UNIVERSITÀ POLITECNICA DELLE MARCHE
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Corso di Laurea Magistrale o Specialistica in

Scienze Economiche e Finanziarie

BEHAVIORAL CORPORATE FINANCE – CAPITAL BUDGETING ANALYSIS

Relatore:

Prof.ssa Caterina Lucarelli

Tesi di Laurea di:

Matteo Pasquino

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Dedicato alle persone che mi hanno accompagnato
e sostenuto in questi cinque anni, senza le quali
questa piccola vittoria non avrebbe lo stesso sapore.

PREFAZIONE

La tesi intende studiare le distorsioni psicologiche che possono influenzare i manager nelle decisioni di investimento aziendali attraverso la raccolta, lo studio e la riorganizzazione in modo organico di numerosi studi e ricerche condotte negli anni su questo argomento. Il primo capitolo si concentra sulla introduzione, definizione e studio della finanza comportamentale e in particolare della finanza aziendale comportamentale. Nel secondo capitolo verrà fornita una panoramica riguardante il capital budgeting seguendo un approccio tradizionale, concentrandosi principalmente sulle tecniche maggiormente utilizzate per la valutazione dei progetti di investimento. Nel terzo capitolo, infine, verranno indagate tre principali tipologie di distorsioni cognitive che possono influenzare significativamente i manager nelle loro decisioni: l'euristica dell'affetto, l'overconfidence e l'intensificazione dell'impegno. Precisamente, si cercherà di capire quali siano le cause alla loro radice, come possono essere misurate, quali sono alcuni esempi empirici e soprattutto quali sono le conseguenze per gli investimenti aziendali e per l'azienda stessa. Infine, verranno fornite delle misure di contenimento per questi bias psicologici, in modo tale da poter migliorare la qualità del processo di giudizio dei manager aziendali.

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ABSTRACT

Corporate decisions imply a complex decision-making process because of several factors like uncertainty, risk and the need of some future estimations. For this reason, the framework offered by traditional financial theories is often questioned when looking at corporate procedures in real life, as an important amount of research has demonstrated a significant gap between theory and practice regarding different areas of corporate finance. Behavioral finance has offered a new complementary way to study economics by including the adoption of psychological and social theories. Since Daniel Kahneman, a psychologist, have been awarded the Nobel prize in 2002 in Economic Science for *"for having integrated insights from psychological research into economic science, especially concerning human judgment and decision-making under uncertainty"* (The Nobel Press Release, 2002), it has become clear that economic and financial studies would never be the same again, as a new investigation's perspective had become necessary to fully understand this subject.

However, research related to a specific branch of behavioral finance, that is corporate behavioral finance, has recently started to flourish. Instead of analyzing the economic implications of individuals behavior in general, this new field of study wants to indagate how behavioral finance theories can be applied to corporate managers, in order to implement the company's efficiency. Among all the corporate decisions areas, capital budgeting is considered the only one through

which is possible to increment the firm's vale and shareholders' wealth but, at the same time, is the most vulnerable to future uncertainty risks and managers subjective distortions.

For these reasons, this work is focused on capital budgeting process and the behavioral implications that can affect managers' decisions, in order to understand how the psychological and social factors can influence such an important, delicate and tricky procedure like the long-term investment decision. The aim of this paper is to provide a literature survey of behavioral corporate finance applied to capital budgeting analysis to thoroughly recognize the importance that its development would have for a new complementary approach to corporate finance studies by expanding the limits of traditional theories.

In Chapter 1, it will be proposed an analysis of the development of behavioral finance, of the approach through which behavioral corporate finance can be studied and an introduction to the most important cognitive distortion that can affect managers.

Chapter 2 will offer an overview to capital budgeting in order to understand its importance within the company, its complexity and the most known techniques adopted in project evaluation. This part is fundamental to really perceive how sensitive capital budgeting is to managers' subjectivity so that it's easier to realize the importance of the studies presented in the final chapter.

Finally, Chapter 3 will focus on three cognitive distortions that influence capital budgeting decisions: the affect heuristic, overconfidence/optimism and escalation of commitment. It will be explained how they are formed, what are the causes, the measures and they concretely perturb investment decisions, together with some empirical example and, in conclusion, how to overcome these biases in the judgmental process.

CHAPTER 1 - INTRODUCTION TO BEHAVIORAL CORPORATE FINANCE

1.1 Birth and development of behavioral finance

"Humans aren't rational, as the recent economic crisis shows. So why should financial theories assume that they are?"[1]. This question appeared in an article named *"Crazy Money"*, published in the magazine *Science*, one of the most prestigious scientific journals, in the midst of the 2008 crisis. Psychological factors play a significant role in financial decision making, and behavioral finance is a relatively recent field of study which aims to understand how those factors can change the expectations given by classical finance theories. *"Behavioral finance attempts to increase understanding of the reasoning patterns of investors, including the emotional processes involved and the degree to which they influence the decision-making process"*[2].

The foundations of standard finance are usually associated with the Modern Portfolio Theory by Harry Markowitz (1952)[3] and the Efficient Market

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[1] *Wald C, "Crazy Money", in Science, 12 December 2008*

[2] *Ricciardi V, Simon H, "What is behavioral finance?" - Business, Education and Technology Journal (2000)- page 2*

[3] *Markowitz H, "Portfolio Selection" - The Journal of Finance, Vol. 7(1), pp. 79-91. (1952)*

Hypothesis by Eugene F. Fama (1970)[4]. In particular, the Efficient Market Hypothesis (EMH) states that a security's price or market value reflect all available information and the consequence is that the stock or bond price in the market is equal to its fair value. Relying on this assumption, Fama developed the idea that investors, portfolio managers or active traders cannot *"beat the market",* that is earning superior returns over time compared to the market. Despite the success of these works, behavioral finance started to flourish as an alternative to the classical finance approach. In fact, the concept of *bubble* in the stock market has been developed in contrast to the EMH, as group thinking cognitive biases have a great impact on the stock market. As Shiller (2003)[5] explains, one of the oldest theories about financial markets is the price-to-price feedback theory: when speculative prices go up leading to success some investors, the interest of the population may increase rapidly, and as this interest increments, the expectations for further price increases will heighten too. This will escalate in a feedback effect, that if not interrupted will lead to the creation of a speculative bubble, in which high prices are based only on investors' expectations for further prices increases, and not on their fair value. This mechanism will eventually induce the

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[4] *Fama Eugene F, "Efficient Capital Markets: A Review of Theory and Empirical Work" - Journal of Finance, Vol.25(2), pp. 383-417. (1970)*

[5] *Shiller R.J, "From Efficient Markets Theory to Behavioral Finance" - Journal of Economic Perspectives, Vol. 17(1), pp. 83–104 (2003)*

bubble to burst, causing the falling of prices. This feedback theory is very old since Charles MacKay (1841)[6] used it to describe the speculative bubble known as the *tulip mania* that happened in Holland in the 1630s: even if we can't properly talk about behavioral finance, MacKay, with his studies about how group behavior applies to financial markets, formed the foundations of applying psychology and sociology to finance. Shiller (2000)[7] argued that the same feedback operated during the stock market bubble in March 2000, the *Dot-com bubble,* and Shefrin (2009)[8] suggests that the foundations of the 2008 global crisis must be found in a psychological ad not fundamental phenomenon. This not only demonstrates the inefficiency of the EMH, but it also means that investors' cognitive distortions can operate in the same manner but on a smaller and micro scale, with an important impact on the daily movement of speculative prices, and that's why financial theories need to adopt a method in which behavioral implications are taken into account. The rest of the chapter is dedicated to the explanation of how behavioral finance evolved into the field of study that we know today.

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[6] *MacKay C, "Extraordinary Popular Delusions and the Madness of Crowds"- Volume 1 – Richard Bentley, London (1841)*

[7] *Shiller R, "Irrational Exuberance" – Princeton, NJ, Princeton University Press (2000)*

[8] *Shefrin H, "Understanding the global financial crisis" - L. Siegel (2009)*

1.1.1 Prospect theory – the foundations of behavioral finance

One of the most fundamental studies that contributed to the evolution of behavioral finance is the Prospect Theory of Kahneman and Tversky (1979)[9], this research was followed in the 1980s by an increasing interest in this field of study. The prospect theory is presented as an alternative model to the Expected Utility Hypothesis (EUH) by Von Neumann and Morgenstern (1944)[10], which try to demonstrate that is possible to associate numerical values to personal preferences of an individual and then calculate the different probabilistic alternatives in such a way that the individual will choose the alternative that has a higher expected utility compared to the others. Individual's attitude versus risk is defined by the shape of his utility function, so if the person is risk-averse the utility function is concave, if he's risk-neutral the function is linear and if he's a risk-seeking person the function will be convex. This implies that individuals are fully rational, meaning that the EUH (like the Efficient Market Hypothesis) is based on the definition of *homo oeconomicus,* a term used to indicate an individual who make optimal decisions regardless of external factors such as biases (Thaler 1999)[11]. Kahneman and Tversky's paper find important contradictions to the EUH, one of

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[9] *Kahneman D, Tversky A, "Prospect Theory: An Analysis of Decision Under Risk" - Econometrica, pp. 263-291 (1979)*

[10] *Neumann J, Morgenstern O, "Theory of games and economic behavior" - Princeton, NJ, Princeton University Press (1944)*

[11] *Thaler R. H, "Mental Accounting Matters" - Journal of Behavioral Decision Making, pp.183-206. (1999)*

these is called the *certainty effect*: they observed that people's preference systematically violates the Von Neumann – Morgenstern principle according to which the utilities of outcomes are weighted by their probabilities. Conforming to the *certainty effect,* when people have to choose between two lotteries they tend to overweight outcomes that are considered certain and underweight outcomes that are merely probable, even though the certain lottery has a lower value compared to the probable but not certain lottery. This obviously contrasts with the Expected Utility Hypothesis. Another criticism against the EUH is represented by the *reflection effect,* which subsist when the preference between negative prospects is the mirror image of the preference between positive prospects. In substance, people prefer positive events with a lower value and a high probability of success compared to positive events with a higher value and a low probability of success. But when we enter in the loss area, this orientation change in a specular way and people will prefer negative events with a higher value and a low probability compared to negative events with a lower value and a high probability. In an experiment conducted by the authors in their 1979 paper[12], people had to choose between two options:

a) Win a certain outcome of $3000

[12] *Kahneman D, Tversky A, "Prospect Theory: An Analysis of Decision Under Risk" - Econometrica, page 268 (1979)*

b) 80% chance of winning $4000 and 20% of winning nothing

Between these choices, 80% of the subjects preferred the option A. But then they asked the specular question, so the two options were:

c) Lose a certain outcome of $3000

d) 80% chance of losing $4000 and 20% of losing nothing

In this case 92% of the subject surprisingly choose the option D rather than the option C. This means that in both cases people preferred the option with the lower expected value and this is clearly inconsistent with the Expected Utility Hypothesis.

After a review of some empirical observations, Kahneman and Tversky go on describing the prospect theory as an alternative account of individual decision-making under risk, according to which the choice process in distinguished in two phases: the first phase of editing and the subsequent phase of evaluation. The editing phase consists of a preliminary analysis of the offered prospects, but because many anomalies of preference emerge in this step, this will often lead to a simpler and distorted representation of the prospects. Then in the second phase, the evaluation, the decision-maker will analyze each one of the edited prospects and will choose the one with the highest value.

Based on these concepts, the authors described the value function for economic subjects which is completely different from the utility function of classical theory. The value function of the prospect theory is characterized by three main points.

The first one regards the individual *reference point*, as Kahneman and Tversky affirm: *"When we respond to attributes such as brightness, loudness, or temperature, the past and present context of experience defines an adaptation level, or reference point, and stimuli are perceived in relation to this reference point"*[13]. Applying this concept to the value function we will obtain that the individual is interested to wealth changes in relation to his reference point rather than the final states, he will think in term of gains and losses and not in terms of net assets. As Jack S. Levi (1992) [14] explains *"The reference point is usually the status quo, but that need not necessarily be the case. One can also speak of deviations from an aspiration level or some other reference point which is not equivalent to the status quo".*

The second feature of the value function in the prospect theory is that it has an *"S"* shape, which represents the different attitude of people toward gains and losses. As a matter of fact, they have a tendency of being risk-averse for what concerns the gains domain and risk-seeking in the loss domain. This *"S"* shape is a consequence of the *reflection effect,* which was mentioned above, and it causes

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[13] *Kahneman D, Tversky A, "Prospect Theory: An Analysis of Decision Under Risk", Econometrica, page 277*

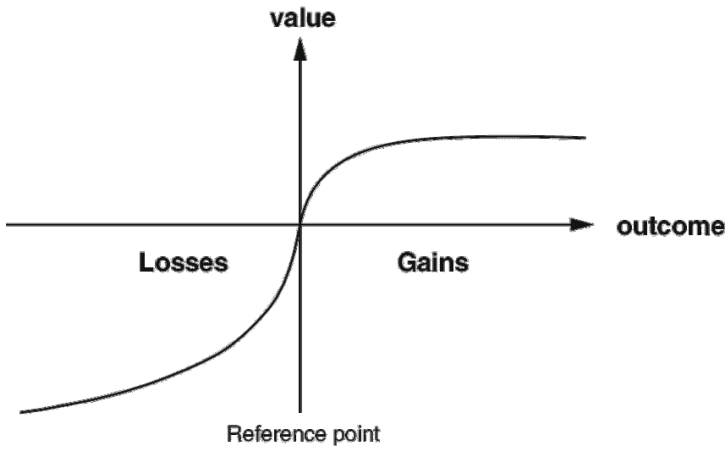
[14] *Levi S, Jack, "Introduction to Prospect Theory", Political Psychology, Vol. 13(2), Special Issue: Prospect Theory and Political Psychology, pp. 171-186 (1992)*

the value function to be concave in the domain of gains and convex in the domain of losses.

Finally, the third characteristic of the function is that it's steeper for losses than for gains, because people tend to suffer more for a loss than to rejoice for a win. This effect, which is called *loss aversion,* will make losses appear larger then gains, as individuals tend to value what they own more than similar or comparable that they do not own.

Considering these three aspects, the value function will look like the one displayed in Figure 1.

Figure 1.1 A hypothetical value function



Source: Kahneman D, Tversky A, "Prospect Theory: An Analysis of Decision Under Risk", Econometrica, (1979)

Another crucial difference from the Expected Utility Hypothesis is that the value of each outcome (each variation from the reference point) is multiplied by a

decision weight: *"decision weights measure the impact of events on the desirability of prospects, and not merely the perceived likelihood of these events"*[15].

The success of Kahneman and Tversky's work led to an incredible development of behavioral finance in the 80s and beyond until today; Barberis and Thaler, for example, argued that *"of all the non-EU theories, prospect theory may be the most promising for financial applications"* and *"is the most successful at capturing the experimental results"*[16].

The prospect theory is considered by many authors the starting point of a new branch of studies concerning behavioral finance and economics, contributing to a new way of understanding the psychological and social factor in the economy.

1.1.2 The two building blocks of behavioral finance

The field of behavioral finance, as Barberis and Thaler (2003)[17] explains, has developed over two main building blocks, namely the *limits to arbitrage* and *psychology*.

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[15] *Kahneman D, Tversky A, "Prospect Theory: An Analysis of Decision Under Risk" - Econometrica, page 280*

[16] *Barberis N, Thaler R, "A survey of behavioral finance" - Handbook of the Economics of Finance, page 1067 (2003)*

[17] *Barberis N, Thaler R, "A survey of behavioral finance" - Handbook of the Economics of Finance, pp. 1052- 1121(2003)*

For what concerns the former, traditional finance is based on the Efficient Market Hypothesis, which asserts that market stock prices are equal to their fundamental value. This view is in turn supported by the work of Friedman (1953)[18], who says that if it happens that the stock price differs from its fundamental value, that is, there's a mispricing, rational agents will immediately catch the investment opportunity and correct the mispricing. This operation is called *arbitrage* and it is considered to be an easy and risk-free investment, and due to *arbitrageurs*, the mispricing will always be instantly corrected. Behavioral finance intervenes against this idea claiming that this is not true, and these arbitrage strategies are not risk-free but on the contrary are quite often very risky. This is due to the fact that, in the markets, rational investors have to interact with irrational investors, or *"noise traders"*. The idea according to which the unpredictability of noise traders creates such a high risk for arbitrageurs that will defer them to exploit the mispricing opportunity can be attributed to De Long et al. (1990)[19]. This, in turn, will let mispricing resists and get even larger in time. Barberis and Thaler (2003)[20] argue that there are two other reasons which enforce the limits to arbitrage: a) the

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[18] *Friedman M, "The Case for Flexible Exchange Rates," – Essay in Positive Economics, Chicago: University of Chicago Press, pp. 157-203 (1953)*

[19] *De Long, J.B., A. Shleifer, L. Summers and R. Waldmann, "Noise trader risk in financial markets", Journal of Political Economy, Vol.98, pp.703−738 (1990)*

[20] *Barberis N, Thaler R, "A survey of behavioral finance", Handbook of the Economics of Finance, p.1056 (2003)*

fundamental value of the undervalued stock, that could still go down after bad news and will lead the investor to losses, this risk will contain arbitrageurs' interventions; b) the costs of the operations, like bid-ask spread and commissions that can make it inconvenient to invest in a short position rather than in a long one.

There is a wide collection of empirical evidence against the EMH and the equality of fundamental value and market prices. Froot and Dabora (1999)[21] demonstrated how two *"Siamese-twin"* company stocks that are traded in different locations don't have the same price, but there's a difference of over 35%. Siamese-twin company stocks are *"corporate pairs with charter that fix the division of current and future cash flows to each twin. Each twin retains its own stock with its own distinct trading habitat"*[22], so according to the Efficient Market Hypothesis and rationality of agents they should have the same price, but this is not the case. Lamont and Thaler (2003)[23] observed the same phenomenon in the US technology stock market. They tried to understand if the *"law of one price"* was valid in that market segment, but they discovered that because of the reasons listed above

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[21] *Froot K. A, Dabora E. M, "How Are Stock Prices Affected by the Location of Trade?" Journal of Political Economy, Vol.53, pp. 189-216 (1999)*

[22] *Op. cit. Froot and Dabora (1999) – page 2*

[23] *Lamont A. O, Thaler H. R, "Can the Stock Market Add and Subtract? Mispricing in Tech Stock Carve-Outs," - Journal of Political Economy, Vol. 111, pp. 227-268 (2003)*

rational investors were not willing to exploit arbitrage opportunities against noise traders.

The second building block of behavioral finance is obviously psychology, indeed thanks to the work of cognitive psychologists it's now possible to make a list of mistakes that affect investors and managers in an economic environment. These deviations from rationality can be categorized in biases, heuristics and framing effects, they will be analyzed later in this work, focusing on the ones that most easily affect managers and corporate decisions.

1.1.3 Recent development of the literature

After Kahneman and Tversky published their work in 1979, studies and research in the field of behavioral finance really improved in time. It's not the intention of this work make a complete list of all the papers regarding this subject that have been published until now, but it's important to understand what are the key topics and the authors that mostly contributed to the improvement of behavioral finance, beginning with De Bondt and Thaler (1985)[24] that elaborated the Investor Over-Reaction Hypothesis in contradiction to the EMH. The authors started their analysis from the representativeness heuristic that was firstly individuated by

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[24] *De Bondt W, Thaler H. R, "Does the Stock Market Overreact?" Journal of Finance, Vol. 40, pp. 793-805 (1985)*

Kahneman and Tversky and developed the idea that people tend to overreact to new information, while at the same time they have the tendency to underweight prior information; they proceeded to search for empirical evidence whether this distortion could affect the stock market. They predicted that if the representativeness heuristic actually affects the investors, then they will overreact to the stocks which had a good performance increasing their price too much and, at the opposite, the price of the stocks which had a bad performance will decrease too much. At this point, if the theory holds, it's possible to predict how the best and worst performers of the stock market will behave in the future: the stocks which had a good performance will be overvalued and will underperform and vice versa. In support of their thoughts, De Bondt and Thaler analyzed monthly return data for the NYSE common stocks, ranked them on the basis of their three to five years past performance and created two portfolios with the best and the worst stocks. They showed how the portfolio which performed poorly in the past years outperformed the other one, as predicted by the overreaction hypothesis.

More recent studies have found out violations of the EMH which have the opposite pattern of the one descripted by the Investor Over-Reaction Hypothesis;

Jegadeesh and Titman (1993)[25] made an empirical analysis similar to the one of the De Bondt and Thaler's paper. They ranked market stocks on the basis of their 6 months prior performance and observed that in the subsequent 6 months period prior winners outperformed prior losers. In finance this is called the *"momentum effect",* and some other empirical observations confirmed this tendency in the short run, like Lee and Swaminathan (2000)[26] and Shleifer (2000)[27]. Both under-reaction and over-reaction are based over psychological evidence, the first one seems to be valid over short periods and the second one over a longer time horizon. They both use cognitive distortion to explain market anomalies and they had a great impact on the nature of finance.

Shefrin (2000)[28] also had a great influence and is one of the most respected names for what concerns the study and divulgation of behavioral finance. His work intends to make people aware of these cognitive mistakes by explaining them, how they operate in our minds and how to avoid them. Moreover, he argues that one investor's mistakes can become another investor's profit, so it's also

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[25] *Jegadeesh N, Titman S, "Returns to buying winners and selling losers: Implications for stock market efficiency" - Journal of Finance, Vol.48(1), pp. 65–91 (1993)*

[26] *Lee C, Swaminathan B, "Do stock prices overreact to earnings news?" - Parker Center, Cornell University (2000)*

[27] *Shleifer A, "Inefficient Markets: An Introduction to Behavioral Finance" - Oxford University Press, Clarendon Lectures: New York (2000)*

[28] *Shefrin H, "Beyond Greed and Fear" - Harvard Business School Press – Boston, Massachusetts (2000)*

important to recognize other investors' behavioral mistakes and exploit the opportunity.

Baker, Ruback, and Wurgler (2004)[29] work is about behavioral corporate finance, a specific branch of behavioral finance: it's one of the most important paper of this subject, they created two different approaches to behavioral corporate finance, and they will be discussed later in this work.

Those cited in this paper until now are some of the most famous and classical authors that revolutionized the study of psychology and sociology applied to economics and finance. There is, however, a continuous flow of new studies and works published in more recent years, to report that this field is in continuous expansion and development.

1.2 Behavioral corporate finance

Behavioral corporate finance is a specific field of investigation which regards how managers are influenced by psychological distortions in committing mistakes about common corporate decisions. Basically, the concept that have been established by behavioral finance concerning the actions of investors in the

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[29] *Baker M, Ruback S. R, Wurgler J, "Behavioral corporate finance: a survey", National Bureau of Economic Research – Cambridge, Massachusetts (2004*)

market are applied in a corporative contest to recognize and prevent managers mistakes. According to Gervais (2013)[30], the first scholars to understand that psychological elements should be incorporated into corporate finance theory were Herbert Simon (1955)[31], who introduced the concept of *"bounded rationality"* assuming that some information-gathering costs prevent agents from making full rational choices, and Julius Margolis (1958)[32]; however, this different approach didn't really develop if not some years later. Another fundamental work in this field that must be cited is the *"hubris hypothesis"* by Roll (1986)[33], where *"hubris"* is an ancient Greek word that describes an overconfident and overly pride personality, sometimes even arrogant. Roll uses this particular aspect of people character as an explanation for corporate takeovers, supporting with evidence that many mergers and acquisitions are made overvaluing the price of the target corporate, in as much as managers' overconfidence push them to pay a higher amount convinced that the consequent synergies would compensate the

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[30] *Gervais W. M, "In godlessness we distrust: Using social psychology to solve the puzzle of anti-atheist prejudice" - Social and Personality Psychology Compass, Vol.7(6), pp. 366–377 (2013)*

[31] *Simon A. H, "A behavioral model of rational choice" - The Quarterly Journal of Economics, Vol. 69(1), pp. 99-118 (1955)*

[32] *Margolis J, "The Analysis of the Firm: Rationalism, Conventionalism, and Behaviorism" - The Journal of Business, University of Chicago Press, Vol. 31, pp. 187-187 (1958)*

[33] *Roll R, "The hubris hypothesis of corporate takeovers" - The Journal of Business, Vol. 59(2), Part 1, pp. 197-216 (1986)*

price premium. Shefrin (2007)[34] in his book offered a complete vision of what behavioral corporate finance is about, identifying the main obstacles that stand in the way of the value maximization of the company, which should be the primary goal of managers. Not only identifying them, but also offering techniques and precautions to avoid them, exploring all the corporate finance areas like capital budgeting, dividend policy, capital structure and mergers and acquisitions, among the others. It's important, according to the author, to distinguish between managers' behavioral mistakes and agency costs. In fact, they both lead to company's value disruption, to the detriment of the shareholders: but while the agency costs are a consequence of different interests between managers and shareholders, and thus a result of a conscious acting of the former, behavioral distortions influence the managers actions without them realizing it. This is important because different remedies are requested for different problems, agency costs can be solved with specific incentives while cognitive distortions need to be solved with learning, determined procedures and different financial techniques.

But perhaps the most important work about this subject, as mentioned earlier in this paper, has been published by Baker, Ruback and Wurgler (2004)[35]. It will

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[34] *Shefrin H, "Behavioral corporate finance: decisions that create value" – McGraw-Hill/Irwin - Boston, Massachusetts (2007)*

[35] *Op. cit. Baker M, Ruback S. R, Wurgler J (2004)*

follow an analysis of behavioral corporate finance based on the two approaches proposed by these scholars.

1.2.1 Two approaches to behavioral corporate finance

Baker, Ruback and Wurgler reviewed a vast amount of economic literature and evidence about behavioral corporate finance and divided the study of this subject into two different approaches: the first theorizes a framework in which investors are less than fully rational and managers are rational, the second one emphasizes the situation in which managers are less than fully rational and investors are rational. Of course, in practice, both these different views can coexist at the same time and irrationality would operate through both the categories, but this division is the most appropriate according the authors to collect the existing literature and explain the problem.

Starting from the former approach, it assumes that managers make financial decisions in response to irrational investors behavior. To analyze a coexistence between rational managers and irrational managers, two hypotheses must be made: a) the Efficient Market Hypothesis does not hold, so there's no perfect arbitrage and investors can influence stock prices driving them too high or too low; and b) managers must be able to distinguish fundamental values from market prices. The studies about the market inefficiency are numerous and we explained some of them earlier in this paper; for what concerns the ability of managers to

identify mispricing, the authors offer different justifications. First, corporate managers have superior information, secondly there's a difference between corporate managers and money managers as the first tend to be judged on longer horizons allowing them to have a broader view of the market and third, managers might follow rules of thumb which concede them to identify mispricing even if they don't really have an information advantage. Developing a theoretical framework, applying it to practical examples and analyzing empirical evidence of different studies the authors showed how mispricing and market inefficiency can affect different corporate decisions.

With reference to real investment in an irrational investors' framework, mispricing can influence corporate investments decisions in two ways. First, corporate real investments may itself be subject to mispricing, as managers could overestimate the value of investments in particular assets like some new technologies. This effect is clear during the formation of markets' bubbles; in fact, as Keynes (1936)[36] states, short-term investors sentiment is a dominant determinant of investments in some eras. Second, if a financially constrained firm is undervalued because of market mispricing, it might be obligated to give up some valuable investment opportunities. Corporates that are equity-dependent and

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[36] *Keynes J.M, "The General Theory of Employment, Interest, and Money" – Macmillan, London (1936)*

financially constrained will have an investment policy which significantly suffers the sensitivity to market mispricing. This kind of firms need to issue equity to finance their investments, and if they are undervalued, managers will prefer to lose the investment opportunity rather than issue shares that are below their fundamental value.

Afterwards, they study the effects of irrational investors on mergers and acquisitions, citing the work of Shleifer and Vishny (2003)[37], who proposed a model of market-timing about acquisitions. This model assumes that acquirers are overvalued and the actual reason behind the acquisition is not to benefit from the subsequent synergies, but to preserve their overvaluation for a longer period of time, benefitting the long-run shareholders. This can be explained by the fact that by acquiring the target firm with overvalued stocks (since the acquirer is temporarily overvalued by a mispricing of the market), the acquirer firm will attenuate its future inevitable stock prices fall for the shareholders by leaving them with more assets per share. This model finds empirical evidence in the work of Dong et al. (2003)[38] and Ang and Cheng (2003)[39], who found out recent

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[37] *Shleifer A, Robert V, "Stock market driven acquisitions" - Journal of Financial Economics 70, pp. 295-312 (2003)*

[38] *Dong M, Hirshleifer D, Richardson S, Teoh H. S, "Does investor misvaluation drive the takeover market?" - Ohio State University working paper (2003)*

[39] *Ang J, Cheng Y, "Direct evidence on the market-driven acquisitions theory" - Florida State University working paper (2003)*

indication of a positive correlation between mispricing proxies and acquisition operations, in which, moreover, the acquirers tend to be overvalued respect to the acquired.

Even diversification operations can be brought to the indulging of market sentiment, rather than real needs. According to the authors this can be the reason of the late 1960's *"conglomerate wave",* when the investors' appetite for diversified conglomerate led corporations to increase the acquisition to cater this market preference.

Switching now to financing operations, Baker and Wurgler (2000)[40] in a previous work suggest that firms time their equity issues to exploit positive investors' sentiment and market timing, i.e., when corporations are overvalued by irrational investors, they take advantage of the situation issuing equity. If that is true, one should see a downward shift of the firm's stock prices after the equity issue. In their work, Baker and Wurgler analyzed whether equity issuance, relative to the total of equity and debt issuance, could predict aggregate market returns between 1927 and 1999. They found empirical confirmation to their hypothesis, observing earning returns below the market average after equity issue operations.

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[40] *Baker M, Wurgler J, "The equity share in new issues and aggregate stock returns" - Journal of Finance, Vol.55, pp. 2219-2257 (2000)*

Henderson, Jegadeesh, and Weisbach (2004)[41] reached similar conclusions studying different international markets from 1991 to 2001. They observed that in 12 markets out of the 13 they analyzed, average market returns were higher after an equity issuance year below the median and, at the opposite, returns were lower after an equity issuance year above the median. This, in turn, will obviously affect firms' capital structure, which will eventually reflect the pursuit of exploiting market timing and positive sentiment with equity issues at the right time with overvalued shares rather than an actual research for the optimal capital structure, like traditional finance theories suggests.

Finally, studying the dividend policy in this framework of irrational investors, Baker, Ruback and Wurgler tested a practice about dividends called the *"catering theory",* according to which the decision of firms to pay dividends or not is merely based upon their observation of other firms shares. That is, firms initiate to pay dividends when the shares of existing payers are trading at a premium relative to the shares of non-payers, and they stop paying them when the opposite situation arises. The authors used data from US stock market between 1963 and 2000 and found out that *"when the rate of dividend initiation increases, the future stock returns of payers (as a portfolio) are lower than those of nonpayers. This is*

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[41] *Henderson B. J, Jegadeesh N, Weisbach M. S, "World markets for raising new capital" - University of Illinois working paper (2004)*

consistent with the idea that firms initiate dividends when existing payers are relatively overpriced"[42]. Ascertained that the catering theory holds, the question is: why does investors' demand for dividends vary over time? The authors tried to respond using the tax changes but didn't find correlation between the two variables in the data they used. A possible explanation has been formulated by Shefrin and Statman (1984)[43], who theorized some possible answers based on self-control problems, prospect theory, mental accounting, and regret aversion.

Until now it was reported Baker, Ruback and Wurgler first approach to behavioral corporate finance, they demonstrated how corporate investments and financing can be influenced by market mispricing caused by irrational investors, even if the managers are fully rational. The latter, in fact, must interact with the former and managers have to act accordingly to market inefficiency.

The second approach developed in their work focus on the opposite extreme, i.e., when investors are fully rational and managers are irrational, assuming that managers will not behave according the definition of homo oeconomicus. They dealt with the same situations as mentioned above but in a specular way, considering some cognitive distortion that can affect irrational managers.

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[42] *Op. cit. Baker M, Ruback S. R, Wurgler J (2004) – page 29*

[43] *Shefrin H, Statman M, "Explaining investor preference for cash dividends" - Journal of Financial Economics, Vol.13, pp. 253-282 (1984)*

However, for the purpose of this paper, I preferred to analyze in a rigorous manner the biases, heuristics and framing effects that can influence managers' decisions to give a complete and detailed framework in the next paragraph, by referring to the classification offered by Hersh Shefrin.

1.3 Irrational managers: biases, heuristics and framing effects

In the following section will be provided a classification and a brief explanation of the main cognitive distortion, i.e., biases, heuristics and framing effects, that could affect corporate decisions following the categorization proposed by Shefrin (2007)[44].

1.3.1 Biases

Shefrin defines a *bias* as a *"predisposition towards error"*, that is a tendency of individuals to make decisions while they are already affected by some determined belief, elaborating in this way an affected or distorted final judgement. The most common biases that can influence corporate managers will be listed below.

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[44] *Op. cit. Shefrin H, (2007)*

Excessive optimism is the disposal to overestimate the possible future favorable outputs and at the same time the underestimation of the unfavorable ones. It's, together with overconfidence, the most common and studied bias among managers. Cooper et al. (1998)[45], for example, provided evidence on excessive optimism among startups. They observed that 68% of startup entrepreneurs thought that their company has more chances to succeed in confront to competitors, and only 5% expected more difficulties. Landier and Thesmar (2004)[46] conducted the same study among startups in France and obtained that 56% of entrepreneurs expected to develop in the near future but repeating the survey with the same participants only three years later, a barely 38% of entrepreneurs expected a future development of their startup. Graham (1999)[47] conducted a survey among 3,200 CFO's who were members of Financial Executives Institute, two-thirds of the participants responded that their shares were undervalued and only 3% of the CFO's considered their shares as overvalued. This survey is very effective in explaining excessive optimism, in

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[45] *Cooper C. A, Woo Y. C, Dunkelberg W. C, "Entrepreneurs' perceived chances for success" - Journal of Business Venturing, Vol. 3, pp. 97-108 (1998)*

[46] *Landier A, Thesmar D, "Financial contracting with optimistic entrepreneurs: Theory and evidence" - University of Chicago working paper (2004)*

[47] *Graham J.R - Duke University CFO outlook survey 1999 Q2 (1999) - http://www.duke.edu/~jgraham/99q2/q299ind.htm*

particular because it was taken just before the internet crash, or *"Dot-com bubble"* burst of 2000.

Overconfidence is another important theme in behavioral finance. It's a cognitive error which concerns one's consciousness of his abilities and limits. It causes an overestimation of an individual capacities, information and knowledge. As Shefrin specifies, overconfidence doesn't imply that people are incompetent or ignorant, it just means that they consider themselves more capable than they really are, leading them to take impulsive decisions. Both Deaves (2010)[48] and Thaler (2017)[49] asserts that overconfidence will cause excessive trading and thus, for managers, excessive investments without considering appropriately the costs. Baker, Ruback and Wurgler assert that *"overconfidence leads naturally to more risk-taking"*[50], meaning that overconfident managers are more likely to perform extremely badly, but at the same time also extremely well: this concept is related to another cognitive error called *self-attribution bias* that induce people to take higher credit for success and lower responsibility for failures. So, even though a manager is not overconfident, because of self-attribution bias he may become.

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[48] *Deaves A, "Behavioral Finance" - Ohio: Cengage Learning (2010)*

[49] *Thaler R. H, "Misbehaving" - London: Allen Lane (2015)*

[50] *Baker M, Ruback S.R, Wurgler J, "Behavioral corporate finance: a survey", National Bureau of Economic Research – Cambridge, Massachusetts (2004) – page 35*

There are many studies that focused on overconfidence errors among different corporate areas, like how overconfidence influences capital structure (Ting, Azizan and Quian,2015)[51] or the firm's pecking order (Frank and Goyal, 2003)[52]. In the third chapter of this paper, it will be analyzed the impact of overconfidence in capital budgeting.

Confirmation bias is the propensity of individuals to ignore or reject information that contrasts with their thoughts and wishes, while accepting only that information which confirms them. Shefrin points out that sometimes managers take too much of their time searching for some proof of their hypothesis, but neglect taking in considerations contradictory arguments. He uses as an example the case of Scott Mc-Nealy, the CEO of Sun Microsystems, a high-tech firm among the main producers of servers. At the end of 2000, during the internet crash, the earnings of leader competitor Cisco Systems were rapidly falling, after they reduced their employees by 18% in March 2001, so the managers of the Sun suggested to implement a cost-cutting plan for their firm. But these considerations didn't confirm Mc-Nealy opinions about the shortness of the recession, so he

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[51] *Ting I.W.K, Azizan N.A.B, Quian L.K, "Upper echelon theory revisited: the relationship between CEO personal characteristics and financial leverage decision."- Procedia, Social Behavioral Sciences, Vol. 195, pp. 686–694 (2015)*

[52] *Frank M.Z, Goyal V.K, "Testing the pecking order theory of capital structure." - Journal of Financial Economics, Vol.67, pp. 217–248 (2003)*

simply ignored these facts exhibiting a clear confirmation bias problem, eventually leading to a drastic loss for his company.

Illusion of control is the tendency of people to assume that they have the control over some events and outcomes while it's actually not true. This illusion of control is the natural way to an increase of optimism and overconfidence in managers. As Shefrin says, outcomes usually are a combination of luck and personal abilities, but people might overestimate their influence over results and consequently building an overconfident tendency over time.

Mental accounting is a concept introduced by Thaler (1980)[53]. Managers, while making investment choices, should base their decisions only on economic accounting methods, i.e., using mainly financial techniques like NPV and not taking in considerations sunk costs. From a theoretical point of view, managers that must decide between abandoning or continuing a specific project have to frame future cash flows according to economic accounting. However, as explained by Statman and Caldwell (1987)[54], if instead of not considering sunk costs, like theory suggests, they would take them into account, then they would frame future cash flows by using mental accounting, leading to a cognitive bias.

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[53] *Thaler R.H, "Towards a positive theory of consumer choice," - Journal of Economic Behavior and Organization, Vol.1, pp. 39-60 (1980)*

[54] *Statman M, Caldwell D, "Applying behavioral finance to capital budgeting: project terminations." - Financial Management, pp. 7-15 (1987)*

1.3.2 Heuristics

Kahneman and Tversky (1974)[55] defines *heuristics* as some strategies or mental process that people rely on to assess the probabilities of some uncertain future event or the value of some uncertain future quantity. Relying on these mental shortcuts can reduce the complex task of predicting future unknown values, and sometimes can be helpful but they often lead to the formation of cognitive biases. This section describes some of the most common cognitive biases which come from relying on heuristics.

Representativeness concerns the way in which people tend to assess the probability, for example, that an outcome A has been generated by a process B. Relying on the representativeness heuristic means that they determine this probability basing their decision on how A is characteristically similar to B, i.e., how much A does conform to the stereotype coming from B. *"For example, when A is highly representative of B, the probability that A originates from B is judged to be high. On the other hand, if A is not similar to B, the probability that A*

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[55] *Kahneman D, Tversky A, "Judgment under Uncertainty: Heuristics and Biases" - Science, New Series, Vol. 185(4157) pp. 1124-1131 (1974)*

originates from B is judged to be low"[56]. Several experiments have been conducted about the representativeness heuristics. Usually, it's involved a set of descriptive information, for example the description of a person character, which represent the variable A, and a list of possible occupations that corresponds to variable B. Participants must then try to understand which is the individual's occupation by ranking all the jobs listed from the most probable to the less probable to be associated with that person. In other words, they have to associate variable A to variables B based on their assessments of probabilities. The results are all pointing to the same direction: participants base their decision on representativeness heuristic, associating the two variables on the stereotype of how they're similar between them (for example, if the person A is shy and less sociable, they will choose occupation like librarian in the first place), and not adjusting their answers to probabilities. This can lead them to rank in the first positions occupations that are very rare, just on the basis of a stereotype rather than actual chances. This can lead to systematic errors in decisions because not all the variables are taken into consideration.

Availability occurs when *"people assess the frequency of a class or the probability of an event by the ease with which instances or occurrences can be*

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[56] *Kahneman D, Tversky A, "Judgment under Uncertainty: Heuristics and Biases" - Science, New Series, Vol. 185(4157) (1974) – page 1124*

brought to mind"[57]. Availability has a greater chance of being present with more recent events that had a great impact, causing the individual to think that this kind of events will have a higher probability of occur in the next future. Because of the enormous amount of information that surround us in our environment, people tend to automatically select the data that will influence the most their decisions. Consequently, when it's time to make a choice among different alternatives, an individual will be brought to attribute probabilities to those alternatives upon the basis of events that happened recently and that gathered more attention. Barber and Odean (2008)[58] argue that these *"attention getter"* factors can be the presence of determined stock in the news, anomalously high trading volume and abnormal one-day returns.

Anchoring is a process that occurs when individuals derive their final estimation by some starting point that comes from the formulation of the problem or by some partial computation. Often, as argued by Shefrin, managers make approximative calculations based on a starting point which they are familiar with, and then they go to change and adjust that starting point to reflect new circumstances and

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[57] *Kahneman D, Tversky A, "Judgment under Uncertainty: Heuristics and Biases" - Science, New Series, Vol. 185(4157) (1974) – page 1127*

[58] *Barberis B.M, Odean T, "All that glitters: the effect of attention and news on the buying behavior of individual and institutional investors." - The Review of Financial Studies, Vol.21, pp. 785-818 (2008)*

information. This initial value can act as an anchor to managers decision, conducting them to a wrong estimation.

Affect heuristic is a phenomenon that causes managers to base their decisions upon what makes them feel good at an emotional level. For what concerns capital budgeting, there is empirical evidence that some CFOs use non-discounting methods like payback period instead of discounting and more correct methods like net present value because the latter is less intuitive and more complex to understand, while payback period is very intuitive and make the managers feel better in using them. This theme will be affronted later in Chapter 3.

1.3.3 Framing effects

Finally, the *framing effect* is introduced by Kahneman and Tversky after the development of the prospect theory, discussed in the first paragraph. An important consequence of the formulation of this theory is in fact the finding of the mentioned effect, because of which people tend to give different answers to the same problem if it's formulated in two distinct forms. This effect is related to the fact that people contextualize a specific problem starting from the *reference point,* with respect to which they ground their analysis.

A very famous experiment conducted by Kahneman and Tversky in a work published in 1981[59] can help us understand what the framing effect is. The experiment's participants must imagine that the U.S. is preparing for an epidemic disease which is expected to kill 600 people. There are two alternative programs to fight the disease and their exact scientific consequences are the following:

A) If program A is adopted, 200 people will be saved

B) If program B is adopted, 600 people will be saved with 1/3 of probability and no people will be saved with 2/3 probability.

72% of the participants choose the program A. It must be noticed that this problem is formulated in terms of lives saved. Then Kahneman and Tversky proposed the same problem but in terms of lives lost, so the two options were:

C) If program C is adopted, 400 people will die

D) If program D is adopted, nobody will die with 1/3 of probability and everybody will die with 2/3 of probability.

This time, 78% of the participants choose the program D. This is obviously the same problem, with the same outcomes, but people tend to solve it in a different manner depending on how it is formulated. Moreover, in this problem is also showed how people react differently to risk depending on where they found

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[59] *Kahneman D, Tversky A, "The framing of decisions and the psychology of choice", Science, Vol. 211, page 453 (1981)*

themselves, if they are in the domain of gains (lives saved) they will be risk-averse, but if they are in the domain of losses (lives lost) they will be risk-seeking. Inconsistent responses in this problem, indeed, come from a conjunction of the framing effect with contradictory attitudes toward risk involving gains and losses.

CHAPTER 2 CAPITAL BUDGETING: TRADITIONAL APPROACH

In the first chapter an analysis of behavioral corporate finance has been conducted, together with an explanation of what are the main papers and thoughts of the field and by which cognitive distortions managers (and people in general) can be affected. In this chapter it will be provided an examination of what capital budgeting represents for a company and what are the techniques used according to classical finance books that are studied today. This analysis will be carried out for two main reasons: a) to understand in detail how managers make corporate investment decisions and how important are these for the firm and b) to make possible a better comparison between the classical view of capital budgeting and the new behavioral approach to the discipline that will be explained in the third chapter.

1.1 Capital budgeting: an overview

The main objective for corporate managers is to create value for the firm. In order to achieve that, they must consider different factors among different operative areas like financial structure, mergers and acquisition, dividend policy and others. Capital budgeting is maybe the most related to unpredictability, because managers must deal with prediction of unknown future cash flows. Capital budgeting can be

defined as the decision-making process of investing in long-term assets, and whenever a firm buys new long-term assets or increases the value of the existing one, we can talk about *capital expenditure* (CAPEX). Managers must choose, among different project alternatives, with limited resources and under conditions of uncertainty and market changes, which investment will create the higher amount of value for the firm and shareholders. It's easy to understand how this process is tricky and important for the existence of the firm already from the definition of it. It's important at this point to define precisely what we mean by the term capital expenditure that regards this decision process. The World Bank gives some exact definitions about capital budgeting and capital expenditure[60], explaining that it's generally about assets with a useful life of more than one year. This also includes, anyway, those investments made to increase and enhance the useful life of physical assets, in distinction to repair or maintenance operations, which are due to assure that the asset will be operative for the rest of its planned life. It's important to point out that there's a cut-off point to distinguish capital expenditure and current expenditure, in as much as the former extend the benefits beyond one year, while current expenditures are investments in assets that will be consumed in one year, independently from the amount of the investment.

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[60] *World Bank, "Ukraine: Creating Fiscal Space for Growth: A Public Finance Review," - Report No. 36671-UA, 2006: p. 84.*

Finally, a practical explanation must be made about what long-term assets are. There are three categories, according to the IFRS[61]:

- Tangible assets (property, plant and equipment like buildings or lands, regulated by the IAS 16);
- Intangible assets (software, licenses, trademarks, copyrights, regulated by the IAS 38);
- Financial assets (like stocks, regulated by the IFRS 9);

1.1.1 Characteristics

To understand how deeply capital budgeting decisions can affect the firm's value, by increasing it or dramatically disrupting it, it's helpful to present a brief overview of the main characteristics concerning the nature of capital budgeting.

Firstly, it implies *Large investments.* Given the nature of capital expenditures, capital budgeting decisions imply the absorption of huge amounts of limited founds. That is why management must properly stabilize in an optimal way the planning of the funds that need to be invested and the future benefits resulting from it.

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[61] *The IFRS Foundation is a not-for-profit international organization responsible for developing a single set of high-quality global accounting standards, known as IFRS Standards - https://www.ifrs.org/about-us/*

Secondly, *decisions are irreversible.* Another factor that must always be taken into consideration for long-term assets investment is that they are irreversible in the sense that it's very hard to sell this kind of assets on a second-hand market. High value assets, in fact, can't be sold at the same purchase price, and the only solutions for firms that want to dismiss a high value asset is to sell them at a drastically lower price or even to scrap them.

There's a *high degree of risk.* This is obviously connected to the fact that the future is uncertain, and these large investments can see their value disrupted by sudden changes in the market like for example in technology, in consumers' taste or in business general conditions. Because of this reason and because of the huge amount of resources invested, capital budgeting decisions must be planned and studied accurately before undertake them.

Capital budgeting decisions have an important *impact on long-term profitability.* The effects of these choices won't affect only current earnings, but the consequences will be extended in the future, having a longer-term impact respect to the implications of current expenditures. Any decision which is not initially well thought out, by bounding the company to the future earnings of the investment, may affect the business growth in a dramatically negative way.

They also have an *impact on cost structure.* By making a long-term investment, the company will be submitted to different costs like interests or rent payments. If

the return of the investment doesn't follow the expectations, this could lead to an exaggerated increase in costs and impact different new investment opportunities.

1.1.2 Importance of capital budgeting

The relevance of capital budgeting in financial management has been underlined by many authors. Among these, for example, Van Horne and Wachowicz (2008)[62] asserts that is the most important between the areas of corporate finance in creating value for the firm. Similarly, Prodanov (2012)[63] says that among the three areas of decisions of financial management, i.e., capital structure, dividend policy and capital budgeting, the latter is the only one that can maximize the value of the firm and hence the wealth of the shareholders.

Some reasons of this importance have already been highlighted earlier in this chapter, since they reflected in the description of the characteristics. But there are two other considerations that must be analyzed, which explain how long-term investment decisions influence the corporate environment.

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[62] *Van Horne J.C, Wachowicz J.M, "Fundamentals of Financial Management" - Prentice Hall, 13th ed (2008)*

[63] *Prodanov S, "Principles of capital budgeting" in Capital Budgeting – ABAGAR, pp. 7-16 (2012)*

Firstly, as explained by Gowtham and Peter (2017)[64], capital budgeting is important because it creates accountability and measurability. In fact, capital budgeting decisions enhance and test the ability of the management to quantify the risks and the future returns of the investment in comparison to the resources that will be utilized. If this process is poorly done, they will be held accountable for the disruption of the firm's value by the shareholders. Moreover, measurability allow management to have an efficient view of the earnings and costs of the investments and this will permit them to make a better comparison. If this capacity should be absent or not sufficient, the firm will have a little chance to survive in a competitive environment.

In second place, capital budgeting involves two different corporate decisions at the same time: investing and financing. Because investments in long-term assets usually need a huge account of resources, when making investment decisions managers must be also consider how this will impact on the financing area. In fact, as Gowtham and Peter highlight, by taking on a project, the firm will automatically make a financial long-term commitment to the project, and thus it will be faced with financial risks in addition to the investment risks. For example, if an investment is completely funded by debt, the firm must consider the financial

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[64] *Gowtham C.S, Peter M, "Role of Capital Budgeting in Project Management" - International Journal of Pure and Applied Mathematics, Vol.116(16), pp 351-355 (2017)*

risk of the interest rate increase besides common project risks like delays or regulatory restrictions.

1.1.3 Objectives

We stated that capital budgeting involves decisions of investment in long-term assets and so they regard capital expenditures. The primary goal of capital budgeting is the wealth maximization of the firm, but more specifically there are actually three reasons why capital expenditures could be made.

Firstly, the objective of the investment can be to increase earnings. Is the most obvious goal of an investment. These are undertaken for example to improve a product line, expand the offer in a new market, increase the production capacity, reach new consumers through advertisement, etc.

Secondly, there are the investments to reduce costs, and they are usually related to new technologies. In fact, they may regard the implementation of old machineries or the acquisition of new technologies that will decrease the production costs.

Lastly, those investments that don't fall into the two categories described above. These are made because of regulatory restrictions, for example investments that must be taken by companies to conform to a new environmental law and reduce pollution. Another example are investments made by companies in order to have a positive impact on society and even if they don't have an immediate economic return, they can heighten the value that people associate with the firm's name.

1.1.4 Classification of investment decisions

Classifications of corporate investment decisions are usually based according to three different factors: their economic life, their nature and their interdependence with other projects. For the purpose of this work, the first factor won't be considered because only long-term investments will be studied, conforming to the definition of capital budgeting as already stated before.

For what concerns the nature of the investment, it will be proposed a classification based on the work of Peterson and Fabozzi (2012)[65] and another paper of Prodanov (2002)[66]:

Firstly, there are *replacement projects.* These investments are made to replace obsolete assets that are not functional anymore or to maintain existence assets in order to continue the current level of operativity. They typically concern tangible assets. The risk of this category is usually low because the firm is simply replacing or renovating existing equipment or buildings which are already operating, so future cash flows are easily predictable.

Secondly, *Expansion projects.* They are intended to enlarge the market share of determined firm's products or services. The risk associated to this kind of

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[65] *Peterson P, Fabozzi F.J, "Capital budgeting: theory and practice" - John Wiley & Sons Inc, New York, USA (2002)*

[66] *Op.cit. Prodanov S, (2012)*

investments is higher than the precedent category, but it's overall still relatively low. This is because the firm probably has some experience about its products and markets, so it won't find relevant difficulties in estimating future cash flows arising from expansion respect to when introducing new products or services in the market.

Thirdly, *Innovative projects.* Here the risk is considerably higher, when introducing new products and services or entering new markets management has little or no experience. This means a higher uncertainty about forecasted cash flow and a higher cost in terms of time and resources to study the operation and do appropriate research. The reason for this type of risky investment can be the pursuit of diversification to lower to overall corporate risk and specialize in more areas by investing in several markets.

Fourthly and finally, *Mandatory projects.* A firm is obligated to undertake these investments. They are common in heavy industries, in which is required a large portion of assets in production. They could be for example chemical industry, pharma industry or utilities industry; these investments are a consequence of the publishing of new standards issued by governmental agency to which firms must comply and they typically concern, among the others, environmental or health issues, but also the improvement of safety conditions in the company.

Investments can also be classified according to their dependence on other projects, like Dayanada et al. (2002)[67] suggests:

There may be *independent projects.* The decision of the company to adopt one project is not influencing the decision to undertake or reject another one. This happens when the company has enough resources to invest in both of them and the future cash flows of the projects are not related. They can be evaluated very easily because they don't interfere with other investments. An example could be when the company wants to introduce a new product line and at the same time wants to replace an old machinery, as long as it has the resources for both the projects, they are independent.

Another type are the *mutually exclusive projects.* In this case, the acceptance of one project precludes the acceptance of another one and vice versa. In this case the firm must choose between one of them. i.e., suppose a company owns a land which is sufficiently large enough to contain a new warehouse or a new production plant, it can't pursue both the projects.

Lastly, *Contingent projects.* The acceptance or rejection of these projects is related to the decision to accept or reject another project. Another similar situation is the one regarding *complementary projects,* that is when the cash flows coming

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[67] *Dayanada D, Irons R, Harrison S, Herbohn J, Rowland P, "Capital budgeting: financial appraisal of investment projects" – Cambridge University Press, Cambridge (UK) (2002)*

from one project will be enhanced by the existence of the other one and vice versa.

1.1 Capital budgeting process

There's not a unique definition of the steps of capital budgeting process in the academic literature, different authors propose different interpretations. In fact, as long as the logic behind the process is always the same, it can be divided in diverse numbers of steps according to description purposes. In this paper it will be proposed a four-steps process of capital budgeting.

1.1.1 Identification of investment opportunities according to the objective

The first thing to do when a firm has decided to undertake a CAPEX investment is to understand the goal it wants to achieve. In doing so, a firm must determine a strategic plan, regarding the purpose of the investment and what kind of capital expenditure will be made. In other words, in which category will the investment fall above the ones mentioned earlier.

After this first point, the investment opportunities conforming to the strategy plan will be identified, but these opportunities don't automatically come to the company. The work of searching for new project opportunities is a work that requires a high amount of information collected, which can take a long time

especially for what concerns innovative projects that are aimed to enter in a new market or introduce a new line of product. This phase will result in an environmental analysis and it's not always a job only for the financial department, but also for other areas that must collaborate between them like R&D, marketing, production etc.

New investment opportunities may be suggested by top management (usually for more demanding projects like entering a new market or a merger), by employees (usually regards reduction costs investments) and even by external subjects like a consultant that was hired by the firm.

1.1.2 Screening and selection

Now there are several project ideas developed and that can exceed their costs, but, obviously, the firm can't undertake all the proposals due to its limited resources. So, the identified opportunities must enter a process of preliminary screening so that the management can isolate the most interesting and proceed to the evaluation and selection.

The successive project analysis is divided into two phases, a quantitative test and a qualitative test.

In the quantitative test, projects will be analyzed in terms of future cash flows, associated risk, sensitivity of the result to possible changes in the market, calculation of alternative cash flows estimations and preparation of alternative

estimates of the NPV. Different mathematical techniques are involved and there may be used methods like linear programming and while some basic processes can be applied to all the projects taken into consideration, there could be particular kinds of investments that may need some expertise and special knowledge. The outcome will be produced in terms of different estimations of NPV and the company must evaluate if proceed or reject the alternatives.

The qualitative test is conducted to study how the investments affect different factors that cannot be included in the precedent appraisal. Dayanada et al. (2002)[68] listed some of these factors to give an idea:

- The impact of the project in the number of employees;
- Environmental impact;
- Possible government responses to the undertake of the project;
- Possible labor unions response to the undertake of the project;
- Difficulties related to the use of legal patents, copyrights and other intangible assets;
- Impact on the firm's name and brand image in the eyes of the consumers;

High management skills and experience are requested for the calculation of the influence of these factors on the project.

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[68] *Op. cit. Dayanada D, Irons R, Harrison S, Herbohn J, Rowland P, (2002)*

From the quantitative and the qualitative tests conducted by the analysts, it will result the value of the Net Present Value that must be subjected, together with appropriate recommendations, to the decision of the executives and directors. As Alkraan and Hopper (2005)[69] note, *"the hierarchical level that authorizes such requests varies according to company size and the nature and cost of the project",* and the higher the amount of capital expenditure is, the higher the hierarchical level will be involved for the decision.

1.1.3 Implementation and monitoring

After the project has passed and has been approved, it's time to implement it. This is a very crucial phase where different departments of the firm must be involved. Translating the project into a concrete investment is a time-consuming activity, even some small delays in the implementation project can disrupt a high amount of the investment and thus of the company's value, so, to make the operation more efficient, the project is divided into individual activities according to a detailed plan that must be studied in advance.

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[69] *Alkaraan F, Hopper T, "Capital Budgeting Decisions" - Handbook of Cost and Management Accounting, Spiramus (2005)*

It's important to keep track of how the investment is going through the monitoring activity on a regular basis. Whenever deviations from the planned cash flow happens, management must intervene immediately with corrective actions. This monitoring activity is fundamental for the success of the investment, and the key factor that is a prerogative of the monitoring operations is the communication between the decision makers and the operative management.

1.1.4 Post-auditing

Post-implementation auditing or post-auditing is not related to the monitoring activity that is made during the project implementation. Post-auditing is an evaluation of past decisions, a comparison of predicted cash flow with the actual cash flow resulted from the investment. As Alkraan and Hopper (2005)[70] indicates, empirical evidence shows that is not a universal practice because managers believe that evaluating and revisiting past irreversible decision serves little function. However, the authors insists that this is a very useful phase in that it can check managers' predictive evaluation accuracy, it can discourage future biases and may improve future predictions by learning from the errors. Although, since it's a time-consuming activity, firms can't implement post-auditing for

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[70] *Op. cit. Alkaraan F, Hopper T (2005)*

every investment made, but for the most important projects it can be an important instrument.

1.1 Capital budgeting techniques

An analysis of the most commonly used capital budgeting financial techniques will follow below, dividing them into two categories: the non-discounting methods and the discounting methods. The main difference between them is that the latter take into consideration the time value of the money. The money you own now is more important than the money that you will collect later, as Amy Gallo (2014)[71] explains, because you can use it to make investments today and because future money's buying power can be eroded by inflation.

The non-discounting methods proposed in this chapter are the Payback Period and the Accounting Rate of Return, while the discounting methods are the Net Present Value, the Internal Rate of Return and the Profitability Index.

1.1.1 Payback Period

[71] *Gallo A, "A refresher on Net Present Value" – Harvard Business Review (2014)*

The *Payback period (PBP)* is the simplest technique for the evaluation of a project, as it merely measures the time necessary to recoup the initial outflow. The formula, in fact, is very simple:

Payback Period = Initial investment / Annual net cash flow

As an example, we consider a project which takes as an initial investment outflow $100,000, from which the firm will obtain an annual cash flow of $30,000 for the following 5 years. We also assume that the investment is made at the end of 2015, and the annual cash flows are paid entirely at the end of every year.

We can see the representation of the payments in the table below:

Table 2.1 - Payback Period example

Year	Expected cash flow	Accumulated cash flow
2016	$30,000	$30,000
2017	$30.000	$60,000
2018	$30,000	$90,000
2019	$30,000	$120,000
2020	$30,000	$150,000

Source: author's elaboration

In this case, the payback period is 4 years, because the initial investment of $100,000 is recouped at the end of 2019. For this example, we hypothesized that the annual net cash flow was paid by the end of every year, so it's easy to

understand that in this way the outcome will always be expressed in terms of whole years. But, if we assume that the payment is done uniformly throughout the year, let's say on a weekly or monthly basis, the result will be expressed in terms of years and fraction of years. In this case, with the investment used as an example before, we will have a payback period of 3 years and 4 months.

The decision criteria adopted by the management with this technique is usually that if the payback period is lower than a predetermined cut-off value, the project will be accepted. On the contrary, the project will be rejected. Following this line of thinking, if the firm must decide between two investments A and B it will reject the project with the higher payback value.

This is a strong simplification, in fact the payback period is, according to many authors, a very unsophisticated and misleading measure if used by itself, because even if between the investments A and B the first has the lower payback period, as Peterson and Fabozzi[72] indicate, it doesn't mean that it will provide the better value for the firm. There are, in fact, several problems associated with this technique:

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[72] *Op. cit. Peterson P, Fabozzi F.J, (2002)*

Firstly, the cash flows are not discounted so it ignores the time value of the money, which states that the money received sooner has a higher value respect to the money received latter.

Secondly, the payback outcome in number of years is not related to the primary goal of the firm, the wealth maximization. It's just a measure of how time is needed to recoup the outflow, but doesn't concern the profitability

Thirdly, there is not an objective and universal measure of a good payback value, so the cut-off period is decided by the management, and for that is subject to numerous biases.

Finally, cash inflows that occurs after the payback period are ignored, and for this reason managers could reject a very profitable investment on the basis of the payback period.

But, on the other hand, payback period is a very simple, intuitive technique which doesn't imply a complicated calculation and it can result useful as a support for other types of measures like the Net Present Value. Moreover, it can give a good indication of the risk of an investment for those firms that use high-tech equipment that becomes obsolete very rapidly. In these industries, projects with lower payback periods are more valuable and that is due to the fact the cash flows farther in the future are more unpredictable.

1.1.2 Accounting Rate of Return

The *Accounting Rate of Return (ARR)* is another non-discounting financial technique used in project appraisal. The formula for the ARR can be expressed as:

Accounting Rate of Return (%) = Average annual profit / Average investment

Where the average investment varies according to the depreciation method that is adopted. If we suppose that the straight-line depreciation method is used (which assumes that the asset's value will be reduce every year by an equal amount for its estimated useful life), then the average investment is calculated as the net investment divided by two. To explain better the use and calculation of the ARR, it will be provided an example:

Table 2.2 - Accounting Rate of Return example

Cash flows	**Investment A**	
Initial outflow	-100.000	
Year 1		30,000
Year 2		15,000
Year 3		20,000
Year 4		20,000
Year 5		30,000
Year 6		5,000

Source: author's elaboration

Assumed that the straight-line depreciation method is used, then the average investment will be $100,000/2 = $50,000. The average profit is then calculated as the total profit divided by the number of the years and it will be equal to $120,000/6 = $20,000. Consequently, the ARR is $20,000 / $50,000 = 40%.

If the ARR is higher than a predetermined cut-off rate (which can be the Return on Assets), then the management will accept the project, otherwise it will be rejected.

In terms of credits, the ARR is superior to the Payback Period because it takes into consideration the different useful lives of the assets. However, it's still an insufficient measure to compute a project value if used by itself. It suffers of the same problems as the PBP, it doesn't take into consideration time value, it can be calculated in different ways so it's very subjective and it's not directly related to the wealth of the firm.

1.1.3 Net Present Value

The *Net Present Value (NPV)* can be defined as the difference between the present value of all the expected future cash flows discounted at the required rate of return and the initial investment. When we talk about expected cash flows, we must consider both positive and negative cash flows in the calculation. The formula for the NPV can be expressed as:

$$NPV = -CF_0 + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \cdots + \frac{CF_n}{(1+r)^n}$$

$$\textit{and so: } NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} - CF_0$$

Where:

CF_t = cash flow at period t

CF_0 = cash flow at period t_0

n = number of years of the project

r = discount rate

The first thing the management have to do is to understand the number of years associated to the investment.

Then, an estimation of future cash flows must be made. The cash flows can be evenly distributed and be equal between them or they can change year by year, in this case it's even possible to have future negative cash flows. The first cash flow will obviously be the initial investment made by the firm, so it will be negative.

After that, it's time to decide what is the required rate of return to use, which is also named discount rate or hurdle rate. This is defined by the CFO's office according to several factors and it usually represents the cost of capital, so it can be the WACC (Weighted Average Cost of Capital), the cost of debt or the cost of equity. However, sometimes, the cost of capital rate can be adjusted increasing or

decreasing it according to the risk of the investment. Alkraan and Hopper (2005) explains that *"the rate is known as the opportunity cost of an investment"*[73], thus companies should choose those investments that can assure returns above the opportunity cost. The rate of return has a positive correlation with its risk, so the higher the risk, the higher will be the rate.

The decision rule for the NPV is very simple, a positive value means that the investment's return is higher enough to compensate the required rate of return, so it will create value for the firm and the project should be accepted. A negative value indicates that the investment decreases the firm's value so it should be rejected. A NPV that equals zero means that the investment's return is equal to the discount rate and it won't create or decrease the company's value. To understand better how NPV works, it will follow an example with two investments made in 2015 and which will produce cash flows for the next 5 years, supposing that a WACC equal to 10% will be used as the discount rate.

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[73] *Op. cit. Alkaraan F, Hopper T, (2005) – page 9*

Table 2.3 - Net Present Value example

	Investment A		**Investment B**	
Year	Cash flow ($)	Discounted cash flow at the end of 2015 ($)	Cash flow ($)	Discounted cash flow at the end of 2015 ($)
2015	-1,000,000	-1,000,000	-1,000,000	-1,000,000
2016	300,000	272,272	100,000	90,909
2017	300,000	247,933	100,000	82,644
2018	300,000	225,394	100,000	75,131
2019	300,000	204,904	800,000	546,410
2020	300,000	186,276	800,000	496,737
NPV		**136,779**		**291,831**

Source: author's elaboration

In this example, the cash flows from every year have been discounted at the rate of 10% and then the sum of this values, reduced by the initial investment, resulted in the NPVs. We can see that the second investment is the one which will create a higher value for the firm and thus, if the projects are mutually exclusive and basing the decision only on this measure, the management should choose project B.

According to Brealey et al. (2017)[74], there are three main points to remember about the NPV: a) is optimal in recognizing the time value of the money; b) is based solely on forecasted cash flows and the opportunity cost of capital, any other investment criteria that is affected by the company's accounting method, the profitability of the company's existing business, or the profitability of other independent projects will lead to inferior decisions; c) the adding-up property, i.e., since the present values are measured in terms of money at the present time, they can be added up. As a consequence, taking two different investments A and B it will be: NPV(A+B) = NPV(A) + NPV(B).

However, some criticalities about this method exists, as highlighted by Berman and Knight (2005)[75]: the main problem is that it is based on several estimations and assumptions, so it's subject to different mistakes by the management. There are three factors that can be affected by manager's errors, firstly the assumption of the initial investment's value. Sometimes it's easy to estimate objectively the cost of a project, but some other times the initial investment requires time, like an upgrading of the IT system and it will have a cost in terms of money, time and employee occupied that is complicate to estimate.

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[74] *Brealey R.A, Myers S.C, Allen F, "Principles of Corporate Finance" - McGraw-Hill, 12th ed (2017)*

[75] *Berman K, Knight J, "Financial Intelligence for Entrepreneurs: What You Really Need to Know About the Numbers" – Harvard Business School Press, 1st edition (2005)*

The second factor that can be subject to errors is the estimation of required rate of return, this is obviously a problem because depending on the type of rate that the management will choose, the NPV can change. This is clear especially when the management decides to adjust the hurdle rate in relation to the risk of the investments, it may thus lower it underestimating the risk of the investment.

Third, the prevision of the investment's return, which is the factor that is mostly subject to mistakes, according to the authors. Managers may be overly optimistic in the cash flows estimation and this problem will be analyzed accurately on Chapter 3.

1.1.4 Internal Rate of Return

The *Internal Rate of Return (IRR)* expresses the result on a percentage return. It's equal to the required rate of return of a project that produces a NPV equal to zero, thus it makes the present value of future cash flows equal to the initial investment's outflow. In other terms:

$$IRR: \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} - CF_0 = 0$$

Where:

r = Internal Rate of Return

CF_t = cash flow at period t

CF_0 = cash flow at period t_0

N = number of years of the project

The decision rule here is that if the IRR is higher than the cost of capital, then the project should be accepted, otherwise it should be rejected[76]. The advantage of the IRR respect to the NPV is that it's not required an estimation of the hurdle rate that could affect the result. In fact, it's sufficient to determine the cost of capital that will compared to the result of the IRR: the result of this method won't change according to managers' subjectivity.

But, on the other side, there are many problems regarding this technique. Brealey et al. (2017)[77], for example, indicates that it can't be used to rank mutually exclusive projects like the NPV and it's not efficient in situations that involve a high degree of uncertainty. Another problem which has been discussed very frequently by academics is the possibility of Multiple IRR or no IRR at all. Usually, in fact, cash flows follow a path according to which in the first years they will be negative and then they'll turn positive in the subsequent years. But this is not always the case: sometimes there could be negative cash flows in between positive cash flows. This situation can generate multiple IRR and it can be shown

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[76] *Hillier D, Ross S, Westerfield R, Jaffe J, Jordan B, "Corporate Finance" - McGraw Hill Publication, 2nd edition (2013)*

[77] *Op. cit. Brealey R.A, Myers S.C, Allen F (2017)*

using the example provided by Dayanada et al. (2002, page 99). If we consider a sequence of cash flows of -$190, +$455, +$270 there is only one IRR as a solution, that is 189%, but if we change the sign of the last cash flow there will be two solutions: 8.49% and 31%. Other times, there could be no solution at all. This feature of the IRR has always been seen as a reason to avoid its use in some situations, like Thuesen and Fabrycky (1989)[78] says, when multiple IRR show up there is no reason to evaluate which one is the most appropriate and it should be not considered at all.

However, some research has been conducted to demonstrate that the IRR analysis shouldn't be abandoned even though multiple results show up. Hazen (2002)[79] supported the thesis that even when multiple IRR exists, their interpretation can still be valid and non-contradictory. He states that *"It does not matter which rate is used to accept or reject the cash flow stream, as long as one identifies the underlying investment stream as a net investment or net borrowing"*[80] and the problem can be dealt with by solving for the IRR, computing the corresponding investment stream, checking the sign of the NPV to determine if it's a net investment or a net borrowing and then treating the IRR accordingly.

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[78] *Thuesen G.J, Fabrycky W.J," Engineering Economy" - Prentice-Hall, Englewood Cliffs, New Jersey (1989)*

[79] *Hazen G.B, "A new perspective on multiple internal rates of return" – The Engineering Economist, Vol. January (2003)*

[80] *Op. cit. Hazen (2002) - page 13*

Kannapiran (2017)[81] asserts that the multiple IRR problem is caused by a non-normal net cash flow (NNCF) that wrongly includes a negative cash flow, which is a reinvestment income, considering it as a normal income or a benefit stream. The author says that this problem is not associated with the IRR itself, but with the *"failure to update the discounted cash flow (DCF) or capital amortization schedule (CAS) methods to handle such problem"*[82], so he proposes a modified capital amortization schedule to eliminate the problem and obtain a unique IRR.

Making a comparison between IRR and NPV, for independent projects with a normal net cash flow, both the indicators reach the same result, but if projects are mutually exclusive and have a different size then the best choice is the NPV, because it indicates the project that maximize mostly the firm's value (Arshad, 2012)[83].

1.1.5 Profitability Index

The *Profitability Index (PI)* is strictly correlated to the NPV. Instead of giving a result in absolute terms, it gives a percentage output. The formula for the PI is:

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[81] *Kannapiran C.A, "A Resolution to the Problem of Multiple IRR" - SSRN Electronic Journal (2017)*

[82] *Op. cit. Kannapiran (2017) – page 1*

[83] *Arshad A, "Net Present Value is better than Internal Rate of Return" - Interdisciplinary Journal of Contemporary Research in Business, Vol 4(8) (2012)*

$$Profitability\ Index = \frac{Present\ value\ of\ future\ cash\ flows}{Present\ value\ of\ investment\ at\ t_0}$$

The NPV is basically the difference between these two values, while the Profitability Index is the ratio and by definition if the former is equal to zero then the latter is equal to 1. It tells how much value is created for each dollar invested.

As a consequence, the decision criterion for the Profitability Index is that the project will be accepted when the value is higher than 1 and rejected in the opposite case.

The PI has the main advantage that it can be very useful in situations of *capital rationing*, i.e., a limitation of the capital budget to invest, due to a situation in which the company must decide between different projects. As an example, we consider the following three project opportunities with a budget constraint of $20,000[84]:

Table 2.4 - Profitability Index example

Project	Investment ($)	NPV ($)	PI

[84] *Op. cit. Peterson P, Fabozzi F.J, (2002) – page 31*

A	10,000	6,000	1.6
B	10,000	5,000	1.5
C	20,000	8,000	1.4

Source: author's elaboration

Basing our choice on the NPV, we would choose the project C which has the highest value, but, if we choose according to the PI, we will select the project A and B and as a consequence the company will have a total NPV of $6,000 + $5,000 = $11,000. Obviously, this is an extreme simplification, in this case it's easy to note that the sum of the NPV of projects A and B is higher than the last one without recurring to the PI to rank them. However, we must take into considerations that large companies must deal with a huge amount of project opportunities to select and evaluate, and they should recur to linear programming to find the best combination of projects under budget constraint. As an alternative, the firm could rank the projects by their Profitability Index and choose those with a higher PI according to their budget limitation. Such a ranking wouldn't be possible in a situation of capital rationing on the basis of the NPV because it won't necessarily give us the greatest value for our investment (in this case it would have indicate to invest in project C). The selection of investments on the basis of Profitability Index in such a situation of bounded capital will result in the maximum total NPV according to the firm's budget.

Of course, the Profitability Index has limits too, some of them can be related to the fact that, like the NPV, relies on subjective estimations of the cash flow and the required rate of return. Moreover, it may not give the correct result when used to compare mutually exclusive project (out of a capital rationing situation) with a different scale of their cash flow.

1.1 Cost of Capital

The cost of capital can be defined as the firm's cost of long-term resources of capital coming from shareholders and creditors, or the cost of raising an additional dollar of capital. We mentioned earlier the cost of capital referring to it also as the required rate of return, discount rate or hurdle rate and we saw that it's fundamental in the calculation of the NPV and PI as well as for the result comparison of the IRR. The fund resources are debt, preferred stocks and common stocks and the cost of these capital sources is proportional to the risk of the assets the firm invests in. The cost of capital also depends by the kind of resources themselves: debt has a lower risk, and thus a lower cost, because creditors will be the first to get paid if the firm is liquidated, then there are the preferred shareholders and finally the most subject to risk: common shareholders. The company, to determine the cost of capital, once it computed the proportion of each source of capital, must figure the cost of each component:

The *cost of debt* is related to those funds raised by external creditors like banks through a loan or investors through the purchase of corporate bonds. It simply represents the interest rate which is paid on debt. If we consider the impact of taxes, since firms can deduct the interest payment from their taxable income, it will be $r^*_d = r_d (1 - t)$ where t is the marginal tax rate, r_d is the cost of debt and r^*_d is the effective cost of debt.

Preferred stocks are a particular kind of stock that can have both the characteristics of bonds and common stocks. In case of liquidation preferred stockholders will have priority on payments compared to common stocks. Assuming that they pay a fixed dividend by contract, the cost of a preferred stock will be equal to the amount of the dividend divided by the price of the share.

To measure the *cost of common stocks* companies usually recur to the Capital Asset Pricing Model. Shareholders require a return that can compensate both the risk of the stock and the time value of money. The formula for the CAPM that managers should use is:

$$E(r_i) = r_f + \beta[E(r_m) - r_f]$$

Where:

- $E(r_i)$ is the expected return required by the shareholders to compensate the risk and the time value
- r_f is the risk-free rate of return

- β measures the sensitivity of the stock to changes in the market's return. If β is higher than 1 it means that the stock is more volatile than the market and vice versa.
- $E(r_m)$ is the expected return of the market, that is an average rate of return of the industry in which the firm operates.
- $E(r_m) - r_f$ is the risk premium required by the shareholders to compensate the higher risk compared to a risk-free investment.

After the determination of the weight of the different resources (w) and the rate of return they require (r), it can be put all together to obtain the Weighted Average Cost of Capital (WACC):

$$WACC = w_d r_d + w_p r_p + w_e r_e$$

Where d represent the debt, p the preferred stocks and e the equity or common stocks.

The problem related to the use of the WACC is known as the *WACC fallacy*[85] and it's the empirically demonstrated[86] attitude of firms to use a single discount rate to

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[85] *Bierman H.J, "Capital budgeting in 1992: A survey" - Financial Management, Vol.22(24) (1992)*

[86] *Graham J.R, Campbell H.R, "The theory and practice of corporate finance: evidence from the field" - Journal of Financial Economics, Vol.60, pp. 187–243 (2001)*

value all of their investments. Krueger et al. (2011)[87] observed how this behavior lead to overestimate the value of riskier projects and underestimate the value of safer projects, especially large companies. Instead of a single rate, firms should use a specific cost of capital for every investment they undertake, but this has a considerable cost in terms of time and organizational.

To conclude, in this chapter it has been provided an overview of what capital budgeting is and what are the most common techniques used in project evaluation. Financial theory suggests that managers should rely mainly on the techniques that provide a more correct evaluation, like, for example, it's usually better to use the Net Present Value rather than the Payback Period or Accounting Rate of Return. But, in reality, there is some significant evidence that this is not always the case, in fact managers often tend to make mistakes about the use of the methods descripted above. An analysis on what these mistakes are, why they happen and in which way they influence the techniques provided by the traditional financial theory will be conducted in Chapter 3. In the end there will be proposed some alternatives and modifications to these methods in order to *debias* the managers

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[87] *Krueger P, Landier A, Thesmar D, "The WACC fallacy: the real effects of using a unique discount rate" – Journal of Finance, Vol. 70(3), pp. 1253 – 1285 (2011)*

choices. The analysis conducted in Chapter 2 has been fundamental to fully understand the content of the next section.

CHAPTER 3 - CAPITAL BUDGETING: BEHAVIORAL APPROACH

The following chapter will analyze how cognitive biases affect managers choices, often causing wrong investment decisions which will disrupt the firm value. Several biases have been observed to influence project appraisal decisions; however, this chapter will focus on the three cognitive distortions that seem to have the greater impact on capital budgeting: the affect heuristic, overconfidence and escalation of commitment. It will follow an exposition of different research that highlight the gap between financial theory and corporate capital budgeting practices, an analysis of the abovementioned cognitive distortion applied to managers' investment decisions and, finally, the chapter will close with some solutions that have been proposed by scholars to overcome these cognitive mistakes. Indeed, even though the literature about these *debiasing* techniques has just started to blossom and there are not actually definitive solutions to overcome cognitive influences, several authors have suggested some very interesting practices that can reduce psychological biases and they will be presented in the last part.

1.1 Theory against practice: empirical evidence

As observed in Chapter 2, traditional theories have always dealt with capital budgeting methods ranking and suggesting their use according to their merits and

their criticalities. It has been illustrated how discounting methods are preferred since they take into consideration the time value of the money, so managers should rely on these when it comes to evaluate possible investments. However, in this paragraph, it will be displayed how different studies have come to the conclusion that theories don't always apply to practice and thus sub-optimal techniques are still dominant in corporate choices.

Graham and Harvey (2001)[88] conducted a survey about capital budgeting practices among US chief financial officers who were members of the FEI (Financial Executives Institution). They had a response by 392 CFOs and the survey included large, medium and small size firms. As a result, the authors obtained that most of the respondents used discounting methods: specifically, 75% of them claimed to use the VAN and another 75% the IRR (obviously, the CFOs could choose more than one method among those that have been proposed). But, on the other hand, they found out that the use of the payback period is more widespread than they expected as 57% of the CFOs adopted it. They stated that *"this is surprising because financial textbooks have lamented the shortcomings of the payback criterion for decades"*[89] due to the fact that it ignores the time value

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[88] *Graham J.R, Harvey C.R, "The theory and practice of corporate finance: evidence from the field" - Journal of Financial Economics, Vol. 60, pp. 187-243 (2001)*

[89] *Op. cit. Graham and Harvey (2001)- page 200*

of the money and the cash flow after the cut-off date, which is subjective. Moreover, it's also worth noting that 25% of the respondents didn't use neither the NPV nor the IRR, which are the most recommended. According to this survey, the Payback is mostly used by smaller firms and by mature CFOs with longer tenure (both in large and small firms).

Moving from the US to Europe, we can see that the gap between theory and practice is even larger. Brounen et al. (2004)[90] extended the results of Graham and Harvey by expanding the survey in Europe, in an analysis that involved 313 CFO's among the U.K., the Netherlands, Germany, and France, finding out that European firms *"are still remarkably keen on applying the payback criterion, instead of discounting their cash flow using the IRR or the VAN"*[91]. In particular, while in the US review the payback method was only the third most popular tool, in Europe it's considered the most frequently used capital budgeting technique: in particular, In the U.K., the Netherlands, Germany and France respectively 69.2%, 64.7%, 50.0% and 50.9% of CFOs used the payback period as their favorite tool. On the other hand, 47.0%, 70.0% 47.6% and 35.1% of all CFOs in these countries relied on the NPV. The authors claim that the diffusion of the payback period in

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[90] *Brounen D, De Jong A, Koedijk K, "Corporate finance in Europe: confronting theory with practice" - Financial Management, Vol. 33, pp.71–101 (2004)*

[91] *Bruenon et al. (2004) page 3*

Europe, in contrast with the financial theory, is surprising. For what concerns the firms' and CFOs' characteristics that use the payback period, the results are the same as the US research.

Rossi (2014)[92] presented an overview on capital budgeting techniques used in Italy and found out that the Payback Period was the most frequently used method to evaluate projects (37.21% of respondents), followed by the NPV (25.58%), the IRR (16.28%), the Profitability Index (11.63%) and the Accounting Rate of Return (9.3%). The author then proposed the same survey among three countries[93]: Italy, Spain and France. He highlights how French firms, due to the presence of more qualified stuff, relied less than the other countries on the Payback, but its use was still very common. However, on the other hand, he states that there's still a lot of lack in the project evaluation's process of French companies. Rossi states that the large use of PP and IRR is due to a short-term vision of firms and a result of their simplicity.

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[92] *Rossi M, "The use of capital budgeting techniques: an outlook from Italy" - International Journal of Management Practice, Vol. 7(4), pp.297–312 (2014)*

[93] *Rossi M, "Capital budgeting in Europe: confronting theory with practice" – International Journal of Managerial and Financial Accounting, Vol. 6(4), pp. 341-356 (2014)*

Sandahl and Sjogren (2003)[94] reproposed the research among the largest Swedish companies and they found out that the Payback not only was the most frequently used but it also was ranked by companies as the favorite and the most important one. It's interesting to note that in this survey the authors report a possible explanation to this phenomenon indicated by Segelod (2000)[95]: the pressure from short-sighted stock market investors forces managers to give priority to short-term profit instead of a long-term vision, causing a decline in the use of more sophisticated capital budgeting techniques. This hypothesis reflects the *irrational investors-rational managers* situation proposed by Baker, Ruback and Wurgler[96] that we studied in chapter 1; the managers, in fact, tend to take financial decisions in response to irrationality of investors, thus making behavioral mistakes themselves (in this case, by increasing the use of the Payback at the expense of the NPV).

This same trend can be observed in other countries like Canada, where Bennouna et al. (2010)[97] observed that among 88 firms a large percentage (78.5%) still used

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[94] *Sadhal G, Sjorgen S, "Capital budgeting methods among Sweden's largest groups of companies. The state of the art and a comparison with earlier studies" - International Journal of Production Economics, Vol. 84, pp. 51–69 (2003)*

[95] *Segelod E, "A comparison of managers' perceptions of short-termism in Sweden and the US" - International Journal of Production Economics, Vol. 63, pp. 243–254 (2000)*

[96] *See Chapter 1, paragraph 1.2, subparagraph 1.2.1 "Two approaches to behavioral corporate finance"*

[97] *Bennouna K, Meredith G.G, Marchant T, "Improved capital budgeting decision making evidence from Canada" - Management Decision, Vol. 48(2), pp.225–247 (2010)*

the Payback Period and discovered that 17 of them didn't use any discounting methods at all (the author said it was unexpected, considering that only large firms were involved in the survey); or in Australia, according to a survey of Truong et al. (2008)[98], where the Payback was still widely used.

There are several empirical surveys that highlight the gap between the theory and practice of capital budgeting, showing how inadequate methods like the Payback are still used in different countries, in opposition to what financial theory suggests. But what are the reasons behind this gap? The majority of the authors have analyzed how sub-optimal methods are usually (but not always) adopted in smaller firms and by mature CFOs with a longer tenure, hence, by less skilled or educated managers. Segelod (2000)[99], as mentioned before, individuate the cause of this situation in Sweden in the short-term vision of the investors. Brounen et al (2004)[100] report that it's sometimes argued that payback is used by capital constrained firms which need positive cash flows as soon as possible, but the authors didn't find any evidence in support of this claim.

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[98] *Truong G, Partington G, Peat M, "Cost of capital estimation and capital budgeting practice in Australia" - Australian Journal of Management, Vol. 33(1), pp. 95–121 (2008)*

[99] *Op. cit. Segelod E, (2000)*

[100] *Op. cit. Brounen D, De Jong A, Koedijk K, (2004)*

According to Shefrin (2007)[101], the reason behind the extensive use of the Payback Period despite the theory's suggestions can be rooted in human minds and is caused by the *affect heuristic*. For the purpose of this work, in the next paragraph the focus will be on this last hypothesis.

1.1 Affect Heuristic

The affect heuristic implies, as explained by Slovic et al. (2007)[102], that the representations of objects and events in people mind are tagged to varying degrees. It's a behavior that attribute a great importance to intuition or instinct, leading the individual that faces different options to choose the one which make him feel better and more comfortable at an emotional level. According to Shefrin, the widespread adoption of non-discounting methods like the Payback by firms can be a consequence of this cognitive selection. If we take into consideration the most common capital budgeting techniques, the NPV is the less intuitive, representing the incremental wealth generated by the project for the shareholders, while the Payback is more easily interpretable, intuitive and understandable referring only to the time needed for the cash flow to recoup the initial outflow.

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[101] *Op. cit. Shefrin H (2007)*

[102] *Slovic P, Finucane M.L, Peters E, MacGregor D.G, "The affect heuristic" - European Journal of Operational Research Vol. 177 pp. 1333–1352 (2007)*

Even if the company compute the Net Present Value and the Internal Rate of Return for a specific investment, managers, under the influence of the affect heuristic, will still base their decision mainly upon the Payback: in other words, even though managers correctly make the appropriate financial analysis using different techniques like the theory suggests, they could be inclined to assign a lower decision weight to the financial analysis and a higher weight to what makes them feel comfortable like, in this case, the full comprehension of the Payback Period.

This hypothesis explaining the extensive use of Payback Period is in accordance with the characteristics of CFOs descripted by the authors of the above-mentioned surveys. A manager who is more mature, has a longer tenure and is less educated is obviously more subject to be biased by the affect heuristic and hence to use the Payback instead of the NPV. One could argue that those with a longer tenure might have a higher experience and thus be less prone to be affected by this heuristic; however, other cognitive biases can influence a manager's life. Consider for example the self-attribution bias, that is the tendency of people to overestimate their contribution in case of success and underestimate it in case of failure. After several years of career, this bias will eventually lead the person to trust more his instinct than a correct financial analysis, according to the definition of affect heuristic.

To understand how affect heuristic can influence investment decisions in concrete, it will be descripted the case of Iridium as an example.

1.1.1 Empirical evidence: Iridium

Iridium is remembered as one of the biggest business failures of the 1990s. It all started when in 1985 an engineer of Motorola, Bary Bertiger, developed the concept behind Iridium, 66 low-earth-satellites that would create a worldwide telephone network, allowing clients to make and receive phone calls from any point of earth. Bertiger, together with two other Motorola's engineers, presented the idea but their superiors rejected the project. However, the CEO Robert Galvin and two other executives of Motorola, John Mitchell and William Weisz, after a two-hour presentation accepted the idea and gave Bertiger the approval to go ahead with the project.

To use the words of Galvin himself, *"And so with no further review, the three of us approved the project on that first sitting"*[103]. As highlighted by Shefrin, neither Galvin nor the other executives asked for a cash flow estimation, a calculation of the VAN or the IRR, not even a Payback analysis substituting their subjective

[103] *Wolinsky H, "Iridium failure brought Motorola back down to earth" – Chicago Sun Times (25 sept. 2003)*

judice to a rigorous financial analysis[104]. In 1999 John A. Richardson, who was the Interim CEO of Iridium, stated *"We're a classic MBA case study in how not to introduce a product. First, we created a marvelous technological achievement. Then we asked how to make money on it."*[105].

Galvin based his decision upon his instinct rather than a correct project evaluation, so in 1991 Motorola established Iridium as a separate company and started to develop the project that wasn't ready until 1998, after a total cost of over 5 billion dollars. In August 1999 Iridium filed for bankruptcy and it was sold to private investors.

The main reasons for the failure of Iridium were the development of cell phones that had a smaller size and a lower cost and some unexpected technical problems like the fact that Iridium phones, which were designated for international business executives, didn't work properly in internal ambientes or in movement.

Obviously, analyzing the situation from a psychological point of view, the affect heuristic is not the only bias that influenced Galvin and the other executives, causing such a dramatic failure of Iridium. One could also recognize an involvement of the optimism bias, leading the managers to overestimate the

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[104] *Op. cit. Shefrin (2007), page 50*

[105] *Finkelstein S, Sanford S.H, "Learning from corporate mistakes: the rise and fall of Iridium", Organizational Dynamics, 29 (2), pp. 138-148 (2000) – page 3*

number of potential subscribers, and the escalation of commitment bias, which brought the company to continue the investment even after the technical problems have arisen and the concurrence of cell phones was evolving; these different biases will be studied soon in this paper.

Another clear example of the affect heuristic can be found in the words of Michael Lehman, CFO of the Sun Microsystems,[106] a high-tech company producer of servers. In 2000, during the dot-com bubble crash, regarding the decision of undertake some acquisition operations, Lehman stated in an article published by the Journal of Applied Corporate Finance: *"Now, in determining the price we are willing to pay for such acquisitions, we are not nearly as formal as the corporate finance textbooks suggest we perhaps ought to be. Our approach to acquisition pricing is more intuitive"*[107]. Lehman explained that instead of using a NPV based approach, the Sun's managers decided to ask themselves how an acquisition could have increased the potential and the experience of the firm. This matches perfectly with the definition of affect heuristics as explained before.

It's surely important for managers to have such an experience that will give them the capacity to have the right intuition, in fact this is a characteristic that

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[106] *The Sun Microsystems has already been briefly cited in Chapter 1, Paragraph 1.3*

[107] *Bank of America Roundtable On:"The Real Options approach to creating value in the new economy" – Journal of Applied Corporate Finance, vol. 13(2), pp. 45-63 (2000)*

companies seek in their executives and are willing to pay for it. However, the intuition and the experience are characteristics that should be complementary and not substitutive to a rigorous financial analysis, which could highlight a negative NPV. We can indeed see that the acquisitions process of the Sun Microsystems, leading to the takeover of the Cobalt, resulted a failure, pushing the CEO Scott McNealy to admit that it was a mistake.[108]

1.1.2 Interpersonal relationships

Affect heuristic can influence capital budgeting choices in different ways other than by selecting the less appropriate project evaluation technique. Since capital budgeting process is also made by numerous interpersonal relationships, managers may be influenced by these interactions with other individuals when making a choice. Several psychologists, in fact, explains that interpersonal relationships will often generate affective reactions (Allred et al. 1997)[109], as a consequence the decision-making process and the selection of the investment opportunities may result as biased. Chalos and Poon (2000)[110] explains that capital budgeting

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[108] *Kerstetter J, Burrows P, "Sun: A CEO's Last Stand" - BusinessWeek, (July 26, 2004)*

[109] *Allred K.G, Mallozzi J.S, Fusako M, Raia C.P, "The influence of anger and compassion on negotiation performance" - Organizational Behavior and Human Decision Processes, Vol. 70(3), pp.175–187(1997)*

[110] *Chalos, P, Poon M.C.C, "Participation and performance in capital budgeting Teams" - Behavioral Research in Accounting, Vol.12, pp.199–230 (2000)*

decisions usually involve negotiations among individuals, transfer-pricing transactions and inter-divisional teams. The delegation of tasks too, relative to project appraisals, is often done within the managerial hierarchy leading to a high rate of interactions among members of the same firm. Since members of organizations often experience strong emotions toward one another (Bies and Tripp 1995)[111], in an articulated and complex process like capital budgeting is very easy to let affective emotions to influence the company decisions, leading to wrong choices. As an example, research shows that, when different managers propose their projects to reviewers, the latter ones are significantly more likely to accept the project of the person who triggers a positive affective reaction, even though the project has less economic value; at the same time, they are significantly more likely to reject the project of the person who triggers a negative reaction, even if the person presented the most valid project (Moreno et al. 2002[112]). In particular, Kida et al. (2001)[113] conducted an experiment among 114 managers and individual with significant business experience to study the

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[111] *Bies R.J, Tripp T.M, "Beyond distrust: Getting even and the need for revenge" - In Trust in organizations, eds. R. M. Kramer and T. Tyler, pp.246–60, Newbury Park, CA: Sage. (1995)*

[112] *Moreno K.K, Kida T.E, Smith J.F, "The impact of affective reactions on risky decision making in accounting contexts" – Journal of Accounting Resources, Vol.40(5), pp.1331–1349 (2002)*

[113] *Kida T.E, Moreno K.K, Smith J.F, "The influence of affect on managers' capital- budgeting decisions" Contemporary Accounting Research, Vol.18(3), pp.477-494. (2001)*

influence of affect heuristic in capital budgeting. The experiment was constructed using 4 different scenarios so that managers would have a negative affective reaction versus an individual associated with one of the capital budgeting alternatives. Their results confirm that affect significantly influences managers decisions, leading them to reject the investment proposal that elicit negative emotional responses, despite the fact that the rejected project had a higher expected value.

1.1 Overconfidence and Optimism

Overconfidence and excessive optimism regarding capital budgeting choices have been documented by several authors. The difference among these two types of biases is that overconfident managers tend to overestimate their abilities, while optimism make them attribute a higher weight to probabilities of a good performance rather than a bad performance of the investment, leading them to think that favorable future events are more likely than they really are. However, even though they are technically different, finance literature often tends to consider them as one unique bias, especially for what concerns capital budgeting

decisions (Gervais, 2009)[114]. Some other authors have highlighted that optimism is a nuance of overconfidence (Libby and Rennekamp, 2012)[115], or the fact that overconfidence has two facets: optimism and miscalibration, where the first refers to an *overestimation of the mean* and the second to an *underestimation of the variance* (Skala, 2008[116]).

In the following paragraphs, by using the term *overconfidence*, it will be implicitly included the *optimism* characteristic, following the example of many authors.

1.1.1 Causes

Overconfidence is defined as the tendency of a subject to overestimate his own abilities and the precision of his knowledge and information, as pointed out by Fischoff et al. (1977)[117] and Alpert and Raiffa (1982)[118].

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[114] *Gervais S, "Behavioral Finance: Capital budgeting and other investment decisions" – Behavioral Finance, published by Wiley/Blackwell*

[115] *Libby R, Rennekamp K, "Self-Serving Attribution Bias, Overconfidence and the Issuance of Management Forecasts" - The Journal of Accounting Research, Forthcoming, Vol.50(1), pp. 197-231 (2012)*

[116] *Skala D," Overconfidence in Psychology and Finance – an Interdisciplinary Literature Review." - Bank i Kredyt , Vol. April, n. 4, pp. 33-50 (2008)*

[117] *Fischhoff B, Slovic P, Lichtenstein S, "Knowing with Certainty: The Appropriateness of Extreme Confidence." - Journal of Experimental Psychology Vol. 3 (4), pp. 552-564 (1977)*

[118] *Alpert M, Howard R, "A Progress Report on the Training of Probability Assessors." In Kahneman, Slovic, and Tversky "Judgment Under Uncertainty: Heuristics and Biases" pp. 294-305. Cambridge: Cambridge University Press (1982)*

It is directly related to the *illusion of control* as analyzed by Langer (1982)[119]: good investments' outcome are usually a mix of management skill and luck, but subjects can frame lucky situations as skill-based situations and will wrongly believe that the situation is under their control.

It's also related to the *self-attribution bias*, which lead individuals to overestimate their credit and responsibility for the success of an investment, causing them to develop overconfidence (Gervais and Odean, 2001)[120].

The first thing to understand about this bias is how and why it develops in individuals and, specifically, in corporate managers. Gervais (2009)[121] explains that there are several factors that cause the existence of overconfidence, especially in the capital budgeting context. First, the complexity of the capital budgeting process under uncertainty; second, these decisions are not well suited for learning from one's own mistakes: in fact, as Kahnemann and Lovallo (1993)[122] explains, learning occurs more easily when a subject encounters problem that are similar, frequent in time and whose outcomes are quickly known, characteristics that can't

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[119] *Langer E.J, "The Illusion of Control." In Kahneman, Slovic and Tversky "Judgment under Uncertainty: Heuristics and Biases", pp. 230-238. New York: Cambridge University Press. (1982)*

[120] *Gervais S, Odean T, "Learning to Be Overconfident." - Review of Financial Studies, Vol. 14(1), pp. 1-27 (2001)*

[121] *Op. cit. Gervais (2009)*

[122] *Kahneman D, Lovallo D, "Timid Choices and Bold Forecasts: A Cognitive Perspective on Risk Taking." - Management Science, Vol. 39(1), pp. 17-31(1993)*

be find in long-term investments. Following this line, Ucbasaran et al. (2010)[123] show how entrepreneurs don't appear to adjust their optimism after project failures. Third, the managers who succeed may become overconfident because of the self-attribution bias and fourth, the fact that managers could be more overconfident than average may be the result of a self-selection (Gervais, Heaton, and Odean, 2003)[124], as those who are overconfident are more likely to apply for high-level positions in firms.

Other reasons of the overconfidence bias existence can be found in the national and social environment in which people are absorbed and it may increase the degree of self-confidence to which they are subject. Koellinger et al. (2007)[125] observed this relation regarding the new enterprises and showed how entrepreneurs mainly base their decisions upon *"perceptions rather than objective chance of success"* and in some cultural environments they will overestimate their control over events. They find a positive correlation between overconfidence, new entrepreneurs and also, in part, the failure rate of new business owners.

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[123] *Ucbasaran D, Westhead P, Wright M, Flores M, "The Nature of Entrepreneurial Experience, Business Failure and Comparative Optimism." - Journal of Business Venturing. (2010)*

[124] *Gervais S, Heaton J, Odean T, "Overconfidence, investment policy, and executive stock options" - Unpublished working paper. Duke University, The Fuqua School of Business (2003)*

[125] *Koellinger P, Minniti M, Schade C, ""I think I can, I think I can": Overconfidence and Entrepreneurial Behavior" – DIW Discussion Paper, No. 501 (2007)*

Shefrin (2007)[126] points out two factors that mainly contributes to the evolvement of overconfidence in managers. The first is the illusion of control, as mentioned before, and the second one is an inadequate risk management and planification, as executives are inclined to be more confident when they themselves have to analyze a series of risks, instead of some investment's risks proposed by others. As a consequence, a lack of risk planification in coordination with risk managers will cause the CFOs to take into consideration only the risks that don't contradict their view (this behavior is attributed to the *confirmation bias*[127]) leading them to be more confident.

1.1.2 Measures

Obviously, having an objective measure of overconfidence in managers is not possible and this problem has been the obstacle that didn't allow scholars to study the effect of this bias in corporate decisions, at least until recent years. So how did the situation change? Which kind of data is taken into account to understand if managers are overconfident? Different authors proposed several *proxies*[128] for this

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[126] *Op.cit. Shefrin (2007)*

[127] *See Chapter 1, sub-paragraph 1.3.1 "Biases"*

[128] *In statistics, a proxy is a variable that is studied as a substitute of an immeasurable variable. It's not directly related to the problem and the higher the correlation between the proxy and the variable, the more correct the results will be.*

scope and a list of some of the most significant will be presented below: it's important to note that all of them resulted to be effective in determining the degree of CEOs overconfidence.

Malmendier and Tate (2005a)[129] have been the first to propose the use of stocks and stock options owned by managers as a proxy to measure overconfidence. CEOs, in fact, often earn as a form of compensation large quantities of stocks and stock options that, in order to maximize their incentive effect, can't be traded and, moreover, the firm prohibits the CEOs to hedge against this risky position by short-selling firm's stocks. Rational managers should thus exercise their stock options when their value is deep in the money, while overconfidence will lead CEOs to postpone the exercise of the options far beyond their exercise price and buy additional stocks, consequently increasing their exposure to firm's specific risk according to their overoptimistic forecast of investments. This same approach has been subsequently followed by many other authors like Hirshleifer et al. (2012)[130], that classify managers as overconfident when they hold options that are

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[129] *Malmendier U, Tate G, "CEO overconfidence and corporate investment" - Journal of Finance, Vol. 60 (6), pp. 2661–2700 (2005a)*

[130] *Hirshleifer D, Low A, Teoh S.H, "Are overconfidence CEOs better innovators?" – Journal of Finance, Vol. 67, pp. 1457–1498 (2012)*

over 67% in the money, but also by Minggui et al. (2006)[131] and Campbell et al. (2011)[132] in their surveys.

The second approach too has been developed by Malmendier and Tate (2005b)[133] and it is built on the perception of outsiders, specifically using the description of the CEOs given by the media. In particular, they analyzed articles about large US firms' managers in *The New York Times, BusinessWeek, Financial Times* and *The Economist*, recording for each year how many times a CEOs has been descripted by these magazines as *confident* or *optimistic* in comparison with the number of articles in which he has been portrayed as *reliable, cautious* or *conservative.* If the number of times that a manager has been addressed with the former adjectives significantly exceed the articles that used the latter ones, he would be considered overconfident by the authors for their survey. Brown and Sarma (2007)[134] used the press coverage in their survey regarding Australian CEOs, explaining how this

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[131] *Minggui Y, Xinping X, Zhensong Z, "The relationship between managers' overconfidence and enterprises' radical behavior in incurring debts" - Management World, Vol. 8, pp. 104–112 (2006)*

[132] *Campbell T.C, Gallmeyer M, Johnson S.A, Rutherford J, Stanley B.W, "CEO optimism and forced turnover" – Journal of Financial Economics, Vol. 101, pp. 695–712 (2011)*

[133] *Malmendier U, Tate G, "Does Overconfidence Affect Corporate Investment? CEO Overconfidence Measures Revisited." - European Financial Management, Vol.11(5), pp. 649-659 (2005b)*

[134] *Brown R, Sarma N, "CEO overconfidence, CEO dominance and corporate acquisitions." -Journal of Economics and Business, Vol. 59(5), pp. 358–379 (2007)*

proxy find his justification in a psychological theory called the *trait theory*[135]. A potential limitation of this proxy is that managers could overemphasize the firm's situation when talking to the press in order to mislead investors and keep their stock prices high, but Malmendier and Tate explains that this strategy can't be pursued in the long-term because they will end up losing credibility.

The third proxy is called the *calibration-based overconfidence measure (CBO).* Pikulina et al. (2017)[136] use this measure for their research regarding overconfidence and corporate investments. The subjects of their survey answered to 20 financial questions to measure their skill level, for every question there were two alternative answers and the subjects also had to indicate the probability (from 50% to 100%) that their choice was correct. A subject's average probability that he has correctly answered the questions represents his subjective confidence in his financial knowledge. The difference between this average confidence in one's own answers and the actual number of correct answers, all divided by 20, which is the number of questions, corresponds to the CBO. A positive value of the CBO means that the subject's confidence in his financial knowledge is higher than his actual performance, i.e., he's overconfident.

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[135] *The trait theory is regularly used by psychologists to measure and explain personality. Traits constitute underlying personality dimensions on which individuals vary.*

[136] *Pikulina E, Renneboog L, Tobler P.N, "Overconfidence and investment: An experimental approach" – Journal of Corporate Finance, Vol. 43, pp. 175-192 (2017)*

The fourth approach is the one used by Ben-David et al. (2007)[137], according to their definition *"overconfident people overestimate the precision of their own beliefs or underestimate the variance of risky processes; in other words, their subjective probability distributions are too narrow"*[138]. They collected a data of stock market predications made by CFOs in 26 quarterly surveys between March 2001 and June 2007. The proxy for overconfidence in the survey is given by a specific question:

"Over the next year, I expect the S&P 500 return will be:

- There is a 1-in-10 chance the actual return will be less than __%

- I expect the return to be: __ %

- There is a 1-in-10 chance the actual return will be greater than__%"

Then they mapped each CFO's 10th and 90th percentile predictions into an individual probability distribution. According to the definition of overconfidence referred above, a wide distribution indicates a high subjective uncertainty about the estimated variable, while a narrow distribution reflects subjective confidence. This is because a narrow distribution means that the subject attributes a lower

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[137] *Ben-David I, Graham J.R, Campbell H.R, "Managerial Overconfidence and Corporate Policies." – NBER Working Paper Series, Duke University (2007)*

[138] *Op. cit. Ben-David et al. (2001) – page 2*

probability for the next year's return to be far from the expected return that he indicated, overestimating the precision of his own belief.

Finally, the last proxy concerns the corporate earnings forecast. Since overconfident managers tend to overestimate their abilities, Ying He et al. (2019)[139], for their research, analyzed the corporate earnings forecasts that are published by managers and simply confronted the previsions with the actual earnings that the company consequently obtained, defining as overconfident the CEOs of those firms in which the forecasted earnings were too high. This same approach has been followed by other authors, especially Chinese scholars (Yueh-Hsiang et al. 2005[140]; Wang et al. 2008[141]; Hribar and Yang 2011[142]), as they didn't have many alternatives because *"constrained by the availability and reliability of data in China"*[143].

As mentioned before, all of these proxies must considered valid because they resulted to have a high correlation with the predicted effects of corporate

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[139] *He Y, Chen C, Hu Y, "Managerial overconfidence, internal financing and investment efficiency: Evidence from China" - Research in International Business and Finance, Vol. 47, pp.501–510 (2019)*

[140] *Yueh-Hsiang, Shing-Yang H, Ming-Shen C, "Managerial Optimism and Corporate Investment: Some Empirical Evidence from Taiwan." - Pacific-Basin Finance Journal, Vol. 13(5), pp. 523-546 (2005)*

[141] *Wang X, Zhang M, Yu F.S, "CEO overconfidence and distortion of firms' investments: some empirical evidence from China." - Nankai Business. Review, Vol. 11, pp. 77–83 (2008)*

[142] *Hribar B.P, Yang H, "CEO overconfidence and management forecasting." - SSRN Electron. Journal (2011)*

[143] *Op. cit. He Y et al. (2019) – page 504*

overconfidence in all of the works cited above. In the next paragraph we will see what these effects on corporate investments are.

1.1.3 Consequences

The main consequences resulting from overconfidence distortion in capital budgeting decision are overinvestment and underinvestment. Larwood and Whittaker (1977)[144] conducted one of the first surveys to indagate the *managerial myopia,* as they called it, which led managers to make overly optimistic planning for the future. March and Shapira (1987)[145] found out how managers behavior can't be descripted by the classical conception of risk, and they often tend to believe they have a higher control over outcomes than they actually have consequently underestimating the risk of their investments. Camerer and Lovallo (1999)[146] studied how overestimations of their skills lead managers to excessively entry new competitive markets and launch new products line, often incurring in substantial losses.

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[144] *Larwood L, Whittaker W, "Managerial myopia: Self-serving biases in organizational planning" - Journal of Applied Psychology, Vol. 62, pp. 94–198. (1977)*

[145] *March J. G, Shapira Z, "Managerial perspectives on risk and risk taking" - Management Science, Vol. 33, pp.1404–1418 (1987)*

[146] *Camerer C, Lovallo D, "Overconfidence and excess entry: an experimental approach" - The American Economic Review, Vol. 89(1), pp. 306–318. (1999)*

Several surveys in economic literature observed how corporate investment is sensitive to the amount of cash in the firm, so that firms with managers that can rely on cash tend to invest more than others, keeping investment opportunities fixed. The two traditional theories for investment distortion are the asymmetric information approach by Myers and Majluf (1984)[147], which claims that managers (who act in the interest of shareholders) are reluctant to undertake positive NPV investments when their stocks are undervalued by the market, in order to avoid diluting shareholder wealth, therefore an influx of free cash flow would be beneficial; the second is the agency cost approach of Jensen (1986)[148], which states that managers with abundant cash resources may undertake investments that increase private benefits for them to the detriment of shareholders wealth, so raising external capital can limit the extent to which managers pursue self-interested investments and more cash a disposition is not beneficial for the company. From this, Heaton (2002)[149] first provided a behavioral approach regarding investment sensitivity to cash flow that delivers these two theories into a single framework. He theorized that, on one hand, optimism will make

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[147] *Myers S, Majluf N, "Corporate financing and investment decisions when firms have information that investors do not have" - Journal of Financial Economics Vol.13, pp. 187– 221 (1984)*

[148] *Jensen M.C, "Agency costs of free cash flow, corporate finance and takeovers" – American Economic Review, Vol.76, pp. 323–329 (1986)*

[149] *Heaton J.B, "Managerial optimism and corporate finance" - Financial Management, Vol.31, pp.33-45 (2002)*

overconfident managers wrongly believe that their company shares are undervalued, so in a financially constrained situation they won't raise external capital and could renounce to positive NPV investments. This is an underinvestment distortion. On the other hand, optimism could lead overconfident managers to make upward biased cash flow forecast overestimating investment opportunities, especially when free cash flow is available to them, making it easier to take negative NPV projects, causing overinvestment. Malmendier and Tate (2005a)[150] in their work showed how Heaton's predictions find confirmation in real life. They indeed observed a strong positive correlation between their executive's overconfidence proxy, as descripted above, and the sensitivity of investment to cash flow, causing overinvestment when free cash flow is available and underinvestment in equity dependent firms. Several other studies confirmed that investment-sensitivity to cash flow gets stronger with CEOs overconfidence (Malmendier and Tate 2005b[151] by using a different proxy came to the same result, confirming the robustness of both the proxies and the result itself; Bates

[150] *Op. Cit. Malmendier and Tate (2005a)*

[151] *Op. cit. Malmendier and Tate (2005b)*

2005[152]; Xin et al. 2007[153]; Bukalska 2020[154] with the first research of this kind in Poland).

Ying He et al. (2019)[155] expanded the research to understand how overconfidence differently afflicts state-owned and non-state companies of China's Shanghai Exchange and Shenzhen Exchange in 2010–2015 and observed how this bias caused overinvestment mainly in the former type.

Pikulina et al. (2017)[156], using the CBO proxy, discovered that a high degree of overconfidence lead to wrong choices of investments, but a moderate degree can result beneficial, especially for what concerns the R&D investments, in line with the assumptions of Hirshleifer et al. (2012)[157] who emphasizes the benefits of overconfidence and overinvestments in innovation.

Another particular consequence that can be related to managers' overconfidence is a high frequency of mergers and acquisitions. Many studies have demonstrated

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[152] *Bates T.W, "Asset sales, investment opportunities, and the use of proceeds." - Journal of Finance, Vol.60(1), pp. 105–135 (2005)*

[153] *Xin Q.Q, Lin B, Wang Y.C, "Government control, executive compensation and capital investment" - Economic Research Journal, pp. 110–122 (2007)*

[154] *Bukalska E, "Are companies managed by overconfident CEO financially constraint? Investment-cash flow sensitivity approach" - Equilibrium. Quarterly Journal of Economics and Economic Policy Vol. 15(1), pp. 107-131(2020)*

[155] *Op. cit. He Y, Chen C, Hu Y, (2019)*

[156] *Op. cit. Pikulina E, Renneboog L, Tobler P.N (2017)*

[157] *Hirshleifer, D, Low A, Teoh S.H, "Are overconfident CEOs better innovators?" – Journal of Finance, Vol. 67 (4), pp.1457–1498. (2012)*

that most of the times firms undertake acquisitions that have a negative impact on their value (Jensen and Ruback 1983[158]; Berkovitch and Narayanan 1993[159]). Some other studies have observed a difference between the returns of the acquirer and the target, while the first kind of firms usually register negative returns, the latter usually have abnormal positive returns (Andrade et al. 2001)[160]. The latter authors and Moeller et al. (2005)[161] documented the high amount of value lost by acquiring firms' shareholders from the 1970s to the 2000s.

Despite this unfavorable situation for acquiring firms, 91.4% of all publicly listed firms in the US engaged in at least one merger or acquisition in the 1990s and 2000s (Netter et al. 2011[162]). This trend has been often explained for a long time with the agency cost theory, i.e., managers undertake acquisitions not to create value for the shareholders but for personal benefits. Roll (1986)[163] tried to give a

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[158] *Jensen M.C, Ruback R.S, "The Market for Corporate Control: The Scientific Evidence" - Journal of Financial Economics, Vol. 11(1), pp. 5-50. (1983)*

[159] *Berkovitch E, Narayanan M.P, "Motives for Takeovers: An Empirical Investigation" - Journal of Financial and Quantitative Analysis, Vol. 28(3), pp.347-362 (1993)*

[160] *Andrade G, Mitchell M, Stafford E, "New evidence and perspectives on mergers" - Journal of Economic Perspectives, Vol. 15, pp.103–120 (2001)*

[161] *Moeller S.B, Schlingemann F.P, Stulz R.M, "Wealth Destruction on a Massive Scale? A Study of Acquiring-Firm Returns in the Recent Merger Wave." - Journal of Finance, Vol. 60(2), pp.757-782 (2005)*

[162] *Netter J, Stegemoller M, Wintoki M.B, "Implications of data screens on merger and acquisition analysis: a large sample study of mergers and acquisitions from 1992 to 2009" - Review of Financial Studies, Vol. 24 (7), pp. 2317–2357 (2011)*

[163] *Roll R, "The Hubris Hypothesis of Corporate Takeovers" - Journal of Business, Vol.59(2), pp.197-216 (1986)*

different explanation and he has been the first to study, through his *hubris hypothesis,* the role of overconfidence in mergers and acquisitions. This hypothesis predicts that the value of the bidding firm should decrease, the value of the target should increase and the combined value of both should fall slightly. Since this work, M&A has been one of the most important fields to study the effects of managerial overconfidence. Hayward and Hambrick (1997)[164] found strong evidence of the efficiency of hubris theory, explaining how hubris is generated in CEOs through strong recent firm performance, favorable descriptions by the media and high relative compensation, leading them to overpay target firms. Malmendier and Tate (2008)[165] observed that overconfident managers are significantly more likely to conduct mergers at any point in time and this effect is accentuated among firms with abundant internal resources (confirming the precedent findings of the investment-sensitivity to cash flow). Specifically, they calculated that the odds of making an acquisition are 65% higher if the CEO is classified as overconfident. For what concerns the results of these investments, market investors react more negatively to merger bids announcements made by overconfident CEO rather than non-overconfident CEO (a loss of 90 basis points

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[164] *Hayward M.L.A, Hambrick D.C, "Explaining the Premiums Paid for Large Acquisitions: Evidence of CEO Hubris" - Administrative Science Quarterly, Vol.42(1), pp. 103- 127 (1997)*

[165] *Malmendier U, Tate G, "Who Makes Acquisitions? CEO Overconfidence and the Market's Reaction." - Journal of Financial Economics, Vol.89(1), pp.20-43. (2008)*

against 12 basis points) over the three days around the announcement. This correlation between overconfidence and frequency of mergers has been also studied with a view to long-term results, which seem to be negative too (Billett and Qian 2008)[166]. Brown and Sarma (2007)[167], by using the press coverage proxy, found evidence that CEO overconfidence destroys firm value by taking frequent and unnecessary M&A operations, moreover they also study the contribution of CEO dominance to this result. CEO dominance is the ability of the CEO to impose his overconfident views on the decision of the firm and is measured by the authors as the ratio between the CEO remuneration and the total assets of the firm[168]. They find that this indicator is significant as much as overconfidence and suggests that having an independent board of directors may help reduce the excessive investments. More recently Hyoseok et al. (2020)[169] analyzed a similar relationship between CEO dominance/power and

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[166] *Billett M, Qian Y, "Are overconfident CEOs born or made? Evidence of self-attribution bias from frequent acquirers" - Management Science, Vol. 54, pp.1037–1051 (2008)*

[167] *Brown R, Sarma N, "CEO Overconfidence, CEO Dominance and Corporate Acquisitions." -Journal of Economics and Business, Vol. 59(5), pp. 358-379. (2007)*

[168] *The authors explain that "huge" CEO pay reflects a board that is shirking its responsibility by not exercising due care in overseeing and negotiating executive pay. As a consequence, a high ratio of CEO compensation to total assets indicates that the firm expects a very large contribution from that person compared to the size of the firm and/or that the CEO has considerable influence over the decisions of the board.*

[169] *Hyoseok H.D, Hyun-Dong K, Taeyeon K, "The blind power: Power-led CEO overconfidence and M&A decision making" - North American Journal of Economics and Finance, Vol. 52 (2020)*

overconfidence and came to similar conclusions by discovering that CEO power is more likely to increase CEO overconfidence, using different power measures (*"CEO pay slice, duality, tenure, the number of insider directors, and a founding CEO"*) and the stock option proxy to measure overconfidence. Their study, based on 13,754 U.S. firms' yearly observations during the 1996–2014 period, suggests that power-led overconfidence is the main driver for overinvestment in M&A. The point of their study is that, among many different sources of overconfidence, from a mere psychological optimism distortion to cultural influences or past firm successes, *power* is the most relevant and the authors explains that the findings on previous studies on M&A could be driven by power-led overconfident CEOs too.

Finally, Ben-David et al. (2007)[170] give a general view on the effects of this bias and using an overconfidence proxy resulted from observations collected over six years as descripted before, they mentioned five firm's characteristics that seems to be caused by overconfident CFOs. First, overconfidence leads managers to underestimate the cash flow volatility and use lower discount rates when evaluating a project, due to an incorrect estimation of the associated risk. Second, the intensity of capital expenditure and acquisitions increase with overconfident CFOs, confirming the assumptions of previous papers. Moreover, they showed

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[170] *Ben-David I, Graham J.R, Harvey C.R, "Managerial overconfidence and corporate policies" - NBER Working Paper Series (2007)*

that merger announcements made by firms with overconfident managers are negatively received by the market, causing an immediate disruption of shareholder's value. Third, firms with overconfident managers tend to distribute less dividends, as they prefer to use internal resources to finance investments. Fourth, overconfidence is correlated with higher long-term debt, because as long as future cash flows are perceived safer than they actually are, the manager will commit more heavily on longer debt maturities. Finally, they found a statistically significant correlation between overconfidence and share repurchases, since CFOs will often perceive their equity as undervalued and will engage in more share repurchases.

1.1 Escalation of commitment

Escalation of commitment is a bias that occurs when managers continue to invest resources into a project in an unjustified manner, after receiving negative feedbacks about the effects of prior resources commitments. Staw (1976)[171] has been the first to develop interest in this cognitive distortion, explaining how the escalation of commitment basically consists in *"throwing good money after*

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[171] *Staw B.M, "Knee-Deep in the Big Muddy: A Study of Escalating Commitment to a Chosen Course of Action." - Organizational Behavior and Human Performance, Vol.16(1), pp.27-44 (1976)*

bad"[172]. Statman and Caldwell (1987)[173] explains that commitment has two different sides. On one hand, it has a positive effect because it implies persistence in pursuing goals generating the mental energy to accomplish difficult tasks, but on the other hand it can stuck managers in losing investments.

1.1.1 Causes

The first reason related to the escalation of commitment is CEOs overconfidence. In fact, it can cause overinvestment in different ways other than by underestimating the volatility or inflating the expected cash flow of the investment. Lovallo and Kahneman (2003)[174] state that managers' overconfidence can lead to an underestimation of the total cost of the project and the time to completion. Specifically, a downward bias in estimating the time of completion could result in losses because some costs, like labor, are positively correlated with the time needed to terminate the project and, secondly, because the positive cash flow resulting from the investment will be delayed in time.

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[172] *Staw B.M, Ross J. "Behavior in escalation situations: Antecedents, prototypes, and solutions" - In L.L. Cummings, & B.M. Staw (Vol. Eds.), Research in organizational behavior, Vol. 9, pp. 39-78) Greenwich, CT: JAI Press. (1987)*

[173] *Statman M, Caldwell D, "Applying behavioral finance to capital budgeting: project terminations" - Financial Management, pp. 7-15 (1987)*

[174] *Lovallo D, Kahneman D, "Delusions of Success: How Optimism Undermines Executives' Decisions" - Harvard Business Review, Vol. 81(7), pp.56-63. (2003)*

Another cause for the escalation of commitment is rooted in the *sunk cost fallacy*, which is defined as the tendency of managers to consider sunk costs (expenses made in the past that can't be recovered) when deciding to continue a project or dismiss it, while financial theory suggests that they shouldn't be taken into account at all. The Expected Utility Theory asserts that, because sunk costs don't affect future cash flow, they should not be considered in the decision of undertaking, continuing or terminating the project, but many authors demonstrated that in practice managers act differently (Ross and Staw 1993[175]; Keasey and Moon 2000[176]). The sunk cost fallacy is in turn a consequence of *mental accounting*, as theorized by Thaler (1985)[177], i.e., instead of using economic accounting, managers use mental accounting to frame future cash flow, inevitably taking into account sunk costs.

Moreover, there can be found other cognitive factors that drive escalation of commitment like denial, social cost of admitting failure or perceived need for self-justification which causes managers to persist in order to prove to themselves and

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[175] *Ross J, Staw B.M, "Organizational Escalation and Exit: Lessons from the Shoreham Nuclear Power Plant" - Academy of Management Journal, Vol.36(4), pp.701-732 (1993)*

[176] *Keasey K, Moon P, "Sunk Cost Effects: A Test of the Importance of Context" -Economics Letters, Vol.66(1), pp.55-58 (200)*

[177] *Thaler R, "Mental accounting and consumer choice" - Marketing science, Vol. 4(3), pp.199-214 (1985)*

others that their decision was correct (Drummond 2014[178]) and, obviously, the loss aversion from a reference point of Kahneman and Tversky discussed in Chapter 1.

1.1.2 Empirical evidence

A first example of how escalation of commitment can affect corporate investments can be found in the above cited case of Iridium. As explained by Finkelstein and Sanford (2000)[179], one of the main forces that caused such a dramatic failure was escalation of commitment, since during the 11 years of the project several problems emerged, like the competition of new cellular phones and the technical problems of Iridium phones and its network. However, top executives, who were totally aware of these risks, maintained blind faith in Iridium, ignoring the sunk costs and pushing to continue the investment.

Ross and Staw (1993)[180] explore the case of the Shoreham nuclear plant in New York in the view of escalation of commitment. In 1966, the Long Island Lighting Company (LILCO) announced plans to construct a nuclear facility in Shoreham,

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[178] *Drummond H, "Escalation of commitment: When to stay the course?" - The Academy of Management Perspectives, Vol. 28(4), pp.430–446. (2014)*

[179] *Finkelstein S, Sanford S.H, "Learning from Corporate Mistakes: The Rise and Fall of Iridium" - Organizational Dynamics, Vol. 29(2), pp.138-148 (2000)*

[180] *Op. cit. Ross and Staw (1993)*

55 miles from Manhattan, starting in late 1969 with an estimated cost between $65 and $75 million. During the construction, several problems emerged raising the costs and the time to completion, like environmental demonstrations, new regulatory requirements, management inefficiencies and a nuclear accident happened in the Three Mile Island nuclear facility in 1979 that enormously affected the Shoreham plant construction. From this date, more unexpected events continued to delay the completion date and heighten the costs. The authors report some statements that can describe perfectly the escalation of commitment framework, for example an analyst that at the time described LILCO as "*some heroin addict, you just have to keep pumping in money"*[181]*;* The New York Times in 1980[182] reported that LILCO was able to continue only by borrowing money and cutting costumer services and maintenance, explaining that they didn't really care about providing service, all they wanted was to build their plant. The Shoreham facility was completed in 1984 but was not ready to operate yet and it never would have been: in 1988, after 21 years from the announcement and $5.3 billion invested, LILCO reached an agreement with the state of New York to close Shoreham.

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[181] *Op. cit. Ross and Staw (1993) – page 710*

[182] *New York Times, "Shoreham clouds LILCO financing" - June 8: XXI-1 (1980)*

Other examples in history are *The Big Dig* of Boston, with an initial estimated cost of $2.56 billion that increased to $7.74 billion in 1992, to $10.4 billion in 1994, and, finally, $14.8 billion in 2007 (Greiman, 2010)[183]; the famous "war" between Coca Cola and Pepsi in the 1980s or the case of the pharmaceutical firm Sintex Inc. and his vice-president of the company and president of the R&D department, John Fried, that kept spending resources for years into a losing project regarding a new drug, the Enprostil, despite the several negative results of the tests (Shefrin 2007)[184]. Fried was one of the major shareholders of the company so this was not a case of agency costs but a clear situation of behavioral bias.

3.5 Debiasing and solutions

Debiasing is a term introduced by Fischhoff (1982)[185] and it indicates the process of reducing or even eliminating cognitive biases from the decision-making process. Fischoff offered four steps that should be taught to students to improve their judgment: 1) explain the bias and offer warnings about them; 2) describe the

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[183] *Greiman V, "The Big Dig; Learning from a mega project" – article publish in ASK Magazine, Issue n. 39 (July 15, 2010)*

[184] *Op. cit. Shefrin (2007)*

[185] *Fischhoff B, "Debiasing" – in Judgment Under Uncertainty: Heuristics and Biases, ed. Kahneman, Slovic and Tversky, Cambridge University Press (MA) (1982)*

direction of the bias; 3) provide a dose of feedback and 4) improve an extended program of training. However, the debiasing process is extremely difficult since the teaching and recognition of our own cognitive mistakes doesn't automatically imply an improvement in our decision-making. The learning process is very slow and debiasing requests an enormous effort, especially in situations where feedbacks need a lot of time and are not very clear, like in capital budgeting. Since the behavioral finance literature is relatively recent, and it's even more so when applied to corporate dynamics and capital budgeting, there are no certified debiasing techniques that will definitely eliminate cognitive biases as the research in this field has just started to develop. Indeed, while some debiasing techniques find more approval, like the use of real options, some others arouse conflicting opinions, for example the group communication or hurdle rates. However, some of the most known suggestions to attenuate distortions will be indicated in the following of the paragraph, in order to understand what are the advises given by different authors to debias investment choices.

3.5.1 Overconfidence and Optimism

Russo and Schoemaker (1992)[186] define *metaknowledge* as an appreciation of what we know and what we don't know, so that developing a good metaknowledge is the starting point to debiasing. An important technique to prevent overconfidence bias is the counter argumentation: it has been demonstrated that finding reasons why a certain belief might be wrong, especially when the cons are suggested by others, can help improve metaknowledge and accuracy. In their experiments, Russo and Schoemaker found out that a single counter argument reduced overconfidence by 40%, but it's important that when managers propose major capital budgeting requests, together with a list of some reasons why not to do it as counter arguments, this process must be taken seriously with real consequences (both good and bad for the manager) or it won't be useful. Several other authors have claimed how the critical communication about the risks and the potential pitfalls of a project are important in reducing overconfidence and optimism. However, it's not just a transposition of the project evaluation from the individual to the group, because emotional group dynamics can increase the biases (Kida et al. 2001)[187], but a self-assessment of cognitive biases, also by enhancing accountability so that the managers proposing the project will need to find more justifications to the potential risks (Fennema,

[186] *Russo E.J, Schoemaker P.J.H, "Managing overconfidence" – Sloan Management Review, Vol.33(2) (1992)*

[187] *Op. cit. Kida T, Moreno K, Smith J, (2001)*

Perkins 2008)[188]. A recent study published by Du et al. (2018)[189] investigated the relationship between communication network topologies and the optimism bias at the group level in capital project planning. They found out, through several experiments, that a group where the communication network is absent tend to give optimistically distorted results, as the insufficient critical assessment won't mitigate individual biases. On the other hand, they surprisingly observed that also a full communication network will lead to optimism bias. This happens because people tend to update their beliefs more in response to positive information rather than negative information (Sharot et al. 2011)[190], as a consequence, in a full communication network between an optimistic person and a relatively realistic/pessimistic person, the latter will be more likely to change his mind since optimism is easier to spread in communication. This contradicts precedent studies that insisted on a linear relationship between decision's quality and the level of communication (Ballard and Howel 1994)[191]. Du et al. eventually observed that,

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[188] *Fennema M, Perkins J, "Mental Budgeting versus Marginal Decision Making: Training, Experience and Justification Effects on Decisions Involving Sunk Costs" - Journal of Behavioral Decision Making, Vol. 21(3), pp. 225-239. (2008)*

[189] *Du J, Zhao D, Zhang D, "Impacts of human communication network topology on group optimism bias in Capital Project Planning: a human-subject experiment" - Construction Management and Economics, Vol. 37(1), pp.44-60 (2019)*

[190] *Sharot T, Korn C.W, Dolan R.J, "How unrealistic optimism is maintained in the face of reality" - Nature Neuroscience, Vol.14 (11), pp.1475–1479. (2011)*

[191] *Ballard G, Howell G, "Implementing lean construction: stabilizing work-flow" - Lean construction, pp. 101–110 (1994)*

as over-communication and under-communication are not useful in debiasing, there is an optimal level of communication between these two extremes that results in the most realistic outcomes, and this deserves further investigation.

Some authors have indicated that a possible solution to overcome the overinvestment problem caused by this bias is the use of higher hurdle rates when calculating the NPV of a project. As optimism can lead to inflated cash flows, the use of a hurdle rate that is higher than the correct one is a crude way to compensate the problem, correcting for the hubris of the manager (Schnabel 2012[192]). However, this is a solution that affects the symptoms of overconfidence and optimism in capital budgeting, but the root of the problem persists. That's the reason why their use is not uniquely accepted by scholars.

Related to the counter argumentation, a possible solution to reduce organizational overconfidence is the presence of an outside view in the board of directors. (Kahneman and Lovallo 1993[193]). An outsider is capable of focus on information that might indicate that the insider's perceptions are wrong, as he makes better estimates, incorporating more relevant data from previous insiders' decisions.

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[192] *Schanbel J.A, "Correcting for Hubris in project appraisal" - International Scholarly Research Network, ISRN Economics (2012)*

[193] *Op. cit. Kahneman D, Lovallo D, (1993)*

Heaton (2002)[194] suggests that the best way to improve the process of project appraisal is to set a combination of contractual incentives and strong outside monitoring, the first are needed to prevent agency costs and the second to prevent overconfidence and optimism distortions. Brown and Sarma (2007)[195] found evidence that effective corporate governance, measured as a higher proportion of independent directors on the board, and thus a higher "*outside view*" rate, mitigates the excessive mergers and acquisitions caused by managers' overconfidence.

Park et al. (2015)[196], from a study conducted in Korea, observed how CEO power exacerbated the negative effects of CEO hubris in capital budgeting, whereas board vigilance mitigated it. According to managerial entrenchment theory, managers try to protect their status of hubristic CEO through entrenchment, i.e., by increasing their discretionary power over governance/market controls and neutralizing the governance control imposed by principals (Walsh and Seward 1990)[197]. The authors highlight the importance of a strong board vigilance,

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[194] *Op. cit. Heaton (2002)*

[195] *Op. cit. Brown and Sarma (2007)*

[196] *Park J, Kim C, Chang Y.K, Lee D.H, Sung Y.D, "CEO Hubris and Firm Performance: Exploring the Moderating Roles of CEO Power and Board Vigilance" – Journal of Business Ethics, Vol.132(2) (2015)*

[197] *Walsh J.P, Seward J.K, "On the efficiency of internal and external corporate control mechanism" - Academy of Management Review, Vol.15(3), pp.421-458. (1990)*

defined as the extent to which boards effectively monitor and discipline top managers, and they point out two indicators of its strength: non duality and outside director representation. The first refers to the situation in which the CEO has separated executive and chair position, and the second causes an increase of board independence and thus of board vigilance and firm performance. These elements will significantly decrease the impact of managerial overconfidence in project appraisal, as empirical research suggest.

3.5.2 Affect Heuristic

As we have seen, affect heuristic can influence capital budgeting decisions by causing managers to act according to their instinct and emotions rather than by computing an objective calculation and analysis. We indagated how affect can lead to a prevalent use of non-discounting and less efficient techniques like the Payback value. However, according to the surveys mentioned before, the average manager who rely on less sophisticated techniques has a longer tenure, is more mature, less skilled and less educated. More educated managers (for example those with an MBA) are usually likely to use more sophisticated techniques like NPV or even Real Options Valuation. We have just seen that learning is not a sufficient technique to debias overconfidence and optimism, as these biases are not easy to individuate objectively and it's not so obvious that learning how to recognize one's own overconfidence mistake will automatically lead to an

improvement in decision-making. However, this principle doesn't apply here, as empirical evidence shows us that a higher education can debias the exclusive use of inefficient capital budgeting techniques, since the learning process is different from the one regarding the recognition of overconfidence bias in our own choices. On the other hand, for what concerns the implication of affect heuristic on interpersonal relationships and project selection, Fehrenbacher et al. (2020)[198], with a very recent study, indagated the impact of accountability in reducing this problem. Since accountability is recognized in psychology as a key force that can significantly improve individuals' decision quality, in their experiment they tried to understand if reviewers, when hold accountable for their choices, will lessen the impact of affect heuristic in their project selection, reducing the degree of "*favoritism*" versus proposers who trigger a positive reaction against those who trigger a negative reaction. Individuals who are accountable, in fact, are more likely to engage in preventive self-assessment, which involves thinking more critically about themselves and trying to anticipate the objections that others could raise to their explanations (Tetlock 1983)[199]. It's important to establish that reviewers will have to justify their decisions *before* making the final decision. An

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[198] *Fehrenbacher D.D, Kaplan S.E, Moulang C, "The role of accountability in reducing the impact of affective reactions on capital budgeting decisions" – Management Accounting Research, Vol. 47 (2020)*

[199] *Tetlock P.E, "Accountability and complexity of thought" Journal of Personality and Social Psychoy, Vol.45(1), pp.74–83 (1983)*

objection that people in this case need to anticipate is exactly the one regarding favoritism, i.e., relying on positive affective reaction rather than objective analysis, and this will reduce the degree of the affect influence. Fherenbacher et al. experiment's results are contrasting. On one hand, they observed that when reviewers are held accountable for their decision, their degree of positive affective reaction will significantly reduce, that is they won't select an economically non-preferred project when proposed by a manger triggering positive feelings. On the other hand, accountability didn't cause a significant improvement in decision-making when related to negative affective reaction. So, even when held accountable, a reviewer could still reject an economically preferred project when proposed by a manager who triggers negative feelings. The results, however, are quite satisfactory in order to consider accountability as an instrument that can improve decisions' quality in firms: companies should add accountability policies and procedures requiring reviewers to explain and justify their capital project choices, nevertheless keeping in mind that some additional review procedures will be needed to guard against the impact of negative affective reactions.

3.5.3 Escalation of commitment

As we studied, escalation of commitment happens when managers continue to invest resources in a losing project. To reduce drastically this bias which can lead to dramatic losses for the company, several authors have suggested the use of an

alternative capital budgeting technique which involves the use of flexibility: *Real Options*. This term has been coined by Myers (1977)[200], that introduced the use of financial option valuation techniques to value firms, defining real options as growth opportunities for a firm whose value depends on the firm's future investments. Several authors later studied their use not only for firm valuation, but also in order to incorporate financial options valuation as a support to discounted cash flow capital budgeting techniques (Lander and Pinches 1998[201]; Trigeorgis 1997[202]).

Saying that their adoption in capital budgeting involves the use of flexibility means that by adopting the real option valuation a manager will consider all possible decision points that can arise as a project develop and the most adequate response of the management at each of these decision point. As Denison (2009)[203] explains, after the valuation of the options at each decision point, the management must compute a weighted average of these possible outcomes based on their probability of occurrence. The resulting value of the project will always be equal

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[200] *Myers S.C, "Determinants of corporate borrowing" - Journal of Financial Economics, Vol.5, pp.147-176 (1977)*

[201] *Lander D.M, Pinches G.E, "Challenges to the practical implementation of modeling and valuing real options" - Quarterly Review of Economics, Vol. 38, pp.537-567 (1998)*

[202] *Trigeorgis L, "Real Options: Managerial Flexibility and Strategy in Resource Allocation" - Cambridge, MA: The MIT Press (1997)*

[203] *Denison C.A, "Real Options and Escalation of Commitment: A Behavioral Analysis of Capital Investment Decisions" – The Accounting Review, Vol.84(1), pp.133-155 (2009)*

or higher than the Net Present Value of the project without Real Options: this difference is due to the flexibility available to the management as in the NPV calculation all possible outcomes are considered while Real Options involves exclusively the consideration of those outcomes that will occur in case the management will choose the best course of action at each decision point. There are different types of real options that can be included in project evaluation, for example: a) *investment-timing options,* which offers the flexibility to delay the capital budgeting decision; b) *growth options,* that refers to the flexibility to increase the scale of the investment committing more resources; c) *expansion options,* that are similar to the previous ones but not identical, as the expansion options are exercised when a company may subsidize an existing product line because it allows the company to quickly expand in another line when the opportunity is deemed favorable; d) *abandonment options,* the one kind on which the escalation of commitment debiasing analysis has focused.

Denison in his work tested the hypothesis that real options could reduce escalation of commitment, as managers who use real options in their capital budgeting decisions will be continuously exposed with the abandonment option, as opposed to managers using only NPV, and this exposure should heighten the accessibility of the possibility of early abandonment of losing projects. His empirical experiments confirmed this theory, participants that used real options exhibited less escalation of commitment in comparison to those using NPV. In order to

understand the validity of real options, it's important to highlight that in this experiment the reduction of escalation of commitment occurred despite the fact that, between the two different groups of participants, the initial investments weren't significantly different, both groups were aware of the abandonment options and both methods should result in the same conclusion for what concerns abandonment. Any different behavior between the two groups must be due to the psychological effect of using real options. However, the use of this instrument is still not really widespread among firms, as demonstrated by several studies like Graham and Harvey (2001)[204] and, more recently, Siziba and Hall (2021)[205]. The latter, in particular, surveyed a total of 83 studies of capital budgeting practices between 1966 and 2016 among India, South Africa, the United Kingdom and the USA and observed that real options are not very used in practice. This is not due to a lack of knowledge, as there is an extensive literature about this instrument, but rather to the complexity of their computation and the preference of managers of simpler and more understandable methods (Cheng et al. 1994[206]; Lander and

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[204] *Op. cit. Graham and Harvey (2001)*

[205] *Siziba S, Hall J.H, "The evolution of the application of capital budgeting techniques in enterprises" – Global Finance Journal, Vol. 47 (2021)*

[206] *Cheng A.C.S, Kite D, Raditke R, "The applicability and usage of NPV and IRR capital budgeting techniques" - Journal of Managerial Finance, Vol.20(7), pp.10-36. (1994)*

Pinches, 1998[207]; Horn et al. 2015[208]), in line with what we previously stated about the affect heuristic. The advantage of real options from a behavioral perspective, anyway, is not reflected only in a diminution of escalation of commitment, but it would improve substantially the decision-making process reducing other biases like overconfidence and optimism.

Other than real options valuation, another instrument that can be used as a debiasing technique regarding escalation of commitment is the change of leadership. Team adaption, in fact, is considered to be a critical factor in dynamic situations and an important challenge for team leaders, as difficulties in adapting to new arising situations in a timely manner could have a serious cost for the firm performance. As a consequence, an excessive commitment to an initial plan reflects a failure of the team to adapt and can deteriorate the situation through an excessive continuation of escalation of commitment. Kalmanovich-Cohen et al. (2018)[209], through an empirical research, observed that a leadership change will effectively help the team to reevaluate the situation more efficiently by creating

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[207] *Lander D.M, Pinches G.E, "Challenges to the practical implementation of modeling and valuing real options" - The Quarterly Review of Economics and Finance, Vol. 38(3), pp. 537-567 (1998)*

[208] *Horn A, Kjærland F, Molnar P, Steen B.W, "The use of real option theory in Scandinavia's largest companies" - International Review of Financial Analysis, Vol.41, pp.74-81. (2015)*

[209] *Kalmanovich-Cohen H, Pearsall M.J, Christian J.S, "The effects of leadership change on team escalation of commitment" – The Leadership Quarterly, Vol.29, pp.597-608 (2018)*

opportunities for reflection about prior decisions. Since the new leader is not responsible for the initial course of action, he will act more objectively, drastically reducing the escalation of commitment bias. Conversely, the authors observed that teams that keep the same leader are more likely to remain committed to the team's initial plan, incurring in higher losses.

CONCLUSIONS

This thesis, in conclusion, tried to make a survey of behavioral corporate finance literature, reorganizing several studies and empirical research in an organic way in order to provide the most accurate possible view about the behavioral implications on capital budgeting decisions. This work was intended to fit into the context of this recently developed field of study as an elaborated summarization of various works, aiming to make them converge towards a unique outcome: finding the most valuable solutions to recognize, prevent and eliminate psychological subjective errors in corporate investment decision-making process.

It has been provided a detailed description of what is behavioral finance and in particular behavioral corporate finance, together with an explanation of some of the most common cognitive distortions that could affect managers. Then, an overview on the capital budgeting process has been offered, in order to understand why this procedure is so delicate, important and subject to errors. It has been showed how financial theories are not always reflected in practice, and an answer can be found in the implications of the affect heuristic, overconfidence/optimism bias and the escalation of commitment bias. They can result in many abnormal behaviors of managers and CFOs: the affect heuristic leads to an intensive use of sub-optimal project appraisal techniques like the Payback Period and to a distorted selection of projects by reviewers, as they can be conditioned by interpersonal relationships occurring between them and the projects' proposers,

causing a fallacy in their judgment process and considerable value losses. Overconfidence and optimism, as demonstrated by many surveys, often generate sub-optimal investment decisions like underinvestment and overinvestment. It has been documented the strong correlation between investment-sensitivity to cash flow and overconfident CEOs, just like the significative correlation regarding this bias and the frequency of mergers and acquisitions, causing a dramatic disruption of shareholders' wealth. Escalation of commitment basically consists of throwing good money after bad and several empirical cases can explain how devastating it can be for the company.

Even though *debiasing* is a complex process and behavioral corporate finance literature don't offer drastic and totally effective solutions, several authors have suggested and discussed some methods to prevent and reduce the impact of the human factor in investment decisions, like critical counter argumentation, the appropriate communication network, higher hurdle rates, an outside view in the board vigilance, learning, an improvement in accountability, a change in team leadership or real options, an important instrument which can bring an uprising in investments quality but that is not still widespread in companies' practices due to its complex calculation.

The application of psychological and social aspects in corporate finance has just started to develop, but the hope for the future is for an improvement of the related results and an increased inclusion of this perspective in traditional financial

studies. It's important to remember that the behavioral branch don't want to impose itself as a substitute to traditional theories, but as a complementary view that can help to explain many corporate problems and improve the efficiency of management.

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