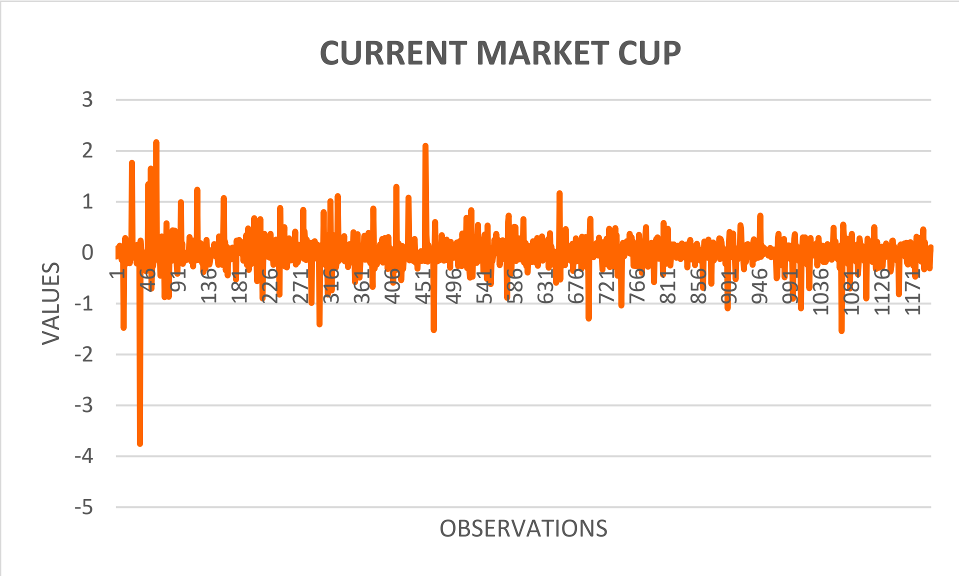


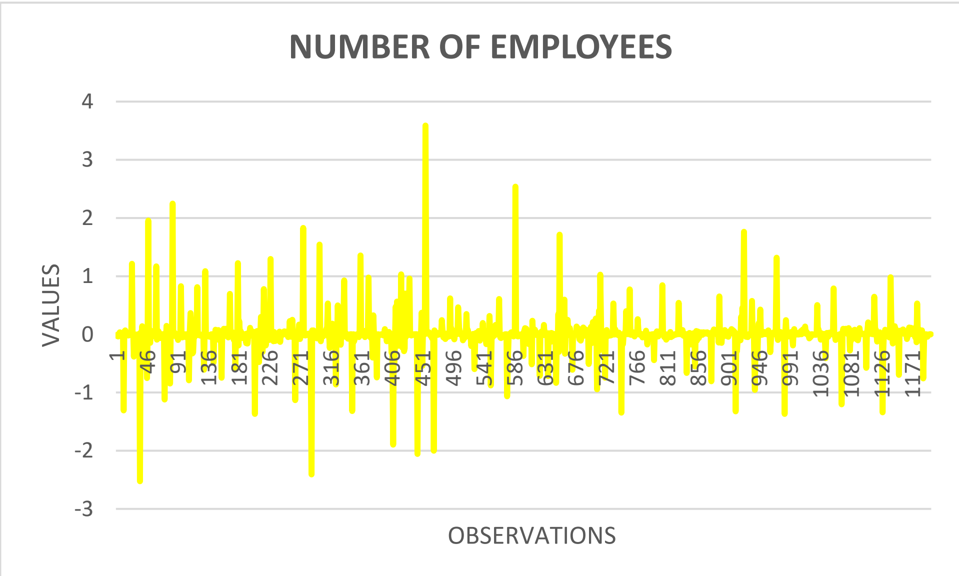


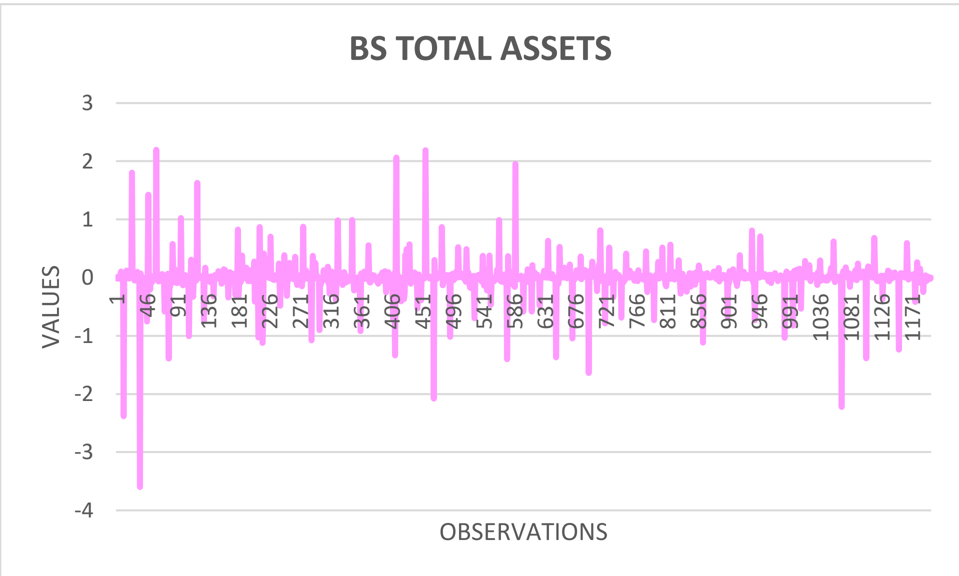

EBIT
VALUES
OBSERVATIONS

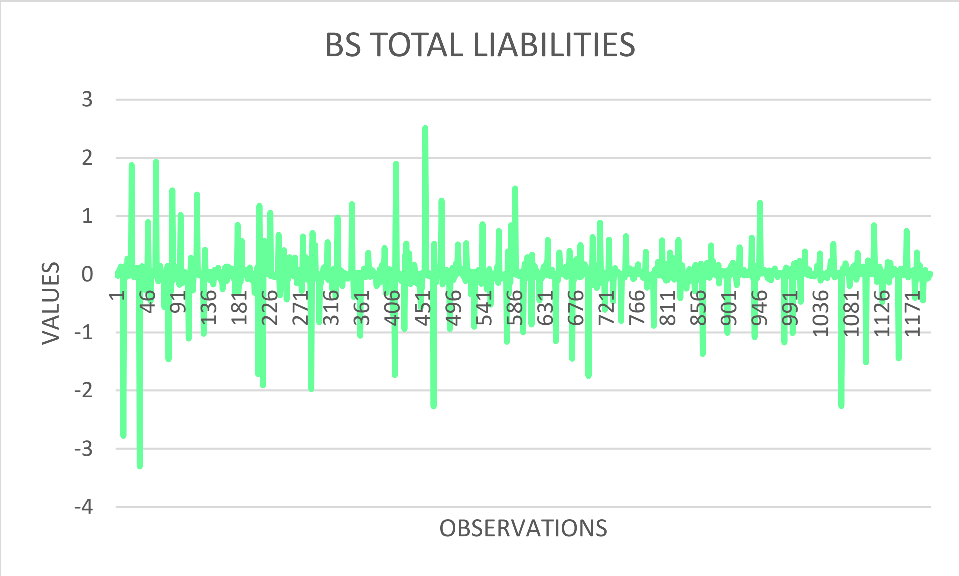

EBITDA
VALUES
OBSERVATIONS

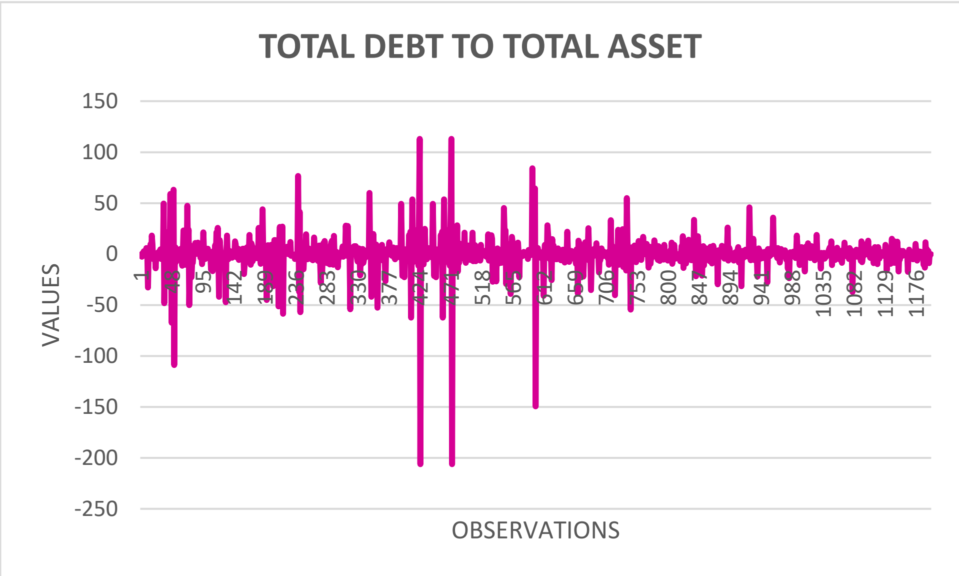

SALES TURNOVER
VALUES
OBSERVATIONS


CURRENT MARKET CUP
VALUES
OBSERVATIONS


NUMBER OF EMPLOYEES
VALUES
OBSERVATIONS


BS TOTAL ASSETS
VALUES
OBSERVATIONS





Analyzing the graphs, it could be said at first that the time series would seem to be stationary not showing a trend in their distribution.

To confirm this thesis, having panel data, it was decided to resort to the use of STATA and in particular to the unit root test introduced by Levin, Lin and Chu (LLC, 2002).

The null hypothesis underlying this test is the presence of unitary roots in each unit in the panel while the alternative hypothesis is the stationarity of the series.

The model assumes that each unit shared the same autoregressive coefficient but with the possibility of individual and temporal effects occurring.

An augmented regression by David A. Dickey and Wayne A. Fuller (ADF) is carried out for each unit: the goal is to prove the existence of a trend in relation to each individual variable for which an autoregression is constructed for each of these:

$yt = ayt-1 + ut$,

then we subtract $yt-1$ from both sides obtaining:

$\Delta\, yt = (a-1)\, yt-1 + ut = \beta yt-1 + ut$.

At this point, a hypothesis test is conducted consisting of:

H0: $\beta = 0$, H_1: $\beta < 0$.

The goal is to understand if *a* is equal to or less than 1. If the null hypothesis is accepted, the presence of non-stationarity is confirmed, if it is rejected, the series is stationary.

The next step is to aggregate the results obtained at the individual regression level in such a way as to obtain a common test statistic.

From a practical point of view, after importing the data of interest from Excel into STATA you have to type the command "tsset ID YEAR" in order to declare the data as panel data; by combining the "xtunitroot LLC" command with the names of the independent and dependent variables, a table is obtained within which there is the p-value that allows you to evaluate whether or not to accept the null hypothesis based on the level of significance predisposed. In this case, all null hypotheses that had a p-value of less than 5% were rejected. Below are the results of the LLC tests:

```
Levin-Lin-Chu unit-root test for TOTAL_INVESTED_CAPITAL
-------------------------------------------------------
H0: Panels contain unit roots            Number of panels  =    100
Ha: Panels are stationary                Number of periods =     12

AR parameter: Common                     Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:    Bartlett kernel, 7.00 lags average (chosen by LLC)
------------------------------------------------------------------
                 Statistic      p-value
------------------------------------------------------------------
 Unadjusted t      -20.2146
 Adjusted t*       -15.6118        0.0000
------------------------------------------------------------------
```

```
Levin-Lin-Chu unit-root test for RETURN_ON_ASSET
------------------------------------------------
H0: Panels contain unit roots            Number of panels  =    100
Ha: Panels are stationary                Number of periods =     12

AR parameter: Common                     Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:    Bartlett kernel, 7.00 lags average (chosen by LLC)
------------------------------------------------------------------
                 Statistic      p-value
------------------------------------------------------------------
 Unadjusted t      -22.3682
 Adjusted t*       -13.4379        0.0000
------------------------------------------------------------------
```

```
Levin-Lin-Chu unit-root test for FIXED_ASSETS_AND_LT_INVESTMENTS
----------------------------------------------------------------
H0: Panels contain unit roots            Number of panels  =    100
Ha: Panels are stationary                Number of periods =     12

AR parameter: Common                     Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:    Bartlett kernel, 7.00 lags average (chosen by LLC)
------------------------------------------------------------------
                 Statistic      p-value
------------------------------------------------------------------
 Unadjusted t      -19.0377
 Adjusted t*       -13.7972        0.0000
------------------------------------------------------------------
```

```
Levin-Lin-Chu unit-root test for RETURN_COM_EQY
-----------------------------------------------
H0: Panels contain unit roots            Number of panels  =    100
Ha: Panels are stationary                Number of periods =     12

AR parameter: Common                     Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:    Bartlett kernel, 7.00 lags average (chosen by LLC)
------------------------------------------------------------------
                 Statistic      p-value
------------------------------------------------------------------
 Unadjusted t      -23.4417
 Adjusted t*       -16.1362        0.0000
------------------------------------------------------------------
```

```
Levin-Lin-Chu unit-root test for EBIT
-------------------------------------
H0: Panels contain unit roots             Number of panels  =    100
Ha: Panels are stationary                 Number of periods =     12

AR parameter: Common                      Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 7.00 lags average (chosen by LLC)
---------------------------------------------------------------------
                   Statistic      p-value
---------------------------------------------------------------------
 Unadjusted t       -19.1651
 Adjusted t*        -13.4118       0.0000
---------------------------------------------------------------------
```

```
Levin-Lin-Chu unit-root test for EBITDA
---------------------------------------
H0: Panels contain unit roots             Number of panels  =    100
Ha: Panels are stationary                 Number of periods =     12

AR parameter: Common                      Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 7.00 lags average (chosen by LLC)
---------------------------------------------------------------------
                   Statistic      p-value
---------------------------------------------------------------------
 Unadjusted t       -51.1711
 Adjusted t*        -52.2200       0.0000
---------------------------------------------------------------------
```

```
Levin-Lin-Chu unit-root test for SALES_REV_TURN
-----------------------------------------------
H0: Panels contain unit roots             Number of panels  =    100
Ha: Panels are stationary                 Number of periods =     12

AR parameter: Common                      Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 7.00 lags average (chosen by LLC)
---------------------------------------------------------------------
                   Statistic      p-value
---------------------------------------------------------------------
 Unadjusted t       -12.4667
 Adjusted t*         -7.6503       0.0000
---------------------------------------------------------------------
```

```
Levin-Lin-Chu unit-root test for CUR_MKT_CAP
--------------------------------------------
H0: Panels contain unit roots             Number of panels  =    100
Ha: Panels are stationary                 Number of periods =     12

AR parameter: Common                      Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 7.00 lags average (chosen by LLC)
---------------------------------------------------------------------
                   Statistic      p-value
---------------------------------------------------------------------
 Unadjusted t       -21.4151
 Adjusted t*        -15.6709       0.0000
---------------------------------------------------------------------
```

```
Levin-Lin-Chu unit-root test for NUM_OF_EMPLOYEES
-------------------------------------------------
H0: Panels contain unit roots             Number of panels  =    100
Ha: Panels are stationary                 Number of periods =     12

AR parameter: Common                      Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 7.00 lags average (chosen by LLC)
---------------------------------------------------------------------
                   Statistic      p-value
---------------------------------------------------------------------
 Unadjusted t       -21.7801
 Adjusted t*        -16.9582       0.0000
---------------------------------------------------------------------
```

```
Levin-Lin-Chu unit-root test for BS_TOT_ASSET
---------------------------------------------
H0: Panels contain unit roots             Number of panels  =    100
Ha: Panels are stationary                 Number of periods =     12

AR parameter: Common                      Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 7.00 lags average (chosen by LLC)
---------------------------------------------------------------------
                   Statistic      p-value
---------------------------------------------------------------------
 Unadjusted t       -19.0643
 Adjusted t*        -14.0536       0.0000
---------------------------------------------------------------------
```

```
Levin-Lin-Chu unit-root test for BS_TOT_LIAB2
---------------------------------------------
H0: Panels contain unit roots             Number of panels  =    100
Ha: Panels are stationary                 Number of periods =     12

AR parameter: Common                      Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 7.00 lags average (chosen by LLC)
---------------------------------------------------------------------
                   Statistic      p-value
---------------------------------------------------------------------
 Unadjusted t       -18.0396
 Adjusted t*        -13.2597       0.0000
---------------------------------------------------------------------
```

```
Levin-Lin-Chu unit-root test for TOT_DEBT_TO_TOT_ASSET
------------------------------------------------------

H0: Panels contain unit roots              Number of panels  =    100
Ha: Panels are stationary                  Number of periods =     12

AR parameter: Common                       Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 7.00 lags average (chosen by LLC)
------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------
 Unadjusted t        -17.9652
 Adjusted t*          -9.7436       0.0000
------------------------------------------------------------------------
```

The LLC test confirms what can be seen from the graphs created with Excel, in fact, since the p-values are zero, the initial assumption of stationarity is corroborated.

2.3 Results

Summary statistics

Before commenting specifically on the results obtained by carrying out a multiple linear regression, it is useful to analyze the descriptive statistics of the chosen variables in order to acquire additional information on the companies studied.

Variable	Obs	Mean	Std. dev.	Min	Max
VAR_1 TOT INVESTED CAPITAL	1,200	2.672581	.8602004	-1.412289	5.138758
VAR_2 FIXED ASSETS	1,200	2.136288	1.021759	0	4.98666
VAR_3_ROA	1,200	.8836758	16.39609	-89.3592	427.9829
VAR_4 ROE	1,200	-6.152984	50.20821	-345.4154	149.9806
VAR_5_EBIT	1,200	3.563066	.1759731	0	4.323046
VAR_6 EBITDA	1,200	3.299823	.2214046	0	4.427129
VAR_7 SALES TURNOVER	1,200	2.490033	.9833608	0	5.132433
VAR_8 CURRENT MARKET CUP	1,200	2.410642	.9142826	.0078331	4.925
VAR_9 NUM OF EMPLOYEES	1,200	2.981586	.9662967	0	4.925312
VAR_10 TOTAL ASSETS	1,200	2.811199	.8894744	-.2368716	5.342174
VAR_11_TOTAL LIABILITIES	1,200	2.587148	.9278428	-1.025488	5.249917
VAR_12_TOT DEBT TO TOT ASSET	1,200	32.12065	20.67161	0	212.1643

The table of "summary statistics" consists of 6 columns: financial variables, number of observations, mean, standard deviation, minimum and maximum values. The number of observations for each variable is 1200, so it can be said that the analysis was carried out on a large sample and this increases the robustness and reliability of the calculated values.

Total invested capital averages is 2.675281, which suggests a positive aggregate value of companies overall. Although the standard deviation is relatively low, the minimum and maximum values indicate some variability that can be explained by the risks associated with variable investments.
As regards the second variable, it can be pointed out that companies on average hold fixed assets and long-term investments equal to 2.14: translation of a high average is the considerable investment in durable goods.
A standard deviation of 1.021759 indicates moderate variability, however the difference between minimum and maximum value is substantial, alluding to the fact that within the sample there may be different operating units.
ROA shows a positive average but very close to zero, synonymous with the fact that many companies have had a very low return on assets. The standard deviation is equal to 16.39609 and is the result of significant fluctuations in revenues due, for example, to changes in market demand, a hypothesis that is also confirmed by looking at the minimum and maximum values, underlining how there are companies that have had negative returns and others that are extremely positive.
The negative average ROE indicates that most companies are confronted with a loss of equity, companies are destroying wealth. A standard deviation of 50.17831, a minimum and maximum value of -345.415 and 1493.2806 suggests a revision of investment strategies and a high variability in terms of profits generated by companies' invested capital.
A high average EBIT indicates good operating performance. The very low standard deviation reflects the fact that companies have operating earnings close to the average. There is a certain variability in terms of minimum and maximum values: the cause of this can be traced back to the different size of the companies in the sample.
A similar argument can be made for EBITDA: good ability to generate earnings before interest, taxes, depreciation and amortization, moderate variability between companies.
With an average of about 2.49, companies show high sales revenues; Standard deviation and minimum and maximum values indicate a certain variability in results, so it can be efficient to implement marketing strategies in order to stabilize sales.
The current market cup with an average of 2.410642 is an indication of good liquidity, the variability in this metric may be due to changes in the market's perception of the company's performance.
The number of employees reflects the size of the company. In the case analyzed, the average is high, reflecting that many companies are medium-large in size. The standard deviation is close to 1: high values can suggest fluctuations in personnel.

Total assets can also be seen as a measure to gain insight into the size of the company. A high average asset total is indicative of a large financial size. The standard deviation is equal to 0.8894744 as a result of the possible significant differences between the operating units or time periods.

The total debt averages 2.5871 and reflects significant leverage. A high standard deviation suggests variability in the level of debt, which may require careful management to avoid financial risks.

The need to maintain financial stability is also underlined by the total liabilities compared to assets, a measure that is characterized by significant variability. High level of average debt among the sampled companies.

In conclusion, these statistics provide an overview of the company's financial health: understanding the causes of changes and developing strategies to stabilize performance can help the company improve its operational efficiency and overall profitability.

Regression

After getting a general idea of the performance of the observed companies, a regression was carried out in order to determine what are the ratios between the total invested capital and the independent variables previously identified.

Source	SS	df	MS		
				Number of obs =	1,200
				F(11, 1188) =	4738.36
Model	867.422878	11	78.8566253	Prob > F =	0.0000
Residual	19.7709262	1,188	.016642194	R-squared =	0.9777
				Adj R-squared =	0.9775
Total	887.193805	1,199	.739944791	Root MSE =	.129

VAR_1_TOT INV. C.	Coefficient	Std. err.	t	P>t	[95% conf.	interval]
VAR_2_FIXED ASS.	.1152358	.0093321	12.35	0.000	.0969266	.133545
VAR_3_ROA	.0008362	.0002414	3.46	0.001	.0003626	.0013099
VAR_4_ROE	-.000151	.0000863	-1.75	0.081	-.0003204	.0000184
VAR_5_EBIT	-.0246026	.0231164	-1.06	0.287	-.0699561	.0207509
VAR_6_EBITDA	.0962994	.0204964	4.70	0.000	.0560862	.1365126
VAR_7_SALES TUR.	-.0824042	.0132212	-6.23	0.000	-.1083437	-.0564647
VAR_8_CURR. MKT	.0239508	.010647	2.25	0.025	.0030619	.0448398

VAR_9_NUM EMPL.	.0054426	.0100204	0.54	0.587	-.0142171	.0251024
VAR_9_TOT ASSETS	1.172111	.0322119	36.39	0.000	1.108912	1.235309
VAR_10_TOT LIAB.	-.2924504	.02453	-11.92	0.000	-.3405773	-.2443236
VAR_11_T D/ T ASS	-.0005025	.000196	-2.56	0.010	-.000887	-.0001179
_cons	-.1964335	.0870444	-2.26	0.024	-.3672113	-.0256557

One of the main aspects to consider to understand if a good regression has been made is to look at "Multiple R": this measure indicates the correlation between the independent and dependent variables.

The fact that it is close to 1 (more precisely equal to 0.9888, a value calculated with Excel) is synonymous with a strong correlation between the variables. In other words, a high multiple R suggests accuracy in predicting observed values.

An R-squared of 0.9777 shows that 97.77% of the variability in the dependent variable is explained by the independent variables in the model. Although the latter value is high, it is also useful to study "Adjusted R squared", this is because only this second measure is strongly linked to the significance of the predictors and not only to the fitting of the model (R squared increases as the predictors increase, regardless of whether they are significant or not, while the R square adjust increases only if the independent variable added turns out to be significant).

Another aspect not to be overlooked is the standard error: the lower it is, the more accurate the estimate. In this case, the value of 0.1290 can be considered relatively low, emphasizing that the model has a good ability to adapt to the data.

Then it is important to look at the significance of F (Fisher's test, 1925): the null hypothesis assumes that there is no difference between the variances of the groups and, since the p-value is zero, the alternative hypothesis is rejected and it is highlighted that the model is highly significant.

Having verified the validity of the model, it is possible to proceed with the analysis of the coefficients: the level of significance is set at 5%, so the null hypothesis of significance is accepted in all cases in which the p-value does not exceed this threshold.

1) The intercept with a value of -0.1964 turns out to be statistically significant having a p-value = 0.0242 which means that when all independent variables are zero, the dependent variable is -0.1964.

2) The relationship between fixed assets and long-term investments is positively significant, indicating that an increase in this variable is associated with an increase in the dependent variable (2020).

This correlation is mostly predictable knowing that total invested capital is composed of fixed capital, consisting largely of fixed assets, and working capital. To be mentioned in this context are A. Damodaran, who has highlighted how investments in fixed assets involve an increase in net worth that is directly reflected in the total invested capital, and A. Chandler who in his book "History of a large American company" (1993) shows how company expansion is a consequence of significant investments in fixed assets.

3) The ROA with a value of 0.0008 is a significant regressor for calculating the total invested capital. The positive relationship between these variables can be explained by the fact that an increase in return on assets is associated with more efficient asset management and utilization. Greater efficiency is synonymous in most cases with greater confidence on the part of investors who will therefore be more predisposed to provide additional capital, also reducing operational risk (Journal of Finance).

4) ROE is the first parameter to be non-statistically with a p-value of 0.0806.

5) EBIT of -0.0246 is not statistically significant.
6) The regression highlights the significance of EBITDA. The relationship with the total invested capital is positive and can be explained by the fact that these two variables are often associated to assess the company's profitability.
   Measures such as Return on Investment or Return on Capital Employed relate operating income (mostly EBIT or EBITDA) to invested capital. Furthermore, by analyzing public balance sheets, it can be seen that companies with a high EBITDA/invested capital ratio are more financially sustainable.

7) The ratio between total invested capital and sales turnover is statistically significant. The negative relationship can be an indication that the company is able to generate a high volume of sales while maintaining a low invested capital and therefore a use of resource efficiencies. However, this is not always the case: in high-turnover sectors, operations are predominantly with moderate invested capital and a high volume of sales, but profits remain low: in this example, the negative relationship reflects operational inefficiencies.

8) The current market cup is a variable to be considered in the analysis of the total invested capital. The significant and positive relationship with the dependent variable can be explained by quoting "Investment Valuation: tools and techniques for determing the value of any asset" (A. Damodaran) in which it is discussed that a high market capitalization relative to the invested capital can indicate a perception of high future profitability.

Kenneth R. French in a study ("The cross-section of expected stock returns") pointed out that there is a relationship between market capitalizations (an aspect associated with company size) and equity returns.

9) The number of employees is not a significant aspect for the purpose of determining the total invested capital.

10) Since the total asset balance sheet is strongly correlated with the dependent variable and the fixed assets and long-term investments variable (see table below), there was no doubt that the ratio in question was statistically significant.
The existing relationship is positive because an increase in total balance sheet assets is associated with an increase in invested capital.

	VAR_1_~L	VAR_2_~S	VAR_3_~A	VAR_4_~E	VAR_5_~T	VAR_6_~A	VAR_7_~R	VAR_8_~P	VAR_9~ES	VAR_9~TS	VAR_9~TS	VAR_10~S	VAR_11~T
VAR_1_TOTA~L	1.0000												
VAR_2_FIXE~S	0.9251	1.0000											
VAR_3_ROA	0.1313	0.0951	1.0000										
VAR_4_ROE	0.2516	0.1945	0.3070	1.0000									
VAR_5_EBIT	0.1536	0.1529	0.0681	0.0947	1.0000								
VAR_6_EBITDA	0.4677	0.4416	0.0787	0.1696	0.3903	1.0000							
VAR_7_SALE~R	0.8411	0.7699	0.1368	0.2555	0.1461	0.4012	1.0000						
VAR_8_CURR~P	0.9044	0.8123	0.1608	0.2684	0.1737	0.4438	0.8191	1.0000					
VAR_9_NUMB~S	0.7491	0.6796	0.1375	0.1943	0.0986	0.3134	0.9185	0.7350	1.0000				
VAR_9_TOTA~S	0.9826	0.9144	0.1135	0.2417	0.1510	0.4519	0.8840	0.9095	0.7913	1.0000			
VAR_9_TOTA~S	0.9826	0.9144	0.1135	0.2417	0.1510	0.4519	0.8840	0.9095	0.7913	1.0000	1.0000		
VAR_10_TOT~S	0.9481	0.8938	0.0865	0.1706	0.1471	0.4393	0.8803	0.8653	0.7899	0.9803	0.9803	1.0000	
VAR_11_TOT~T	-0.0141	0.0377	-0.0932	-0.1716	0.0054	-0.0063	-0.0412	-0.0607	-0.0090	0.0130	0.0130	0.0795	1.0000

11) The opposite argument with respect to the total asset balance sheet must be made for the total liabilities balance sheet: from the model the variable is statistically significant and with a negative relationship with respect to the capital invested. The motivation for this ratio is explained by the fact that an increase in liabilities tends to reduce the capital invested since the resources are used to cover debts and not for new investments. The relationship between these two aspects is also analyzed by authors such as G. Ferrero, F. Dezzani, P. Pisoni, L. Puddu in the book "Analisi di bilancio e rendiconti finanziari".

12) The last variable of interest is the total debt to total asset ratio characterized by a p-value of 0.0105. The negative sign in front of the coefficient is intended to underline the fact that excessive debt can be harmful to corporate health: Richard A. Brealey, Stewart C. Myers, Franklin Allen in "Principles of Corporate Finance" address the various business cases in which an increase in debt negatively affects the capital invested.

The final equation resulting from the model is:

Total invested capital = -0.1964335 + 0.1152358 · Fixed assets and lt investments + 0.0008362 · ROA + 0.0962994 · EBITDA – 0.0824042 · Sales rev turnover + 0.0239508 · Cur mkt cap + 1.172111 · Bs total asset – 0.2924504 · Bs total liabilities – 0.0005025 · Tot debt to tot asset + u.

At this point, it was decided to deepen the analysis by dividing the sample of 100 listed companies into two subcategories: in particular, on the basis of the average of the observations of the "balance sheet total asset" variable, the companies were divided into small and medium-large.
The first data set is therefore composed of all companies that had an average value of total assets between 1.16155774 (BWZ IM Equity) and 2.727553529 (BSS IM Equity).
In the second group, on the other hand, there are all companies with an average total asset between 2.785239559 (GSP IM Equity) and 5.252196115 (ENEL IM Equity).
The goal is to verify whether the independent variables influence the total invested capital differently if grouped according to the size of the company.

The first regression is carried out on the 50 smaller firms:

VAR 1 TOT NVESTED_CAPITAL	Coefficient	Std. err.	t	P>t	[95% conf.	interval]
VAR 2 FIXED_ASSETS	.1173262	.0147761	7.94	0.000	.0883059	.1463466
VAR 3 RETURN_ON_ASSET	.0007461	.0003142	2.37	0.018	.000129	.0013631
VAR_4 RETURN_COM_EQY	-.0002673	.0001206	-2.22	0.027	-.0005042	-.0000304
VAR 5 EBIT	18.56632	6.496122	2.86	0.004	5.807897	31.32475
VAR 6 EBITDA	-3.531829	2.749176	-1.28	0.199	-8.931228	1.86757
VAR 7 SALES TURNOVER	-.1086403	.0280963	-3.87	0.000	-.1638215	-.0534591
VAR 8 CURRENT MKT	-.0497288	.0214174	-2.32	0.021	-.0917927	-.0076649
VAR 9 NUM OF EMPLOYEES	.0218533	.0189729	1.15	0.250	-.0154096	.0591161
VAR 10 TOT ASSETS	1.21315	.0545348	22.25	0.000	1.106043	1.320257
VAR_11 TOT_LIAB.	-.3497894	.0399061	-8.77	0.000	-.4281652	-.2714136
VAR 12 TOT DEBT/TOT_ASSETS	-.0009327	.0003334	-2.80	0.005	-.0015874	-.0002779
_cons	-54.23185	17.08552	-3.17	0.002	-87.78794	-20.67577

Source	SS	df	MS	Number of obs =	600
				F(11, 588) =	374.39
Model	102.496035	11	9.31782137	Prob > F =	0.0000
Residual	14.6342189	588	.024888127	R-squared =	0.8751
				Adj R-squared =	0.8727
Total	117.130254	599	.195542995	Root MSE =	.15776

The first difference that is found compared to the full model is the decrease in the squared R and the adjusted squared R: although the value remained high, only 87% of the variability in the dependent variable is explained by the independent variables in the model compared to 97.77% in the previous regression. There is also an increase in the standard error from 0.1290 to 0.15776.

F is statistically significant.

From the point of view of the coefficients, the only variables that are not significant are EBITDA and the number of employees. EBITDA can be unstable and not representative of the actual business performance of small businesses due to the fact that they face more variable operating and financial costs than larger companies.

In addition, EBITDA does not consider interest and taxes that may represent a significant part of the total expenses incurred by the companies in question. With regard to the number of employees, it can be emphasized that in capital-intensive, highly automated or technological sectors or for example in companies that resort to outsourcing this variable has no influence on the total invested capital.

The EBIT and ROE variables are statistically significant: in favour of the relationship between EBIT and total invested capital, the academic study carried out by Francesca Querci on private equity funds is cited, in which a positive correlation was found between the return on investment and the dependent variable, and the analyses carried out by Borsa Italiana which underlined how having a high EBIT compared to invested capital is an indication of good operating profitability.

As far as ROE is concerned, the coefficient is negative and this means that as this variable increases, the total invested capital decreases: in other words, we could be faced with operational inefficiencies. The mark in front of the current market cup coefficient has become negative, an indication of a decrease in investor confidence or an increase in debt.

The final equation resulting from the model is:

Total invested capital = -54.23185 + 0.1173262 · Fixed assets and lt investments + 0.0007461 · ROA – 0.0002673 · ROE + 18.56632 · EBIT – 0.1086403 · Sales rev turnover - 0.0497288 · Cur mkt cap + 1.21315 · Bs total asset – 0.3497894 · Bs total liabilities – 0.0009327 · Tot debt to tot asset + u.

The second regression would seem to be at first glance more robust than that relating to small companies. R squared and R squared adjusted have very high values that are almost close to one. The standard error has decreased, approaching zero, while F turns out to be statistically significant.

```
   Source |       SS           df       MS           Number of obs   =       600
---------------------------------------------        F(11, 588)      =   4106.27
    Model | 226.436306  11 20.5851187     Prob > F        =    0.0000
  Residual | 2.9476998  588  .005013095    R-squared       =    0.9871
---------------------------------------------        Adj R-squared   =    0.9869
     Total | 229.384005 599  .382944917   Root MSE        =    .0708
```

VAR 1 TOT INVESTED_CAPITAL	Coefficient	Std. err.	t	P>t	[95% conf.	interval]
VAR 2 FIXED ASSETS	.1152506	.0091251	12.63	0.000	.0973288	.1331724
VAR 3 RETURN_ON_ASSET	.0020535	.0010582	1.94	0.053	-.0000248	.0041317
VAR_4 RETURN_COM_EQY	-.0010457	.0002897	-3.61	0.000	-.0016146	-.0004768
VAR 5 EBIT	-.0246354	.0129201	-1.91	0.057	-.0500106	.0007399
VAR_6 EBITDA	.0753428	.0138562	5.44	0.000	.048129	.1025565
VAR 7 SALES TURNOVER	-.0819978	.0094845	-8.65	0.000	-.1006255	-.0633701
VAR 8 CURRENT MKT CAP	.0656129	.0090853	7.22	0.000	.0477692	.0834565
VAR 9 NUM OF EMPLOYEES	.0150661	.007826	1.93	0.055	-.0003041	.0304363
VAR 10 TOT ASSETS	1.041864	.0319704	32.59	0.000	.9790737	1.104654
VAR_11_TOT_LIAB	-.1856633	.0227592	-8.16	0.000	-.2303625	-.140964
VAR 12 TOT DEBT/TOT_ASSETS	-.0001924	.0001724	-1.12	0.265	-.000531	.0001462
_cons	-.1845468	.0535652	-3.45	0.001	-.2897491	-.0793445

As in the first regression, the number of employees and EBIT are statistically insignificant, having p-values of 5.7% and 5.5% respectively.

ROE shows a negative but significant relationship with total invested capital while ROA and total debt to total asset ratio can be ignored.

The current market has returned to show a positive relationship with the dependent variable while the ratio between sales and invested capital remains negative. In this case, the final equation resulting from the model is:

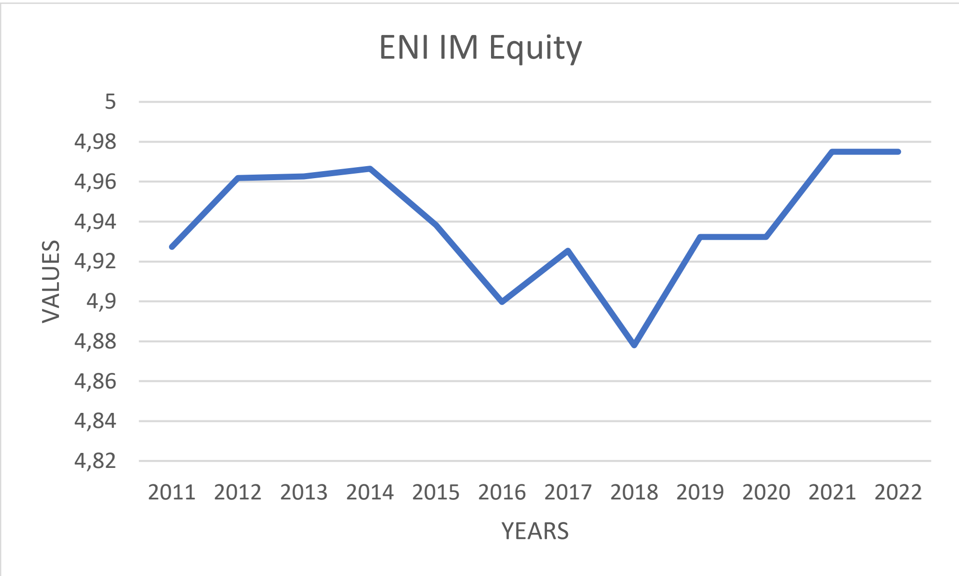
Total invested capital = -0.1845468 + 0.11506 · Fixed assets and lt investments - 0.0010457 · ROE + 0.0753428 · EBITDA – 0.0819978 · Sales rev turnover + 0.0656129 · Cur mkt cap + 1.041864 · Bs total asset – 0.1856633 · Bs total liabilities + u

2.4 The trend of total invested capital

In order for the evaluation of invested capital to be reliable and complete, as already mentioned, it is not enough to refer to econometric models or financial analyses but it is also necessary to take into account the importance of the global context.

By analyzing the trend graph of the employee variable of the chosen company, we will try to verify whether peaks or valleys are found on the basis of knowledge of the daily events that occurred between 2011 and 2022. The selected company is ENI IM Equity (one of the largest companies in the sample, operating in the electricity sector).

The first aspect to focus on to get a general idea of the total invested capital is the graph that will be created using Excel:



As can be seen, from 2011 to 2012 there was a moderate growth in invested capital, which may be due to the response given by companies to the global economic crisis of 2008: to stimulate growth, they opted for increased investments. In order to be in line with global trends in those years, ENI invested heavily in renewable energy.

In the two-year period 2012-2014 it experienced a further increase in invested capital, a possible consequence of the new discoveries of oil fields, which stopped until 2016. 2016 was a particularly delicate year due to the United Kingdom's exit from the European Union and the fall in the prices of raw materials such as oil.

In 2017 there was a peak: with no global event of particular significance to report, it is assumed that the cause was an improvement in profits due to an increase in natural gas prices.
The constant growth, interrupted only at the end of 2019 following Covid, and in 2022 following the Russia-Ukraine conflict, was a consequence of the increase in energy demand.
All this to highlight how it is in the analyst's interest to have a 360-degree view of everything happening in the world and how investors must be able to adapt subjects such as econometrics and statistics to the context in which they find themselves.

CONCLUSION

In this thesis, starting from the definition of investment, investment valuation methods were introduced, including the Net Present Value (NPV) method, the Internal Rate of Return (IRR), the Payback Period (PBP) method and real options.
Each method has its own advantages and limitations, which must be carefully considered based on the context of the investment.
A significant contribution to this paper was the development of a regression model that uses total invested capital as the dependent variable.
This model made it possible to analyze the impact of several independent variables, such as ROE, fixed assets and long-term investments, EBITDA, etc.
The results obtained showed that total invested capital is significantly influenced by these factors, providing a solid basis for more informed investment decisions.
The combination of investment valuation methods, combined with econometric analysis and qualitative analysis provides a more comprehensive and robust assessment of investments. In particular, the integration of real options with traditional methods and the regression model developed allows to better capture the value of future opportunities and flexible managerial decisions.

For example, after calculating the regression that describes how total invested capital is affected, the corresponding value of NPV can be found: if total invested capital represents investment in a project, cash flows could be calculated as revenues generated minus operating costs and other expenses.

In conclusion, the choice of the most appropriate valuation method depends on the specific characteristics of the investment and the investor's objectives.
It is essential to adopt a critical and integrated approach, which considers both quantitative and qualitative aspects, to support informed and strategic investment decisions

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