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Behavioral corporate finance: M&A and overconfidence analysis

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INTRODUCTION

Behavioral finance is a branch of behavioral economics, born in the 70s by two psychologist named Amos Tversky and Daniel Kahneman. They showed how individual decisions were not coherent with the classical economic theory which assumes that every man behave as a perfectly rational one. Their first work was “Judgment under uncertainty: Heuristics and Biases” published in 1974, where they described all the heuristics and biases employed to assess probabilities and predict value and the implication these observation on the economic theory. For the first time someone showed how the real humans behave, how the economic theory does not take into account several behavior and errors that we see and make almost every day. But it was in 1979 that they published their most important work (Prospect Theory: An Analysis of Decision Under Risk) which introduced the prospect theory. In this publication they showed how people behave differently when they are in the domain of losses rather than the domain of gains.

After these publications, many studies and researches have been made about behavioral economics, and one branch that was developed in those years was behavioral finance. These researches replaced the assumption of a perfectly rational men with a more evidence-based theory.

The purpose of this work is to show how the traditional approach to corporate finance can fail, and how easy it is to observe biases even from CEOs and CFOs. Traditional approach to corporate finance in fact it is no more enough to explain all the different phenomena that characterize corporate finance: do executives always take their decisions following the theoretical model? Are they always rational? Is it true that they always seek the maximization of the shareholders' value? In order to understand that, it is firstly necessary to understand what behavioral economics is: in the first chapter in fact it is explained all the theory about behavioral economics and how economists came to the idea of behavioral corporate finance. Then, limits to the traditional view of the market efficiency will be shown, and it will be analyzed their impact on investment decision. The perception about risk, for managers, has a great impact too on their decisions, and how they subjectively interpret traditional models like CAPM it is a interesting field of analysis. At the end of the first chapter it will be shown how traditional efficient market hypothesis fail for some of the most common operations in Corporate Finance, such as IPOs, or in the stock market.

In the second chapter the focus will be on the Mergers and Acquisition, where, with the help of an empirical case, the Discounted cash flow method to valuate a company will be analyzed. Synergies and estimates about future cash flow will be analyzed as well, also in order to detect all the possible biases and heuristics executives have made during the decisional process. It will be analyzed the bias related to growth rate opportunities and whether analysts tend to overestimate this rate. The HP-Compaq merger has been one of the most discussed deals of the first years of 2000. Starting from the decisional process, passing through the discounted cash flow analysis and synergies estimates, and finishing with a retrospective view of that estimates, the aim of this work is to fully cover this deal, and detecting, where possible, all the bias and heuristics that involved HP's CEO Carly Fiorina and all the directors in charge of taking the final decision. Was It possible to predict before that the deal would have not been profitable? Which were the signals that could have lead analysts to consider Carly Fiorina overconfident and risk tolerant?

In the third chapter the focus will be on the theoretical analysis about M&A, and how behavioral corporate finance is explaining all the different behaviors that traditional economies cannot explain. First of all the most common biases related to M&A will be shown: how analysts systematically overestimate growth opportunities and how risk tolerance can affect the number of mergers undertaken. Then there will be a full analysis about the role of overconfidence in the M&A sector: through different empirical researches and surveys it is possible to find a relationship between overconfidence and bad M&A. Starting from the detection of the overconfidence it will be find whether it is possible to predict bad deals.

1. BEHAVIORAL ECONOMICS AND ITS APPLICATION TO CORPORATE FINANCE

1.1 HEURISTICS AND BIASES

One of the most important paper in behavioral economics history is surely “Judgment under Uncertainty: Heuristics and Biases” by Amos Tversky and Daniel Kahneman. This paper radically changed the approach to economics by researchers: Tversky and Kahneman in fact considered economics as a social science and started testing whether the commonly accepted economics theory were effectively valid also for real human beings. They argued that the perfectly rational human does not exist (Amos Tversky and the Ascent of Behavioral Economics, Laibson Zeckhauser, 1998) and that economic theories do not take into account this aspect.

Since 1970 the two psychologists started working together on this paper in order to detect and show all the different biases that all of us have, but that classical theoretical approach do not consider.

The first bias that they showed on their paper is the representativeness bias: they argued that every time an event A is more representative than an event B, A is judged as more probable than B. For example, if a basketball player has physical characteristics more similar to an nba player than another one, the first one is considered to have more chance than the second to play in the NBA. It does not matter which is their effective probability distribution: the most important thing is how they appear to be with respect to the reference sample.

This phenomenon was showed through the following experiment: to a group of people were shown brief personality descriptions of several individuals, randomly selected from a group of 100 professionals, composed by engineering and lawyers. Than the group of people undergoing the test was split in two part: to one half it was said that the group of professionals was composed by 70 lawyers and 30 engineers, to the other half they said that it was formed by 30 lawyers and 70 engineers. They discovered that “subjects evaluated the likelihood that a particular description belonged to an engineer rather than to a lawyer by the degree to which this description was representative of the two stereotypes, with little or no regard for the prior probabilities of the categories”. This is the so-called insensitivity to prior probability of outcomes: when uninformative

description was introduced, people did not consider the actual probability distribution, when instead no additional information are given, prior probabilities are properly utilized.

People tend to assess the probability of a specific sample result to the generic population and do not consider how big the sample is with respect to the population. Tversky and Kahneman used the following example to explain how people do not judge correctly probability when different sample sizes are involved: in a certain town there are two hospitals, in the smaller one 15 babies a day are born, in the bigger one 45. On average 50% of the babies born are boys and the other 50 are girls. Most of the people interviewed did assume that both hospital had the same probability of having for one day more boys than girls. But according the sample theory, the smaller a sample is, the greater the probability of obtaining a deviation from the mean is.

David Einhorn in 2007 talked about this phenomenon: “People ask me “Is poker luck?” and “Is investing luck?” The answer is, not at all. But sample sizes matter. On any given day a good investor or a good poker player can lose money. Any stock investment can turn out to be a loser no matter how large the edge appears. Same for a poker hand. One poker tournament is not very different from a coin-flipping contest and neither is six months of investment results. On that basis luck plays a role. But over time – over thousands of hands against a variety of players and over hundreds of investments in a variety of market environments – skill wins out.”

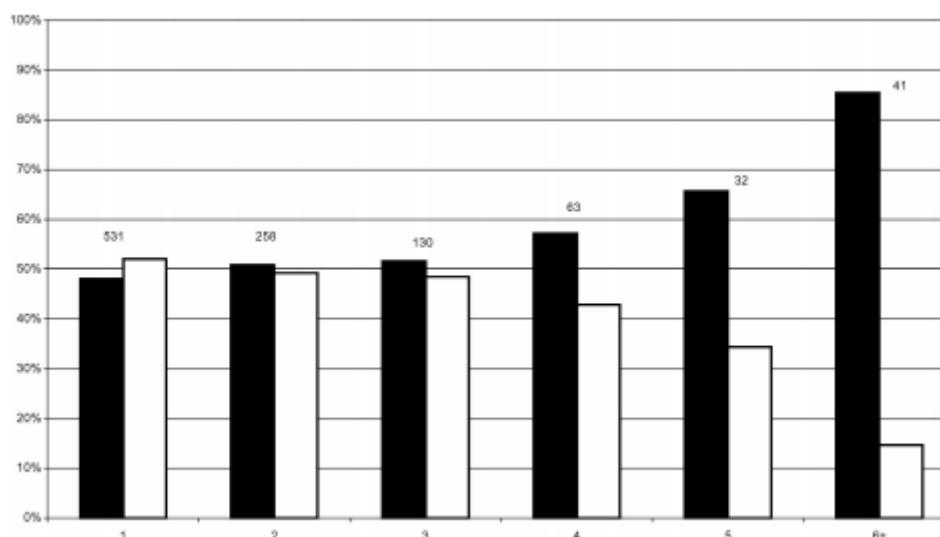
Another aspect related to the representativeness heuristics is the misconceptions of chance and randomness: people consider more probable that after two consecutive heads, in the third toss the coin will be tail. People expect that the probability of a particular event changes after the previous result, since it should always get close to the mean. So, after two consecutive heads, people expect that the coin will have higher probability to be tail, since in the long term the number of heads should be equal to the number of tails. This is the so-called gambler’s fallacy: for random events, runs of a particular outcome (e.g., heads on the toss of a coin) will be balanced by a tendency for the opposite outcome (e.g., tails). So the gambler will continue betting even if he is losing money since he forecasts that the probability of winning increases after every loss.

The opposite of the gambler’s fallacy is the hot hand, which is the belief that a player which is winning a lot, will continue winning: a non-autocorrelated series is considered

to be positive autocorrelated. While in some sports activities there might be small evidences of the hot hand phenomena (Surprised by the Gambler's and Hot Hand Fallacies? A Truth in the Law of Small Numbers, Joshua B. Miller and Adam Sanjurjo, November 2016) most of the time this belief is a true fallacy, since the chances of a coin to be head or tail are always the same.

Several empirical studies have been made in the last several years about these phenomena: in 1998 Croson and Sundali (The Gambler's Fallacy and the Hot Hand: Empirical Data from Casinos, 2005) observed 18 hours of play from a casino in Reno in order to find out statistical evidence of the gambler's fallacy and the hot hand phenomenon.

Figure 1 - Proportion of gambler's fallacy outside bets after a streak of at least length N



Fonte: The Gambler's Fallacy and the Hot Hand: Empirical Data from Casinos, 2005

As it can be seen in the table above, the longer is the streak of a particular outcome, the more likely the gambler will be to bet against the streak. For example if in the roulette a red number has won the last five trials, 68% of the gambler betted on black. Even the hot hand phenomenon is proved in this empirical demonstration: on average after an outside bet win, gamblers bet 1.53 times while after an outside bet lose, they place 1.38 outside bets. As it can see in the tables below, almost the same results can be observed for inside bets.

Table 1 : Number of outside bets placed

	Average	St. dev.	N
First spin	0.48	0.71	139
Won prior spin outside	1.53	0.63	454
Lost prior spin outside	1.38	0.57	608

Source: *The Gambler's Fallacy and the Hot Hand: Empirical Data from Casinos, 2005*

Table 2: Number of inside bets placed

	Average	St. dev.	N
First spin	7.63	6.12	139
Won prior spin inside	13.62	6.60	570
Lost prior spin inside	9.21	5.35	1487

Source: *The Gambler's Fallacy and the Hot Hand: Empirical Data from Casinos, 2005*

Table 3: Hot hand regression

Intercept	1.63**	-1.83
Win previous trial	1.09**	0.99**
# bets placed last spin	0.58**	0.27**
# bets placed first trial	0.23**	2.07**
Individual dummies	No	Yes
R ² (adjusted)	.64	.64

** p < 0.01; * p < 0.05; ^ p < 0.10.

Source: *The Gambler's Fallacy and the Hot Hand: Empirical Data from Casinos, 2005*

People do incur often in the insensitivity to predictability: they tend to formulate prediction about the future according to information which are not relevant with the prediction they have to make. So, for instance, if a very favorable description of a company is given to a person, this one will tend to believe that the company will see high profits in the near future. This can be associated with what it is happening for example with Tesla: in 2017 Damodaran said that Tesla is the ultimate story stock (<https://www.bloomberg.com/news/videos/2017-02-23/nyu-s-aswath-damodaran-calls-tesla-ultimate-story-stock>), since all the eco-friendly characteristics of tesla and the promises about the future are more relevant than future free cash flow (<https://www.forbes.com/sites/hershshefrin/2017/07/23/the-psychology-roiling-teslas->

[stock-price/#501a379951cf](#)). In 2017 in fact Damodaran estimated a value of \$151 per share for Tesla, while its market price in that period was around \$365, in 2013 he estimated a value of \$67.12 while the market price was \$168.

Daniel Kahneman, Nobel prize for the Economy in 2002, served after his undergraduate degree in the psychology department of the Israeli Defense Forces and he was in charge of the evaluation and selection of the candidates. In an article he wrote for the New York Times in 2011 (https://www.nytimes.com/2011/10/23/magazine/dont-blink-the-hazards-of-confidence.html?_r=1&ref=magazine), he said that:

"Because our impressions of how well each soldier performed were generally coherent and clear, our formal predictions were just as definite. We rarely experienced doubt or conflicting impressions. We were quite willing to declare: "This one will never make it," "That fellow is rather mediocre, but should do O.K." or "He will be a star." We felt no need to question our forecasts, moderate them or equivocate. If challenged, however, we were fully prepared to admit, "But of course anything could happen." We were willing to make that admission because, as it turned out, despite our certainty about the potential of individual candidates, our forecasts were largely useless. The evidence was overwhelming. Every few months we had a feedback session in which we could compare our evaluations of future cadets with the judgments of their commanders at the officer-training school. The story was always the same: our ability to predict performance at the school was negligible. Our forecasts were better than blind guesses, but not by much. I thought that what was happening to us was remarkable. The statistical evidence of our failure should have shaken our confidence in our judgments of particular candidates, but it did not. It should also have caused us to moderate our predictions, but it did not. We knew as a general fact that our predictions were little better than random guesses, but we continued to feel and act as if each particular prediction was valid. I was reminded of visual illusions, which remain compelling even when you know that what you see is false. I was so struck by the analogy that I coined a term for our experience: the illusion of validity."

The illusion of validity is still one particular aspect of the representativeness bias: people tend to overrate their ability to predict future, and by doing that they select certain criteria that they consider good indicator of future outcomes. For example, people predict with

more confident the final grade point average of a student that has a very low variance on his grades than one with many up and downs.

Another great fallacy is the misconceptions of regression: Daniel Kahneman observed during his years in the Israel Army the so called Consistent Positive Reinforcement policy. The instructors, following the recommendations of the psychologists, praised the pilots after every good maneuver. However according to the experience of the instructors, they saw that high praise for good execution of complex maneuvers typically resulted in a decrement of performance on the next try (The Undoing Project: A friendship that changed our minds, Michael Lewis, 2016). In reality, their words had no influence on the pilots' outcome of the flight maneuver: that was just due to the regression to the mean.

People in fact tend not to expect regression to the mean when they should; when they correctly recognize instead they invent spurious casual explanation for it, such as the beliefs of the flight instructors.

The second main heuristics they discovered it was the availability: this is a mental shortcut that people use to asses the frequency or a probability of an event, by considering immediate example related to that topic. The easier people can call some scenario to mind, the more available it will be and the more probable they consider that to happen. Any vivid or recent fact is likely to be recalled with ease, and so be disproportionately weighted in any decision. For instance, after seen a car crash in the highway, people tend to slow down immediately after it; or after the view of a movie regarding nuclear war, people were more worried about a possible nuclear war.

These two examples regard the retrievability of instances: the easier a person can retrieve an instance, the more probable he considers that to happen. In 1974 Tversky and Kahneman tested this by telling a group of people a list of known personalities of both sexes and then they asked them whether the list contained more men or women. They found out that people considered as more frequent the sex with the higher number of famous personalities.

During their experiments at the University of Oregon, they posed to the students the following questions:

The frequency of appearance of letters in the English language was studied. A typical text was selected, and the relative frequency with which various letters of the alphabet appeared in the first and third positions of the words was recorded. Words of less than three letters were excluded from the count.

You will be given several letters of the alphabet, and you will be asked to judge whether these letters appear more often in the first or in the third position, and to estimate the ratio of the frequency with which they appear in these positions. . . .

Consider the letter R

Is R more likely to appear in _____ the first position?

_____ the third position?

(check one)

My estimate for the ratio of these two values is: _____:1

69% of the students believed that for consonants like R,V,K,L,N the first position was more likely, while according to Mayzner and Tresselt (Tables of single-letter and digram frequency counts for various word-length and letter-position combinations, 1965) they are more common in the third position. The median estimated ratio was 2:1 for each of the five consonants. This is the so called bias due to the effectiveness of a search set: When people have to solve a problem that requires them to consider a search set, they will answer to the problem based on ease of search due to information that is available, rather than the effectiveness of the search. When people have to assign the probability to a certain event, they tend to consider as more probable the one that is more common in their search set.

The third bias related to the availability heuristic is the bias of imaginability: easily imaginable events tend to be considered as more probable. For example, a group about to embark on an expedition together have to consider all possible problems they might have. So, the relieve it takes them to recall possible difficulties during their trip seem more likely than they actually are.

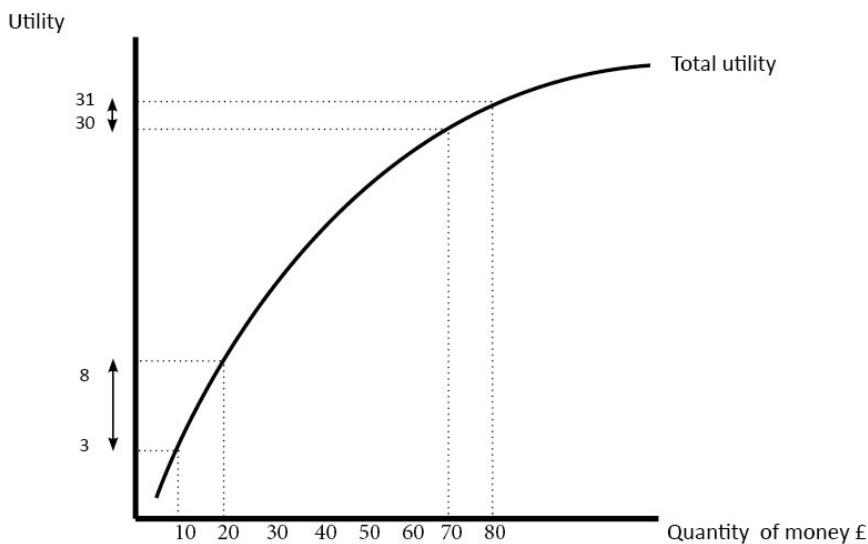
Another important heuristics that it is necessary to discuss is the adjustment and anchoring: people tend to make estimates by starting from an initial value, then they decide the final answer by keeping close to that. To test this heuristic, Tversky and Kahneman asked to some subjects to estimate the percentage of African country which are member of the UN. Before doing that however, they had to spin a wheel of fortune (with number from 1 to 100) and then to say whether the percentage of African countries in the UN is above or below the number obtained from the game. Only after that, they had to say the exact percentage. They discovered that people did consider the number of the wheel of fortune when doing their final estimate: those who obtained 10 gave an average answer of 25%, those who obtained 65 the final average answer was 45%. Even if everybody knew that no correlation there is between the wheel of fortune and the percentage of African nations which are part of the UN, most of the subjects considered the wheel of fortune as an actual variable.

1.2 PROSPECT THEORY

Something really close to the anchoring is a theory developed by Tversky and Kahneman some years later (Prospect Theory: An Analysis of Decision under Risk, 1979): the Prospect Theory. This is a theoretical model related to decisional process that induce people to take sub optimal decisions. The first main assumption of the Prospect theory is that the decision maker interprets an economic result according to its own reference point. People in fact perceive gains or losses with respect to the reference point; an outcome above the reference point is considered a gain, an outcome below it is a loss. Usually the reference point corresponds to the current asset position, so gains and losses coincide with the amount people receive or pay. However, it can change if the decision maker expects something different.

The fact that the vectors of values are the change in wealth rather than final states is coherent with it has been analyzed above: people often take decisions considering factors that should not have any impact on the decision. The fact that one person expects €100 but then he gets only 80, according to the classical economic theory, correspond to a gain of 80. But the one who expected 80 and gets 80 will be better off than the first one, even if they received the same amount of money. The value function explains this behavior. In 1738 Bernoulli, when he still was a student, invented the idea of risk aversion: he theorized that people's happiness increases as they get wealthier but at a decreasing rate. This is the so-called diminishing sensitivity.

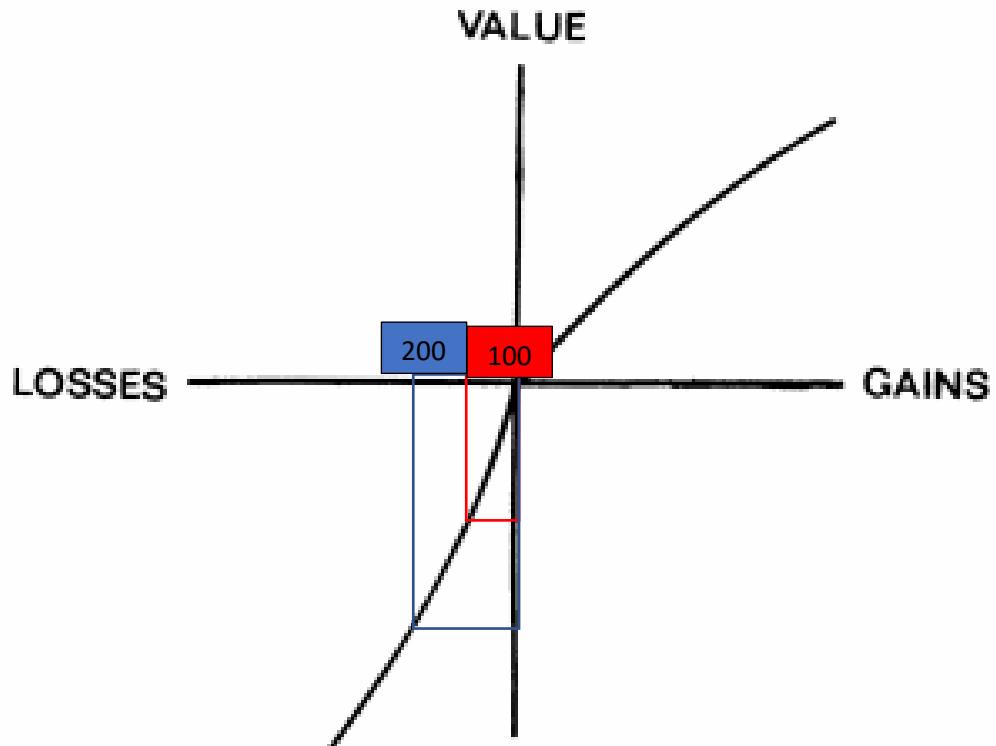
Figure 2: diminishing marginal utility of wealth



This implies that if you offer to a person with a wealth of \$100.000 the choice between a sure win of \$1000 and a 50% win of 2000, this one will select the sure prize. Following Bernoulli studies, Oskar Morgenstern and John von Neumann published in 1944 The Theory of Games and Economic Behavior, a 600 pages book which, among other things, formalized the expected utility theory. So, in 1979 Tversky and Kahneman wanted to expand this theory by trying to formalize how people behave in the real world. and they did it in Prospect Theory: An Analysis of Decision under Risk, published in Econometrica of March 1979. To create a better descriptive model, they recognized as seen before, that it was necessary to change the focus from levels of wealth to changes in wealth (Misbehaving, The Making of Behavioral Economics, Thaler 2015): “*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. Thus, an object at a given temperature may be experienced as hot or cold to the touch depending on the temperature to which one has adapted. The same principle applies to non-sensory attributes such as health, prestige, and wealth. The same level of wealth, for example, may imply abject poverty for one person and great riches for another--depending on their current assets.*” (Prospect Theory: An Analysis of Decision under Risk, Tversky, Kahneman, 1979).

They theorized that value should be considered as function of two arguments: the reference point and the magnitude of change. The difference in gaining 100 or 200 is greater than the difference between 1100 and 1200, and in the same way the difference between a loss of 100 or 200 is greater than the difference between 1200 and 1100: the value function for changes of wealth is concave above the reference point and convex below. Small changes next to the reference point have a greater impact on the utility than changes far from it. Psychologists call this phenomenon “Just noticeable difference”: people experience diminishing sensitivity to changes away from the status quo. This brings to the fact that people are risk averse on gains but risk seeking on losses: as it can be seen in the graph below, the pain of losing the second hundred dollar is lower than the loss of the first hundred dollars. So, people are more willing to risk losing money when they are far from the reference point.

Figure 3: value function



Source: www.researchgate.net

In prospect theory the value of each outcome is multiplied by its weight: the decision weight, for example, of a gamble in which one can win 1000 or nothing depending on a toss of a coin is not 50%. It has been shown in fact that people, because of the risk aversion, tend to accept slightly lower but certain amount than the expected value of the gamble.

It happens something different, however, when the probability of the win (or of loss) is really small: when people were asked to chose between a sure win of 5 dollars and a free lottery ticket that with 0,1% of probability would have given to them \$5000, 72% of the people preferred the lottery ticket. The opposite happens when people are in the domain of losses: they prefer sure but small losses rather than very unlikely but huge wins.

Figure 4: problems survey value function

PROBLEM 14:

$$(5,000, .001), \quad \text{or} \quad (5).$$

$$N = 72 \quad [72]^* \quad [28]$$

PROBLEM 14':

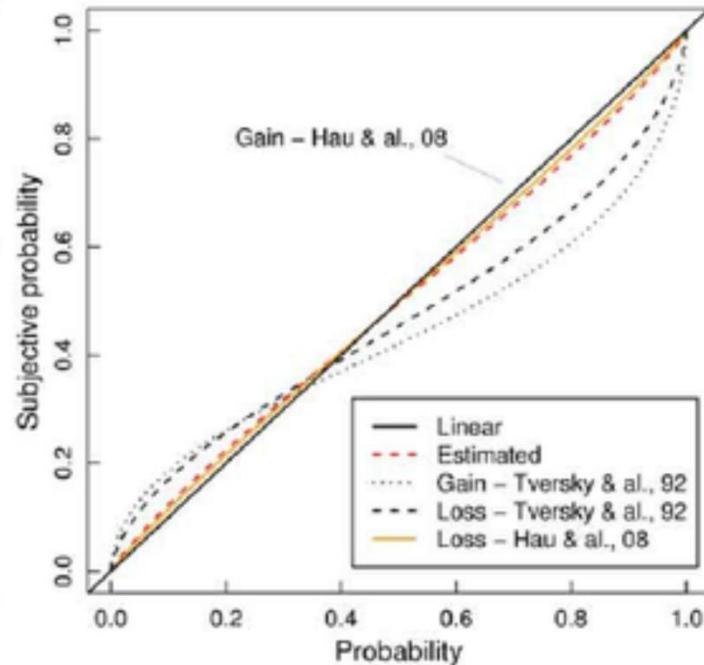
$$(-5,000, .001), \quad \text{or} \quad (-5).$$

$$N = 72 \quad [17] \quad [83]^*$$

Source: Prospect Theory: An Analysis of Decision under Risk, Tversky, Kahneman, 1979

The decision maker in fact tend to overestimate the probability related to unlikely events and underestimate the probability of almost certain events. The difference for the people from a certain win and a 95% probability win is higher than it should be: this is the so-called subjective probability.

Figure 5:subjective probability



Source: From Activity in Inferior Parietal and Medial Prefrontal Cortex Signals the Accumulation of Evidence in a Probability Learning Task, M d'Acremont - 2013

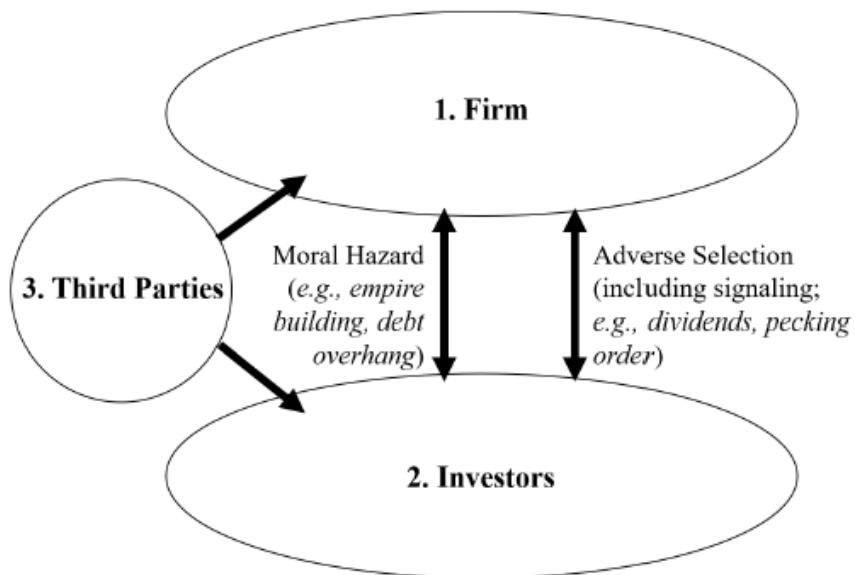
Something similar to the anchoring bias is called confirmation bias: people tend to interpret information in such a way that they confirm the first decision maker preconception. (Behavioral Corporate Finance, Shefrin, 2007). The confirmation trap is very relevant in the field of M&A: directors tend to estimate synergies and focus on irrelevant aspect, with the only purpose of justify the deal. Because of the complexity of all the different tasks that it is necessary to undertake before the completion of the deal, it is easy for the management of the bidding company to find information that confirm their decision of engage the M&A activity. In chapter 2 will be analyzed a specific Merger where there is evidence of how the managers of the bidding company selected only the information in favor of their initial hypothesis.

1.3 BEHAVIORAL CORPORATE FINANCE

In order to understand what exactly behavioral corporate finance is, it is necessary to start from the traditional Corporate Finance, and understand what are all the possible biases observable in that field.

When a firm want to get financing from the investors, it has to overcome two hurdles: moral hazard and adverse selection. The first one regards the relationship between managers and shareholders: even though the purpose of the managers should be to maximize the shareholder's value (Damodaran, Applied Corporate Finance 4th edition, 2014), they tend to maximize their own profit, by undertaking deals not profitable or value destroying projects. This leads to an increase cost of financing for firms where the management's behaviors cannot be directly observed. The adverse selection instead regards the inability for the investors to detect whether an investment opportunity is profitable or not.

Figure 6: Corporate finance in a Nutshell



Source: Behavioral Corporate Finance, Ulrike Malmendier, 2018

So, Behavioral Corporate Finance is a combination of the classical corporate finance and the Behavioral Economics; as stated by Rabin (A perspective on psychology and economics, 2002) behavioral economics is an approach that allows:

1. deviations from rational belief formation,
2. non-standard utility maximization, and
3. imperfect maximization processes due to cognitive limitations.

So, as seen before, both investors and managers may suffer from biases that lead them to wrong decision. Investor biases in the behavioral industrial organization literature have been considered only for the mis-valuation of stocks, not considering all the other biases that affect every day investors. The fact that investors can be too optimistic about the future, may bring, as discussed by Baker and Wurgler (Market Timing and Capital Structure, 2002) in a too cheap equity financing: whenever investors overvalue the firm value, the rate of return they will require will be lower, hence the managers will prefer issuing stocks rather than debt. This may lead to an interesting behavior: since rational managers know exactly the real value of the company, every time they see an overvaluation of it by the investors, they should prefer to issue new equity rather than debt. Myers and Majluf (Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have, 1984) showed that when managers have more information than the investors, external finance is more costly than internal finance.

So, the percentage of debt issued with respect to the equity should be a signal of how overvalued the market is. Baker and Wurgler (The Equity Share in New Issues and Aggregate Stock Returns, 2000) found out that there is a relationship between the total volume of new equity issued and the subsequent market return: when the equity issued is low, in the following years the market will observe higher returns, when the equity issued is high, the returns will be lower. And this is coherent with the theory of the rational managers: after a period of overvaluation, low returns of the stock are natural.

Figure 7: Mean equity returns by Prior Year Equity Share in New Issues, 1928, 1997



Source: *Behavioral Corporate Finance*, Ulrike Malmendier, 2018

From this graph it is possible to see a clear negative relationship between stock returns and the equity share. This relationship may be explained by three non-behavioral factors:

- the leverage effects
- the equity share is related to future returns through investment
- unobserved factors that may change optimal capital structure

For the first possible explanation, Baker and Wurgler (2000) showed that the empirical equity share coefficient is too large to be explained by the leverage effect: the theoretical equity share coefficient explained by the leverage effect is -0,28 while the actual coefficient is between -7,42 and -7,88.

The second possible explanation to this relationship is that if the discount rate falls, firms will increase investment and the equity share may start to increase as well. If in fact firms must keep at a constant fixed level the debt, the only way managers can raise capital is through equity. However Baker and Wurgler found a statistically insignificant relationship between the level of investment and the equity share.

The last possible explanation is that risk may change over time, and so the optimal capital structure; this however should bring to the opposite result it has been observed in practice. When risk increases, the expected returns and the financial distress increase as well; since tax schedules are convex, the extra risk reduces the expected benefit of debt, so the cost of leverage increases and the benefits of it fall. So, the higher is the risk, the higher will be the return, the lower will be the benefit of debt and the higher will be E/V ratio. Also

empirical results confirmed that a change in risk do not explain the negative relationship between stock returns and equity share. So, the only possible explanation of this relationship is, according to Baker and Wurgler, that managers believe that they can time the market.

On the other side, also managers can be biased: for example overconfidence may explain their constantly willingness to merge or the experience effects could explain their investment decision.

A growing literature in corporate finance tries to explain variables like investments, mergers and financing decisions through the role of managers' individual characteristics and biases; in "Managerial Duties and Managerial Biases" (Malmendier and Zheng, January 2018) it has been shown how CEO overconfidence influences financial policies while CFO's behavioral traits are crucial for capital structure decisions.

1.4 PERCEPTION ABOUT RISK AND RETURN

As seen before, corporate managers make estimates and judgments about risk and return, with the purpose to estimate the cost of capital necessary to make decisions about investment and capital structure. On the other side investors make judgments about risk and return to construct portfolio and value securities. The traditional treatment for the risk and return analysis need to consider the Capital Asset Pricing Model, since it provides the underlying theory behind the expected return of the investors. The main assumption about CAPM is that the risk premium of a stock is the product of its beta and the market risk premium. Through this approach, the only factor that measure risk is the market premium: other methods such as the multivariate models take into consideration much more risk factors than CAPM. However almost 75% of the respondents corporate finance managers claimed to use the CAPM to evaluate the goodness of projects (The theory and Practice of Corporate Finance: Evidence from the Field, Graham and Harvey 2001)

But even just considering the Capital Asset Pricing Model, the CFO tend to wrongly consider and estimate the factors of risk that the model considers. According to the Duke University survey about the return expectations of CFO, when they have to estimate the risk premium (which is the difference between the return of the market and the risk free rate), on average, they tend to start from one third to the risk free rate, simply add a fixed premium of 4.9 percent and then add again a 2 percent of the prior year return. The fact that they add (part of) the risk free rate to the market premium means that executive consider the risk free rate negatively correlated with the risk premium: the higher the risk free rate, the lower will be the premium. Another estimate that they systematically fail to forecast correctly is the market volatility: always according to Duke University survey, CFO consider as a good estimate of volatility a value between 4,2% and 8%, while the historical volatility of the S&P 500 has been about 19 percent. This means that they feel too overconfident about the future, and as long as volatility is considered to be a good measure of risk, they systematically underestimate risk.

Another aspect that confirm their inability to correctly asses risk is the fact that during CFO's insider trading activities, they suffer to the gambler's fallacy explained above. In the Duke University survey it has been shown that financial executives tend to hold stock of their firms when they badly perform, and sell the stocks that featured high price appreciation in the previous years.

According to Jenter (Market timing and managerial portfolio decisions, 2005) and Chan, Ikenberry and Lee (Economic Source of Gain in Stock Repurchases, 2004) there is no evidence that firms with inside purchases outperform firms with concurrent inside sales. This, along with the high level of inside purchases in repurchasing firms, is consistent with the fact that managers try to time the market but on average fail to earn excess returns. *“In summary, there is little evidence that managers are able to earn economically significant excess returns with their trades. This could be due to a variety of reasons, among them that insider trades may be driven by motivations other than inside information”* (Jenter, 2002).

1.5 BEHAVIORAL APPROACH TO MARKET EFFICIENCY

1.5.1 *Traditional to behavioral approach to market efficiency*

The risk premium for a stock is defined as the return over the risk free rate that investors expect; any time the a security has a return higher than the risk premium, investors earn a positive abnormal return. According to the traditional framework, any profit opportunities would be exploited by rational investors, giving rise to the arbitrage: the rational investor can, in fact, buy an underpriced security and sell an overpriced one at the same time. By doing that, the market would compensate all the exceptions, and all the arbitrage opportunities due to returns higher than the risk premium, should disappear in the long term. According to Shefrin (Behavioral Corporate Finance, chapter five, 2018) “*The main message from traditional textbook is that corporate managers should trust market prices as far as publicly available information is concerned*”.

1.5.2 *Limits to arbitrage*

However in the real world there are valuation errors, that can bring prices of the securities far from their real value: these errors are known as sentiment, and the inability to eliminate mispricing due to these sentiments is called limits to arbitrage. As pointed out by Barberis and Thaler in 2003 (A survey of behavioral finance, chapter 18 of Handbook of the Economics and Finance) the fact that when prices are right there is no free lunch available, do not imply that when there is free lunch the prices are also right. In fact, arbitrage can be both risky and costly: the first, and obvious, risk arbitrageurs have to face is the fundamental risk. Every time they buy a stock at a certain price, there is always the risk that a bad news comes out and the price of the stock drops: even if they decide to protect themselves buying a stock negatively correlated to the first one, it is impossible to remove all the fundamental risk.

The second risk they have to face is the noise trader risk: when people realize that a stock is underpriced, there is also the chance that future price movements will increase the divergence from the real value. This can force arbitrageurs to liquid too early their position, so not only they do not earn the difference between the stock price and its intrinsic value, but also they have to sell the stock to a price lower than the purchase price (The limits of Arbitrage, Shleifer and Vishny, 1997).

This becomes a problem when most of the arbitrageurs do not use their own money but manage money for other people: when a mispricing that the arbitrageur is trying to exploit get worse, he generates negative returns. So, investors may withdraw their funds due to the belief that he is incompetent, forcing also the arbitrageur to liquidate his position prematurely. With this fear arbitrageurs tend to be less aggressive in fighting the mispricing (Barberis, Thaler, 2003).

The third reason arbitrage are not as effective as economic theory suggest is that transaction cost, and there might be restrictions that forbid for example the short-selling. For example pension and mutual fund managers cannot short sell any security.

Corporate managers can be considered natural candidates to be arbitrageurs, since they should always know the exact value of their company: Muelbreok (An empirical analysis of Illegal insider trading, 1992) and Seyhun (Why does aggregate insider trading predict future stock returns?, 1992) empirically demonstrated the fact that managers have more information about their firms than other investors. But do they exploit this superior information when they have to take managerial decisions? How market inefficiency impact on their ability to effectively arbitrage?

1.5.3 Earning guidance

The underlying intrinsic value of any firm should always be measured by the NPV: the higher is the cash flow, the higher will be the value of a firm. However, according to a survey of 2005 (The economic implications of corporate financial reporting, Graham, Harvey and Rajgopal), CEO consider earning the most important factor in determining the value of a firm.

Table 4: Unconditional averages – most important factors for increasing firm's value

Panel A: Unconditional averages

Measure	#1 Rankings	#2 Rankings	#3 Rankings	Total Points	Average Points
Earnings	159	67	31	642	2.10
Revenues	36	97	75	377	1.24
Cash flows from operations	36	72	93	345	1.13
Free cash flows	30	41	42	214	0.70
Pro forma earnings	38	10	24	158	0.52
Other	7	13	28	75	0.25
EVA	2	4	5	19	0.06

Source: The economic implications of corporate financial reporting, Graham, Harvey and Rajgopal, 2005

CEO in fact consider, as the most important thing for increasing the value of a firm, to meet the expectation of the market about future EPS. Their main goal about earnings is to seek earnings at least equal to the same quarter last year's EPS. By doing that they want to:

- gain credibility on the capital market
- maintain or increase stock price
- increase the reputation of the management team
- transmit future growth prospects

This survey showed how managers take real economic actions to meet short term earning benchmarks: “*One CFO candidly admits that his/her company would defer or eliminate maintenance spending to meet earnings targets, even if such deferment would accelerate the need to replace the asset in the future. The CFO went on to illustrate that retrenching trained personnel might be economically sub-optimal in the long-run, but that his/her company has taken such actions to meet the earnings target. Similarly, another CFO mentioned that his/her firm would perform “band aid” maintenance for several years to protect earnings, even if a decision to take a hit to earnings and refurbish the plant all at once would have been NPV positive.*”

Almost half of the managers interviewed, answered that they prefer avoid initiating a positive NPV project, if by doing so they would miss the expected EPS. These are the answers to the question: “*Your company’s cost of capital is 12%. Near the end of the quarter, a new opportunity arises that offers a 16% internal rate of return and the same risk as the firm. The analyst consensus EPS estimate is \$1.90. What is the probability that your company will pursue this project in each of the following scenarios?*”

Table 5: Unconditional averages - results of survey

Panel A: Unconditional averages		Probability that the project will be pursued: (Percent of respondents indicating)						Average probability of pursuing
EPS if you do not pursue	EPS if you pursue	0%	20%	40%	60%	80%	100%	
\$2.00	\$1.90	4%	4%	5%	10%	32%	45%	80%
\$1.90	\$1.80	10%	14%	10%	20%	28%	18%	59%
\$1.80	\$1.70	14%	12%	13%	21%	22%	17%	55%
\$1.40	\$1.30	20%	13%	12%	15%	20%	19%	52%

Source: The economic implications of corporate financial reporting, Graham, Harvey and Rajgopal, 2005

For example, furniture manufacturer Herman-Miller in 2000 was considering doing a project with a positive NPV; as soon as an accounting issue arose and it was no longer possible to capitalize all the costs of this project, the managers decided not to do it anymore. They admitted that eroding EPS was not acceptable.

Another behavior it is possible to observe is that executives strongly prefer smooth earnings: they not only are perceived as less risky by the investors, but also reassure suppliers and clients about the stability of the business. 78 percent of the executives interviewed said that they would sacrifice some value in order to avoid a bumpy earning path.

Table 6 – answer to survey about sacrifice to avoid bump in earning path

Panel B: Conditional averages		
<i>Response</i>	<i>% of Respondents</i>	<i>obs</i>
none	22.0%	302
small sacrifice	52.0%	302
moderate sacrifice	24.0%	302
large sacrifice	2.0%	302

Source: The economic implications of corporate financial reporting, Graham, Harvey and Rajgopal, 2005

1.5.4 IPO decisions

When there is an IPO, three phenomena often occur: hot issue market, initial underpricing and long term underperformance:

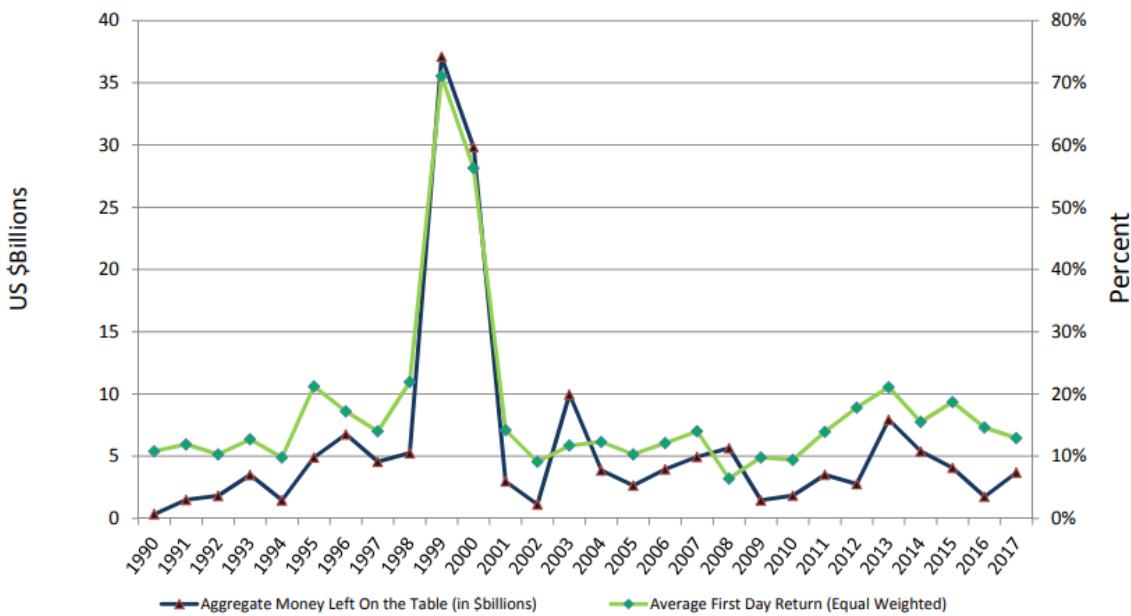
- in hot issue markets, the demand for IPOs is very high
- the initial pricing may be too low, resulting in very high returns the first day of trade
- after the first six months, on average, these firms' stocks start to underperform with respect to comparable shares.

Traditional theory about market timing say that the way managers raise capital does not depend on the market's situation: since the market is efficient, raise capital through IPO in one year or in another, it is irrelevant. However, it has been shown that there is correlation between the number of IPOs and the mean first day return: the higher is the

number of IPOs done in one year, the higher will be probability to face positive returns in the first day of trading (Behavioral Corporate Finance, Shefrin, 2018).

The second really common phenomena is the initial underpricing: on average managers accept to leave money on the table to compensate the risk of the initial buyers. However there is evidence of the presence of bubbling in this effect: during the first years of 2000 the amount left on the table was on average about \$30 per share.

Figure 8 : Average first day return and aggregate money left on the table, 1990-2017



Source: Initial Public Offerings: Underpricing, Ritter, 2018

While one possible explanation to the presence of these waves may be the changing in risk from the investor, behaviorists suggest that the main reason of those fluctuations are agency conflicts (Why has IPO underpricing changed over time? Loughran and Ritter, 2004).

The anchoring and adjustment heuristics and the prospect theory come in our help in order to understand why shareholders are so willing to leave so much money on the table: every time the CEOs accept an offer price, they already consider that value as their reference point. So, every price above the offer price is considered to be a gain: due to the average positive return on the first day of trading, both investors and CEOs are satisfied.

Another explanation to this phenomenon is the agency conflict of investment banks responsible of the underwriting of the stock: underwriters can allocate hot IPO shares (likely to have high returns in the first days of trading) to clients which do a lot of business

with them. Underwriters in fact not only charge fees to the firm that wants to go public, but they often keep the price low in order to gain favor from their closest investors.

So, market efficiency can fail in certain circumstances seen before: it is not true that prices are always correct and that arbitrage opportunities are possible in any situation. It has been showed that arbitrage can be costly and limited, and that the degree to which a security is mispriced is due to the sentiment beta. We have seen how both investors and managers can incur in biases that can bring them to sub-optimal decisions, far from the optimal.

2. MERGERS AND ACQUISITION

2.1 INTRODUCTION AND THEORY ABOUT VALUATION AND M&A

2.1.1 *Traditional approach to valuation*

The two most common approach to valuation is intrinsic valuation (DCF model) and valuation by comparables (ratios such as P/E and P/S). The intrinsic value of a firm is the present value of all the future expected cash flows discounted by the cost of capital of the firm. it is common to divide the cash flow in two or more horizons: the intermediate horizon and the terminal horizon. There are three ways to obtain the value of the equity of a certain firm: the first one consists on subtracting the firm's debt to the firm value obtained before with the DCF mode. The second possible way is to use the dividend discount method, where the value of the equity is given by the present value of the future expected dividends. The third way to compute the value of the equity is through the formula $\frac{E_1}{K_E} + PVGO$, where PVGO stands for Present Value of Growth Opportunities.

The valuation by comparables instead focuses on how each characteristics of the firm is valued from the market: for example P/E is the ratio between the price of the stock and the earnings estimated for the next year. It indicates how many times a certain equity is valued over the earnings that the firm is able to generate. Other indices as Price to sales, market to book ratio and price to cash flow are also used in the valuation by comparables.

Mergers and acquisitions are transactions where the ownership of companies are transferred and two entities become one. There are three types of possible mergers: horizontal, vertical and conglomerate mergers. Horizontal mergers consist on a combination of two firms in the same line of business; one example it can be the HP-Compaq merger that will later be analyzed. Vertical mergers instead involve companies in the same line of business but at different stages of production: the 2008 acquisition of Tele Atlas by Tom Tom is an example of how the world's largest maker of car navigation devices wanted to directly use and exploit Tele Atlas maps in order to provide real time updates to sat-nav systems. Conglomerate mergers instead involve companies at different and unrelated lines of business; this type of business was quite popular during the 60s and 70s mainly due to the diversification myth.

The main purpose of M&A is to create efficiencies with a positive impact on the overall economy; synergies in fact are often the real justification behind the M&A decisions.

Synergies can impact in different way: in horizontal mergers synergies comes from economies of scale which reduce costs or increase market power. The primary source of synergies in vertical mergers comes from a higher control of the supply chain: vertical integration, even though it sometimes can be very inefficient, facilitates to coordinate the production process. However, companies have found outsourcing a better and more efficient way to obtain services and various types of production.

Another reason for merger it can be the presence of complimentary resources that both the companies need to have: for example small firms with unique product but with lack of organization and engineering may find convenient to merge with a bigger firm with the organization needed to make that product profitable. This is a very common reason to merge in the pharmaceutical industry.

Industries where there are too many companies and too much capacity seem to trigger waves of mergers and acquisitions: one example it is the banking sector. Both in the US during the 80s and in Europe during the past 20 years there have been many waves of bank mergers due to companies that wanted to reduce costs (Where do merger gains come from? Bank Merger from the perspective of insiders and outsiders, Houston, James, Ryngaert, 2001) and starting operating successfully all around the world.

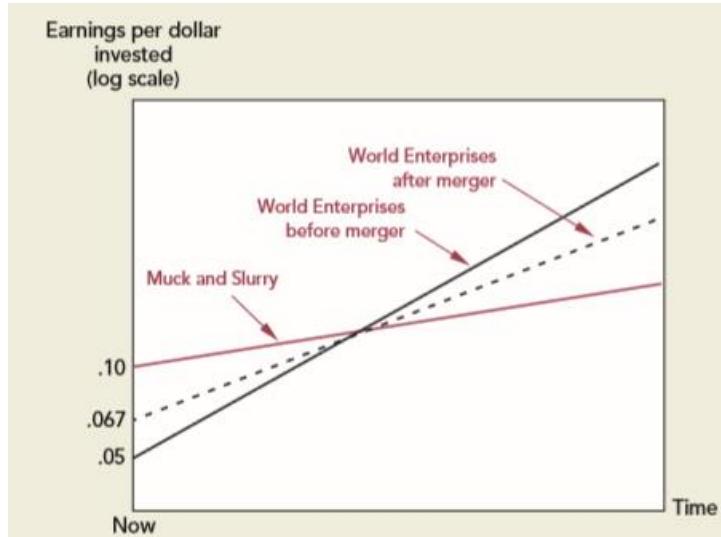
But not all the reason for merging have economic sense: as it has been shown in the first chapter, both investors and managers are not fully rational and tend to systematically face the same heuristics. The first reason why executives of a firm may be willing to merge, could be the fact that in most of the acquisitions the earning per share increases, even though there are no economic gains in the deal.

Table 7 : example of the impact of merger on EPS

	World Enterprises before Merger	Muck and Slurry	World Enterprises after Merger
1. Earnings per share	\$2.00	\$2.00	\$2.67
2. Price per share	\$40	\$20	\$40
3. Price-earnings ratio	20	10	15
4. Number of shares	100,000	100,000	150,000
5. Total earnings	\$200,000	\$200,000	\$400,000
6. Total market value	\$4,000,000	\$2,000,000	\$6,000,000
7. Current earnings per dollar invested in stock (line 1 ÷ line 2)	\$.05	\$.10	\$.067

The price per share in fact, after the merger in theory remains the same, but earnings increase: this is the so-called the bootstrap effect, since there is no economic gain generated by the merger and the two firms' combined value does not increases.

Figure 9: impact of merger in EPS after the deal



Source: *A Framework for evaluating mergers*, S.C. Myers, 1976

Another reason why mergers are so common is that they help to reduce the cost of borrowing even though there is no real economic reason behind this: if two companies which have \$50 million of debt merge, their new cost of debt will be lower. In fact, when both companies are separated one cannot pay the other loan, so if one of the two runs out of money it cannot repay the debt. When, instead, they are merged, both entities can pay the other's loan. But on the other side, if shareholders gain from lower interest rate, they lose by having to guarantee each other's debt.

2.1.2 Estimating merger gains and costs

A merger generate a gain if and only if two firms are worth more together tan apart:

$$Gain = PV_{AB} - (PV_A + PV_B) = \Delta PV_{AB}$$

If the gain is higher than zero, merger it can be justified if the price paid is lower than this gain:

$$Cost = cash paid - PV_B$$

$$NPV = \Delta PV_{AB} - (cash - PV_B)$$

In other words, the overprice spent for the firm must be lower than the synergies the merger generate (ΔPV_{AB}).

Some companies when they want to analyze whether a certain merger it can be profitable, start with the forecast of the target firm's future cash flow: any revenue increases or cost reduction directly due to the merger are considered in the forecast. But, according to Brealey, Myers, Allen (Principles of Corporate Finance, tenth edition, 2011), this is a dangerous procedure: the estimated gain may be positive because of a too optimistic cash flow forecast of the analysts. The right procedure starts with identifying the market value of the target company, and only then focus on how cash flow of the acquiring company would change

2.2 STUDY OF A MERGER (HP-COMPAQ)

2.2.1 Introduction

In May 2002 Hp acquired Compaq in one of the most famous and controversial takeover of the last years. The family foundation of the founders Hewlett and Packard opposed to the merger, while the CEO Carleton Fiorina was sure that this operation would have benefit the company in several ways.

It is necessary however, to explain the brief history of how they came up with the decision of undertake the merger with Compaq and how healthy the different segments of HP were. In 1999 HP had 3 main business segments: enterprise computing and services for businesses, personal computers and imaging and printing. The executives taught that the first segment was no more able to adapt to consumers' needs and in order to solve this problem many investments were needed. The second sector was instead far from being profitable, had an operating margin close to zero, far from the 7% of Dell Computer. Imaging and printing were by far the most profitable sector of the company, in fact it generated more than 118% of its overall operating profit. Even here, however, the board believed that in order to remain competitive there were needed several investments.

While the easiest way to make HP profitable again (HP missed earning targets in the last quarter of 2000) could have been to exit from the PC business, the board started to think about a major acquisition to confront industry leader IBM more effectively. Both IBM and Dell were gaining momentum, while HP was trudging. The board started thinking about Kodak, Apple Computer and PricewaterhouseCooper (Pwc) as possible targets for a merger, all of them however have been rejected. In June 2001 HP Ceo Fiorina contacted Compaq Computer CEO to explore the possibility of licensing some Compaq technology; this discussion later became a conversation about a possible merger.

When Fiorina explained the idea to the board, only three of the directors were interested in this merger; HP director Sam Ginn was concerned that after that acquisition HP would have been even more dependent to the least profitable sector (for both HP and Compaq), which was PC business. McKinsey consultants estimated \$2.5 billion a year in cost saving, which led many executives to be in favor of this operation. According to "Perfect enough: Carly Fiorina and the reinvention of Hewlett Packard" (G. Anders, 2003) in order to obtain the support of the whole board, she gave to each director a sheet of paper with the following three questions:

1. “Do you think the information-technology industry need to consolidate, and, if so, is it better to be a consolidator or a consolidate?”
2. How important is it to our strategic goals to be Number 1 or Number 2 in our chief product categories?
3. Can we achieve our strategic goals without something drastic?”

This is one of the main aspects which is interesting to analyze for this merger: Carly Fiorina’s questions were posed in such a way that HP executives felt themselves in the domain of losses. As seen before, when a subject is in the domain of losses, he is more willing to seek the risk and come back in the domain of gains. By asking whether it was better to be number 1 or number 2, since it was known that HP was becoming more and more less competitive, Fiorina convinced the executives that they were in the domain of losses (their reference point was being number one in the market). In such a mental state they were more risk seeking, and ready to undertake unnecessary risks.

The next day almost all the executives changed their opinion about the merger: Sam Ginn who was before doubtful about the benefit of this operation, after these questions, she supported the merger indicating that the main goal of HP was to compete with IBM and a merger with Compaq would have helped.

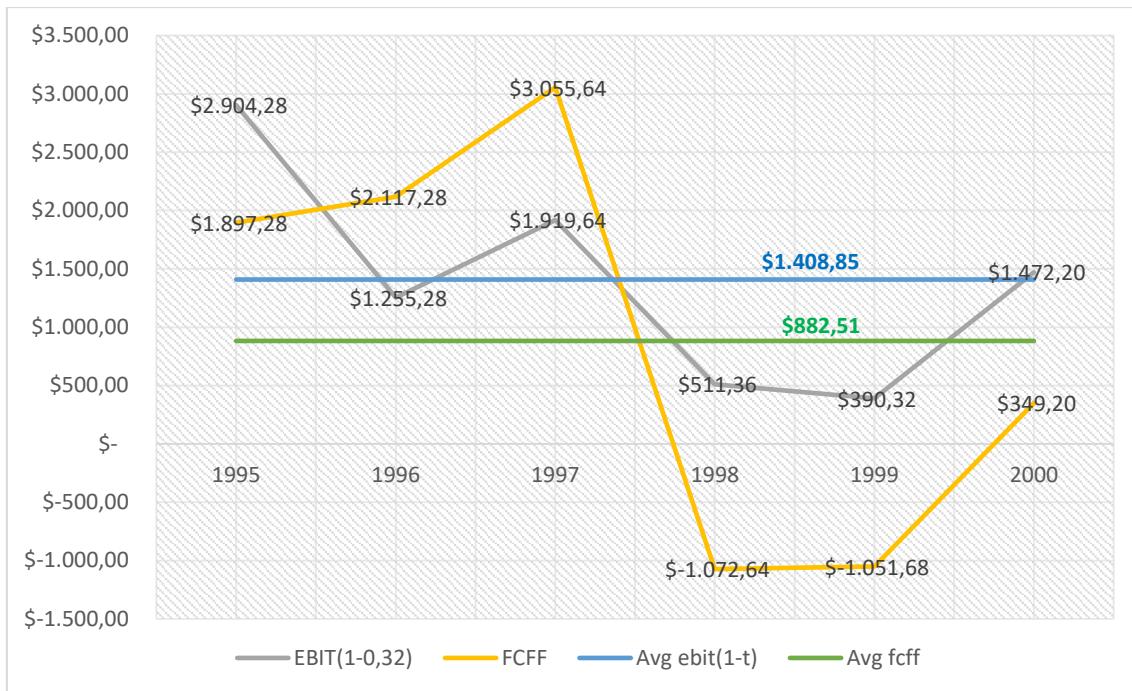
In September 2001 HP and Compaq signed an agreement consisting of a stock-for-stock merger: every Compaq stock would be equivalent to 0.6325 of an HP share.

2.2.2 Valuation

In order to obtain the value of the merger, it is necessary to make the Discounted Cash Flow valuation for both companies involved and then evaluate the merged company to find out whether the merger was profitable or not. First of all I calculated the value of Compaq.

Since the annual report of the last available year (ended in December 2000) both for Compaq and HP is not fully representative of the real value of the firm, I took the average values from 1995 to 2000. In fact during these years there have been many oscillations (due to different acquisitions made by Compaq and HP or small crisis period), and to find a single value that could fully represent the value of the firm it was necessary to take many years.

Figure 10 Compaq's EBIT and FCFF fluctuations



Source: Compaq annual reports from 1995 to 2001

Now it is necessary to estimate the Free Cash Flow to the Firm for the future: as reported in “Applied Corporate Finance” (Damodaran 4th edition, 2014), I calculated this value as the EBIT(1 – tax rate) plus Depreciation and Amortization, plus (or minus) the variation in the net working capital and minus the capital expenditure. All the values have been found in the 2001 annual report of Compaq, both in the consolidated statement of income and in the consolidated statement of cash flow. The tax rate I have considered for this analysis is the 32%, as stated in the overview section of the annual report (“The effective tax rate was 32 percent for the year ended December 31, 2000”). The reinvestment rate is calculated as the ratio between the FCFF and the EBIT(1-t).

Table 8 : FCF calculation for Compaq

	95	96	97	1998	1999	2000	AVG
Revenue	\$ 16.675,00	\$ 20.009,00	\$ 24.584,00	\$ 31.169,00	\$ 38.525,00	\$ 42.383,00	\$ 28.890,83
Cost	\$ 12.291,00	\$ 14.855,00	\$ 17.833,00	\$ 23.980,00	\$ 29.798,00	\$ 32.417,00	\$ 21.862,33
Adm+R&d	\$ -	\$ 3.202,00	\$ 3.764,00	\$ 6.262,00	\$ 8.001,00	\$ 7.513,00	\$ 4.790,33
EBITDA	\$ 4.384,00	\$ 1.952,00	\$ 2.987,00	\$ 927,00	\$ 726,00	\$ 2.453,00	\$ 2.238,17
Interest	\$ 113,00	\$ 106,00	\$ 164,00	\$ 175,00	\$ 152,00	\$ 288,00	\$ 166,33
EBIT	\$ 4.271,00	\$ 1.846,00	\$ 2.823,00	\$ 752,00	\$ 574,00	\$ 2.165,00	\$ 2.071,83
EBIT(1-0,32)	\$ 2.904,28	\$ 1.255,28	\$ 1.919,64	\$ 511,36	\$ 390,32	\$ 1.472,20	\$ 1.408,85
D&A	\$ 384,00	\$ 483,00	\$ 545,00	\$ 893,00	\$ 1.402,00	\$ 3.163,00	\$ 1.145,00
NWC	\$ -508,00	\$ 1.958,00	\$ 859,00	\$ -808,00	\$ -375,00	\$ -3.055,00	\$ -321,50
Capex	\$ 883,00	\$ 1.579,00	\$ 268,00	\$ 1.669,00	\$ 2.469,00	\$ 1.231,00	\$ 1.349,83
Reinv rate	0,653270346	1,686699382	1,591777625	-2,097622028	-2,694404591	0,237196033	0,626408362
FCFF	\$ 1.897,28	\$ 2.117,28	\$ 3.055,64	\$ -1.072,64	\$ -1.051,68	\$ 349,20	\$ 882,51

Source: Compaq annual reports from 1995 to 2001

Secondly, I calculated the weighted average cost of capital (Wacc). To calculate that, it was necessary to know the risk-free rate in that period, the Beta of the stock, the debt to equity ratio, the cost of debt for Compaq and the equity risk premium. According to the HP annual report, the 10-year yield of US Treasury bond in 2001 was 5,1 (<http://www.multpl.com/10-year-treasury-rate/table/by-year>) . For calculating the beta first of all it is necessary to calculate the monthly return both for the Compaq stocks and for the S&P 500 from September 1996 to August 2001 (5-year monthly beta, as stated in “Principles of Corporate Finance” (Brealey, Myers, Allen, 2010)) and then find calculate it through the “SLOPE” function on excel. Otherwise it is possible to calculate the Beta as the ratio between the covariance between the return of the stock with the return of the index, and the variance of the index. However, since the data about Compaq stock price are no more available, I used the Beta considered by Yahoo Finance as of August 2001 which is equal to 1.39 (http://pages.cs.wisc.edu/~anhai/wisc-si-archive/data/company_profiles/yahoo/instances/company-index/Technology/Computer_Hardware/instances/http:%5E%5Ebiz.yahoo.com%5Ep%5Ec%5Ecpq.html).

For the debt to equity ratio, I used the market value for both: the debt was equal to \$1.128 billion while the market value of the equity before the announcement was \$21.513 billion (\$12.35*1.742.000.000 shares). For the debt calculation, I only used long term debt and postretirement benefits, since the cash and the short-term assets (such as trade receivables) were higher than current liabilities; in fact according to the Moody’s rating

report of 28th July 2000 “The company's commercial paper is fully supported by a sizable backup credit facility, which contains no material adverse change clause” (https://www.moodys.com/research/MOODY'S-RATES-COMPAQ-COMPUTERS-LONG-TERM-DEBT-Baa2-AND-CONFIRMS--PR_38591) . As stated in the 2001 annual report, Compaq just issued \$575 million of unsecured notes at a weighted average interest rate of 7.55% which is compatible with the risk free rate of that period: in fact the Moody's rating as of September 2001 (https://www.moodys.com/research/MOODY'S-LOWERS-LONG-TERM-RATINGS-OF-HEWLETT-PACKARD-SENIOR-TO--PR_48678) was Baa2, that on average brings to a cost of debt 200 basis point higher than the risk free rate. The cost of debt taken into account for this analysis then, was then 7.55%.

The equity risk premium, which is the difference between the return of the market and the risk free rate, can be calculated in many ways: it can be computed through an historical average of past returns, the dividend discount model or some surveys given to the investors in order to capture their feelings about the future. According to Damodaran the advantage of the dividend discount model is that “it is market-driven and forward-looking and does not require any historical data. In addition, it will change in response to changes in market conditions”, so I considered this method to calculate the equity risk premium, which for 2001 is equal to 4,4% according to a 2006 JP Morgan report (<https://www.jpmorgan.com/jpmpdf/1320675769380.pdf>).

Table 9: WACC calculation for Compaq

Risk free rate	5,10%
Equity risk premium	4,40%
Beta	1,39
Debt	\$ 1.128.000.000,00
Equity	\$ 21.513.000.000,00
Cost of debt	7,55%
Cost of equity	11,22%
WACC	10,91%

Source: Compaq annual reports from 1995 to 2001

Now it is necessary to compute the return on capital, in order to estimate the possible expected growth in the future for Compaq: the expected growth rate in fact, for firms that expect to maintain the current return on capital over time, is equal to the product of the reinvestment rate and the return on capital.

$$\text{Expected growth}_{EBIT} = \text{Reinvestment rate} * \text{Return on capital}$$

$$\text{Reinvestment rate} = \frac{\text{Capital expenditure} - \text{Depreciation} + \Delta \text{Noncash WC}}{\text{EBIT}(1 - \text{Tax rate})}$$

$$\text{Return on capital} = \frac{\text{EBIT}(1 - t)}{(\text{BV of equity} + \text{BV of debt} - \text{Cash})}$$

Since these values need to be forward-looking, even here I took the average of the years considered before to calculate the return on capital. So, the average return on capital for Compaq is equal to 8.45%. Now to find out the expected growth rate I multiplied this value with the reinvestment rate which is equal to 62.64%.

$$\text{Expected growth}_{EBIT} = 0.6264 * 0.0845 = 0.05291 = 5.29\%$$

I considered for this analysis a two-period growth rate: for the first five years the growth rate is equal to the product of the reinvestment rate and the return on capital. Then, I considered as long-term growth rate, the product of retention rate and return on invested capital. This product is useful in long term analysis since it represents the amount of earnings kept into the firm, multiplied by the return they generate. Even here I considered the average of the period from 1995 to 2000, in order to stay coherent with the computations made before.

$$\text{Expected growth}_{Long\ term} = \text{Retention rate} * \text{Return on invested capital}$$

$$\text{Retention rate} = \frac{(\text{Net income} - \text{Dividends})}{\text{Net income}}$$

$$\text{Return on invested capital} = \frac{\text{Net income} - \text{Dividends}}{\text{Equity} + \text{Liabilities}}$$

$$\text{Expected growth}_{Long\ term} = 91.17\% * 4.15\% = 0.0378 = 3.78\%$$

Table 10 : Expected growth rate in long term for Compaq

	95	96	97	98	99	2000	Average
Net income	\$ 789,00	\$ 1.318,00	\$ 1.855,00	\$ -2.743,00	\$ 569,00	\$ 569,00	\$ 392,83
Dividends	\$ -	\$ -	\$ 23,00	\$ 95,00	\$ 144,00	\$ 170,00	\$ 72,00
Equity	\$ 4.614,00	\$ 7.290,00	\$ 9.429,00	\$ 11.351,00	\$ 14.834,00	\$ 12.080,00	\$ 9.933,00
Equity+liability	\$ 7.294,00	\$ 12.331,00	\$ 14.631,00	\$ 23.051,00	\$ 27.277,00	\$ 24.856,00	\$ 18.240,00
tru	1	1	0,987601078	1,034633613	0,746924429	0,701230228	0,911731558
roic	0,1081711	0,106885086	0,125213588	-0,123118303	0,015580892	0,016052462	0,041464138
g (roic)	0,1081711	0,106885086	0,123661074	-0,127382335	0,011637749	0,011256472	0,037804163

Source: Compaq annual reports from 1995 to 2001

Since for long term I only considered the Terminal Value period, from 2006 to 2010 the growth rate decays constantly from 5.29% to 3.78%. The long term growth rate is consistent the PVGO requirements.

Table 11: discounted cash flows for Compaq from 2001 to terminal period

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Terminal value
Growth rate	0,05291	0,05291	0,05291	0,05291	0,05291	0,04989	0,04687	0,04385	0,04083	0,03780	0,03780
Ebit(1-t)	\$ 1.483,3	\$ 1.561,8	\$ 1.644,5	\$ 1.731,5	\$ 1.823,1	\$ 1.914,1	\$ 2.003,8	\$ 2.091,6	\$ 2.177,0	\$ 2.259,3	\$ 2.344,8
FCFF	\$ 929,21	\$ 978,38	\$ 1.030,1	\$ 1.084,6	\$ 1.142,0	\$ 1.199,0	\$ 1.255,2	\$ 1.310,2	\$ 1.363,7	\$ 1.415,3	\$ 1.468,8
DFCF	\$ 837,78	\$ 795,32	\$ 755,01	\$ 716,74	\$ 680,41	\$ 644,07	\$ 607,91	\$ 572,13	\$ 536,90	\$ 502,37	\$ 7.309,61
	1,10913	1,23016	1,36441	1,51331	1,67846	1,86163	2,06479	2,29012	2,54004	2,81724	2,817241

Source: Compaq annual reports from 1995 to 2001

The sum of all the discounted cash flows for these years plus the terminal value is equal to \$13.958,25.

In order to obtain the equity value, it is necessary to subtract from this sum the total debt of the firm and add its cash.

$$\begin{aligned} \text{Equity value} &= \text{Sum of DFCF} + \text{Terminal value discounted} + \text{Cash} \\ &\quad - \text{Total debt} \end{aligned}$$

$$\text{Equity value} = 13.958,25 + 1.128,00 - 2.569,00 = \$ 15.399,25$$

I then performed a sensitivity analysis in order to find a confidence interval: I considered a range for the long term growth rate from 2,78% to 4,78% and a range for the wacc from 9,99% to 11,91% (+/- 50 basis point for both)

Table 12: sensitivity analysis about firm's value

Sensitivity analysis					
	0,027804163	0,032804163	0,037804163	0,042804163	0,047804163
0,099129879	\$ 14.622,43	\$ 15.383,79	\$ 16.269,00	\$ 17.311,05	\$ 18.555,76
0,104129879	\$ 13.641,13	\$ 14.285,30	\$ 15.026,32	\$ 15.887,89	\$ 16.902,11
0,109129879	\$ 12.781,05	\$ 13.331,20	\$ 13.958,25	\$ 14.679,58	\$ 15.518,25
0,114129879	\$ 12.021,09	\$ 12.494,85	\$ 13.030,45	\$ 13.640,92	\$ 14.343,17
0,119129879	\$ 11.344,81	\$ 11.755,76	\$ 12.217,04	\$ 12.738,56	\$ 13.332,96

Table 13: sensitivity analysis about equity value

Equity value					
	0,02780416	0,032804163	0,03780416	0,04280416	0,04780416
0,099129879	\$ 16.063,43	\$ 16.824,79	\$ 17.710,00	\$ 18.752,05	\$ 19.996,76
0,104129879	\$ 15.082,13	\$ 15.726,30	\$ 16.467,32	\$ 17.328,89	\$ 18.343,11
0,109129879	\$ 14.222,05	\$ 14.772,20	\$ 15.399,25	\$ 16.120,58	\$ 16.959,25
0,114129879	\$ 13.462,09	\$ 13.935,85	\$ 14.471,45	\$ 15.081,92	\$ 15.784,17
0,119129879	\$ 12.785,81	\$ 13.196,76	\$ 13.658,04	\$ 14.179,56	\$ 14.773,96

The value of Compaq according to the DCF model is between \$ 12.785,81 and \$ 19.996,76.

To calculate the equity value for HP, in order to stay coherent with the analysis made before, as reference values, I took the 5-year average from 1997 to 2001

Table 14: FCFF calculation for HP

	1997	1998	1999	2000	2001	AVG
Revenue	\$ 35.465,00	\$ 39.419,00	\$ 42.371,00	\$ 48.870,00	\$ 45.226,00	\$ 42.270,20
Cost	\$ 24.524,00	\$ 27.790,00	\$ 29.888,00	\$ 35.046,00	\$ 33.474,00	\$ 30.144,40
Adm+R&d	\$ 7.536,00	\$ 8.962,00	\$ 8.665,00	\$ 9.799,00	\$ 10.313,00	\$ 9.055,00
EBITDA	\$ 3.405,00	\$ 2.667,00	\$ 3.818,00	\$ 4.025,00	\$ 1.439,00	\$ 3.070,80
Interest		\$ 910,00	\$ 345,00	\$ 356,00	\$ 266,00	\$ 445,50
EBIT	\$ 3.405,00	\$ 1.757,00	\$ 3.473,00	\$ 3.669,00	\$ 1.173,00	\$ 2.695,40
EBIT(1-0,32)	\$ 2.315,40	\$ 1.194,76	\$ 2.361,64	\$ 2.494,92	\$ 797,64	\$ 1.832,87
D&A	\$ 1.144,00	\$ 1.377,00	\$ 1.146,00	\$ 1.241,00	\$ 1.369,00	\$ 1.255,40
NWC	\$ -57,00	\$ 1.806,00	\$ -1.381,00	\$ -841,00	\$ 576,00	\$ 20,60
Capex	\$ 2.572,00	\$ 608,00	\$ 628,00	\$ 1.371,00	\$ 549,00	\$ 1.145,60
Reinv rate	0,359	3,155	0,635	0,611	2,750	\$ 1,071
FCFF	\$ 830,40	\$ 3.769,76	\$ 1.498,64	\$ 1.523,92	\$ 2.193,64	\$ 1.963,27

Source: HP annual reports from 1997 to 2001

Then I calculated the weighted average cost of capital. All the data regarding the market (risk free rate and equity risk premium) are the same as for Compaq. For calculating the beta of HP stock, I considered the monthly return of HP stock from 1996 to 2001; I then used the “slope” function on Excel in order to find the Beta.

Figure 11: Beta calculation for HP



Source: HP monthly returns from 1996 to 2001 from Yahoo finance

For the WACC calculation I considered, as for Compaq, only the long term debt since the current liabilities were largely covered by current and liquid assets. As before, I calculated the market value of it.

Table 15: Debt analysis for HP

Debt	Maturity	Interest	Weight	Avg maturity	Avg int rate
\$ 1,496,00	2005	7,150%	0,47311828	1,892473118	3,3828%
\$ 673,00	2006	5,250%	0,21283997	1,064199873	1,1174%
\$ 465,00	2017	3,130%	0,14705882	2,352941176	0,4603%
\$ 528,00	2003	5,705%	0,16698292	0,333965844	0,9526%
				5,643580013	5,9131%

Source: HP annual reports from 1997 to 2001

These are the debts explained in the annual report with maturity and interest rate; I found an average interest rate and an average maturity and calculate through these a market debt value for all the long term debt and “other liabilities”. In order to calculate that I considered, as stated in “Applied corporate finance” (Damodaran, 2014), the entire debt as a coupon bond, with the coupon equal to the interest paid in the last year and the maturity equal to the face value weighted average maturity of the debt.

$$\text{Estimated market value of debt} = \text{interest} * \left(\frac{1 - \frac{1}{(1 + \text{interest rate})^{\text{maturity}}}}{\text{interest rate}} \right) + \frac{\text{book value of debt}}{(1 + \text{interest rate})^{\text{maturity}}}$$

$$\text{Estimated market value of debt} = 266,000,000 * \left(\frac{1 - \frac{1}{(1.059)^{5.64}}}{0.059} \right) + \frac{4,667,000,000}{(1.059)^{5.64}} = \$ 4,620,329,410.02$$

For the market value of the equity I just multiplied the number of stocks outstanding, for the price of them at the day of the announcement of the merger. So the market price of the equity was equal to \$35.3 billion.

For the cost of debt, I considered the average interest rate considered in the analysis of the market value of debt.

Table 16: WACC calculation for HP

Risk free rate	5,10%
Equity risk premium	4,40%
Beta	1,338
Debt	\$ 4.620.000.000,00
Equity	\$ 35.500.000.000,00
Cost of debt	5,91%
Cost of equity	10,99%
WACC	10,38%

Source: HP annual reports from 1997 to 2001

To compute the return on capital I considered, as always in this analysis, the five-year average from 1997 to 2001.

Table 17: return on capital calculation for HP

	1997	1998	1999	2000	2001	AVG
D+E	\$ 31.749,00	\$ 31.708,00	\$ 35.297,00	\$ 34.009,00	\$ 32.584,00	\$ 33.069,40
Cash	\$ 3.072,00	\$ 4.046,00	\$ 5.411,00	\$ 3.415,00	\$ 4.197,00	\$ 4.028,20
EBIT(1-t)	\$ 2.315,40	\$ 1.194,76	\$ 2.361,64	\$ 2.494,92	\$ 797,64	\$ 1.832,87
Return on capital	8,07407%	4,31914%	7,90216%	8,15493%	2,80988%	6,31128%

Source: HP annual reports from 1997 to 2001

So, the expected growth rate in the short term is equal to:

$$\text{Expected growth}_{EBIT} = 1.071 * 0.0631 = 0.0676 = 6.76\%$$

The short-term period, as considered in the analysis for Compaq, is only the first 5 years. After these 5 years the growth rate gradually declines to the long term expected growth rate.

Table 18: long term growth rate for HP

	1997	1998	1999	2000	2001	AVG
Net income	\$ 3.119,00	\$ 2.945,00	\$ 3.491,00	\$ 3.697,00	\$ 408,00	\$ 2.732,00
Dividends	\$ 532,00	\$ 625,00	\$ 650,00	\$ 638,00	\$ 621,00	\$ 613,20
Equity	\$ 16.155,00	\$ 16.919,00	\$ 18.295,00	\$ 14.209,00	\$ 13.953,00	\$ 15.906,20
Equity+liability	\$ 31.749,00	\$ 31.708,00	\$ 35.297,00	\$ 34.009,00	\$ 32.584,00	\$ 33.069,40
tru	82,943%	78,778%	81,381%	82,743%	-52,206%	54,728%
roic	8,148%	7,317%	8,049%	8,995%	-0,654%	6,371%
g (roic)	6,758%	5,764%	6,550%	7,442%	0,341%	5,371%

Source: HP annual reports from 1997 to 2001

Since the long-term growth rate is too high, I consider as the growth rate for the terminal value computation, the 10-year average GDP growth rate (from 1992 to 2001) for US economy, which is equal to 3.55%. It is not possible in fact, that a company in the long term can growth more than the economy. The long-term growth rate is consistent the PVGO requirements.

Table 19 Discounted free cash flow for HP from 2001 to terminal period

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Terminal value	
Growth rate	0,0676	0,0676	0,0676	0,0676	0,0676	0,0648	0,0620	0,0593	0,0565	0,0537	0,0355	
Ebit(1-t)	\$ 1.956,78	\$ 2.089,06	\$ 2.230,29	\$ 2.381,07	\$ 2.542,03	\$ 2.706,82	\$ 2.874,77	\$ 3.045,15	\$ 3.217,18	\$ 3.389,98	\$ 3.510,32	
FCFF	2.096,00	2.237,69	2.388,97	2.550,47	2.722,89	2.899,40	3.079,29	3.261,80	3.446,06	3.631,16	\$ 3.760,07	\$ 55.067,79
DFCF	\$ 1.898,92	\$ 1.836,68	\$ 1.776,48	\$ 1.718,26	\$ 1.661,94	\$ 1.603,29	\$ 1.542,67	\$ 1.480,45	\$ 1.417,03	\$ 1.352,75		\$ 20.514,91
	1,1038	1,2183	1,3448	1,4843	1,6384	1,8084	1,9961	2,2032	2,4319	2,6843		2,6843

The sum of all the discounted cash flows for these years plus the terminal value is equal to \$ 36.803,39.

In order to obtain the equity value, it is necessary to subtract from this sum the total debt of the firm and add its cash.

$$\begin{aligned} \text{Equity value} = & \text{ Sum of DFCF} + \text{Terminal value discounted} + \text{Cash} \\ & - \text{Total debt} \end{aligned}$$

$$\text{Equity value} = 36.803,39 + 4.197,00 - 4.620,00 = \$ 36.380,39$$

I then performed the sensitivity analysis: I considered a range for the long term growth rate from 4,37% to 6,37% and a range for the wacc from 9,38% to 11,38% (+/- 50 basis point for both)

Table 20: sensitivity analysis about firm's value of HP

Sensitivity analysis					
Wacc / growth rate	0,04371269	0,048712686	0,053712686	0,058712686	0,063712686
0,09378068	\$ 42.568,19	\$ 42.985,90	\$ 43.407,94	\$ 43.834,33	\$ 44.265,11
0,09878068	\$ 39.095,71	\$ 39.467,29	\$ 39.842,70	\$ 40.221,97	\$ 40.605,13
0,10378068	\$ 36.134,61	\$ 36.467,29	\$ 36.803,39	\$ 37.142,93	\$ 37.485,94
0,10878068	\$ 33.580,13	\$ 33.879,64	\$ 34.182,22	\$ 34.487,90	\$ 34.796,68
0,11378068	\$ 31.354,26	\$ 31.625,23	\$ 31.898,96	\$ 32.175,48	\$ 32.454,80

Table 21: sensitivity analysis about equity value of Hp

Equity value					
Wacc / growth rate	0,04371269	0,04871269	0,053712686	0,05871269	0,06371269
0,093780684	\$ 42.145,19	\$ 42.562,90	\$ 42.984,94	\$ 43.411,33	\$ 43.842,11
0,098780684	\$ 38.672,71	\$ 39.044,29	\$ 39.419,70	\$ 39.798,97	\$ 40.182,13
0,103780684	\$ 35.711,61	\$ 36.044,29	\$ 36.380,39	\$ 36.719,93	\$ 37.062,94
0,108780684	\$ 33.157,13	\$ 33.456,64	\$ 33.759,22	\$ 34.064,90	\$ 34.373,68
0,113780684	\$ 30.931,26	\$ 31.202,23	\$ 31.475,96	\$ 31.752,48	\$ 32.031,80

So, the equity value of HP prior of the acquisition was between \$30.931 million and \$43.842 million with the mean value equal to \$36.380,39.

Now it is necessary to calculate the equity value of the merged entity, both with and without synergies. During the decision-making in fact, one of the main arguments in favor of this acquisition was the fact that it would have brought considerable synergies. First Call estimated that the expected synergies for this merger would have been around \$1.3 billion per the first year, while according to HP this synergy would have been around \$2 billion per year. Now, since the merger dates back to 2001, it is possible to see whether the estimation were correct, and how much the FCFF increased over time, after the acquisition. First of all, it is necessary to calculate the equity value of HP after the

acquisition of Compaq, secondly I will try to estimate the equity value considering the synergies. Lastly, I will compare the estimated Free Cash Flow to the Firm of Hp after the merger, with the actual FCFF of HP for the next 3 years.

The procedure to calculate the Equity value through the DCF model is the same as before: I considered the 5-year average both for Hp and Compaq, I summed their values and found the FCFF without synergies.

Table 22: FCFF analysis of HP after the merger

5 year average			
	Compaq	Hp before	HP after
Revenue	\$ 28.890,83	\$ 42.270,20	\$ 71.161,03
Cost	\$ 21.862,33	\$ 30.144,40	\$ 52.006,73
Adm+R&d	\$ 4.790,33	\$ 9.055,00	\$ 13.845,33
EBITDA	\$ 2.238,17	\$ 3.070,80	\$ 5.308,97
Interest	\$ 166,33	\$ 469,25	\$ 635,58
EBIT	\$ 2.071,83	\$ 2.695,40	\$ 4.673,38
EBIT(1-0,32)	\$ 1.408,85	\$ 1.832,87	\$ 3.177,90
D&A	\$ 1.297,20	\$ 1.255,40	\$ 2.552,60
NWC	\$ -284,20	\$ 20,60	\$ -263,60
Capex	\$ 1.443,20	\$ 1.145,60	\$ 2.588,80
Reinv rate	0,62640836	1,07114518	0,90566099
FCFF	\$ 882,51	\$ 1.963,27	\$ 2.878,10

To calculate the weighted average cost of capital I firstly computed the unlevered beta of both HP and Compaq; I then obtained the unlevered beta of the combined firm by considering the weight of the two companies:

$$\begin{aligned} \text{Unlevered beta}_{\text{combined}} &= 1,23 * \left(\frac{40120}{40120 + 22641} \right) + 1,34 * \left(\frac{22641}{40120 + 22641} \right) \\ &= 1,27 \end{aligned}$$

Table 23: calculation of Beta of HP after the merger

	HP	Compaq	Combined Firm
Beta (pre-acquisition)	1,338	1,39	
Market Value of Equity	35500	21513	
Debt	4620	1128	
Market Value of Firm	40120	22641	
D/E Ratio	13,01%	5,24%	
Tax Rate	32%	32%	
Unlevered Beta	1,23	1,34	1,270

To obtain the levered beta it is sufficient to use the conventional approach formula (<http://people.stern.nyu.edu/adamodar/pdffiles/eqnotes/discrete2.pdf>) :

$$B_L = B_U \left(1 + (1 - t) \frac{D}{E}\right)$$

$$B_L = 1,270 \left(1 + (1 - 0,32) \frac{5748}{57013}\right) = 1,357$$

To obtain the cost of debt, I calculated the weighted average by considering as weight the total amount of debt of the two companies

$$\text{Cost of debt}_{\text{combined}} = \frac{(0,05913 * 1128) + (0,0755 * 4620)}{4620 + 1128} = 7,22\%$$

Table 24: calculation of WACC of HP after the merger

Risk free rate	5,10%
Equity risk premium	4,40%
Beta	1,357
Debt	\$ 5.748.000.000,00
Equity	\$ 57.013.000.000,00
Cost of debt	7,22%
Cost of equity	11,07%
WACC	10,50%

Now, as done before, to calculate the expected growth rate of HP after the merger, I multiplied the new reinvestment rate (as the ratio between FCFF and EBIT(1-t)) with the return on capital. In order to obtain the return on capital, I considered, as before, the book value for both equity and debt.

Table 25: calculation of return on capital of HP after the merger

Ebit(1-t)	\$ 3.177,90
D+E	\$ 53.498,60
Cash	\$ 6.766,00
D+E-Cash	\$ 46.732,60
Return on capital	6,80018%

So, the expected growth rate of EBIT in the short term period is equal to:

$$\text{Expected growth}_{EBIT} = 0.9057 * 0.0680 = 0.0616 = 6.16\%$$

Since the retention ratio represents how much of the net income are kept inside the firm, and is unique for every company, it was not possible to make, as before, a simple weighted average. In fact the two companies had different dividend policies and since it was HP that incorporated Compaq, I considered as reference dividend policy the one of HP. So, in order to calculate the dividends, I checked in the annual report of HP which were their criteria to distribute dividends.

I found out that they distributed 0.32\$ per share each year, independently from their net income. So, to find out the “natural” dividend of HP after the merger, I multiplied 0.32 for the number of shares after the merger:

$$\text{Dividends}_{2002} = 0,32 * 3043733 = 973994,56$$

In reality, the dividends payed in 2002 were lower since the exchange of the shares was made in May 2002. But since this analysis takes into account the natural dividends payed by the company, it was better to use the dividends HP would have payed after the merger.

Now, to find out the long-term growth rate I used the same formula as before:

$$\text{Return on invested capital} = \frac{(2532 + 569) - 973,99}{53498,60} = 0,043062627 = 4,3\%$$

$$\text{Retention rate} = \frac{(2532+569)-973,99}{2532+569} = 74,29\%$$

$$\text{Expected growth}_{\text{Long term}(ROIC)} = 4,3\% * 0,7429 = 3,19\%$$

Table 26: discounted cash flow plus terminal value of hp after the merger

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	TV
Growth rate	0,06159	0,06159	0,06159	0,06159	0,06159	0,05567	0,04975	0,04383	0,03791	0,03199	0,03199
EBIT(1-0,32)	\$ 3.373,62	\$ 3.581,39	\$ 3.801,95	\$ 4.036,10	\$ 4.284,67	\$ 4.523,19	\$ 4.748,21	\$ 4.956,32	\$ 5.144,22	\$ 5.308,80	\$ 5.478,64
FCFF	\$ 3.055,35	\$ 3.243,52	\$ 3.443,28	\$ 3.655,34	\$ 3.880,46	\$ 4.096,47	\$ 4.300,27	\$ 4.488,75	\$ 4.658,92	\$ 4.807,97	\$ 4.961,79 67.896,51
DFCF	\$ 2.764,85	\$ 2.656,05	\$ 2.551,54	\$ 2.451,14	\$ 2.354,68	\$ 2.249,42	\$ 2.136,81	\$ 2.018,39	\$ 1.895,72	\$ 1.770,36	\$ 25.000,39
Discount rate	1,10507	1,22118	1,34949	1,49128	1,64797	1,82113	2,01247	2,22393	2,45760	2,71582	2,71582

The sum of all the discounted cash flows for these years plus the terminal value is equal to \$47.849,35

So, the enterprise value of Hp after the merger is only \$11 million higher than the one prior of the acquisition, while the shareholders payed more than 21 billion for obtaining all of the Compaq shares, with a net loss of almost \$10 billion

However, the consideration of the synergies can bring to different results: during the days before the acquisition, as seen before, were made several estimation about the potential

amount of the synergies that this merger would have brought to HP. The most independent report was made by First Call, which estimated a net yearly synergy of \$1.264 million. By taking into account this amount and by considering these synergies as perpetual, the final enterprise value of HP would be of \$61.822 million with a net gain for the shareholders of about \$4 billion.

But, have these synergies estimation been observed after the merger? Through a simple average of the FCFF for the years from 2002 to 2004 (in February 2005 HP CEO Carly Fiorina was forced to resign) it is possible to see that almost no synergies were made by this acquisition.

Table 27: analysis of real data for hp after the acquisition

	2002	2003	2004	Average
Revenue	\$ 56.588,00	\$ 73.061,00	\$ 79.905,00	\$ 69.851,33
Cost	\$ 41.793,00	\$ 53.858,00	\$ 60.340,00	\$ 51.997,00
Adm+R&d	\$ 12.131,00	\$ 14.663,00	\$ 14.530,00	\$ 13.774,67
EBITDA	\$ 2.664,00	\$ 4.540,00	\$ 5.035,00	\$ 4.079,67
Interest	\$ 52,00	\$ 21,00	\$ 35,00	\$ 36,00
EBIT	\$ 2.612,00	\$ 4.519,00	\$ 5.000,00	\$ 4.043,67
EBIT(1-0,32)	\$ 835,84	\$ 1.446,08	\$ 1.600,00	\$ 1.293,97
D&A	\$ 2.119,00	\$ 2.527,00	\$ 2.395,00	\$ 2.347,00
NWC	\$ 492,00	\$ -445,00	\$ -1.589,00	\$ -514,00
Capex	\$ 3.118,00	\$ -1.512,00	\$ -2.454,00	\$ -282,67
FCFF	\$ 6.564,84	\$ 2.016,08	\$ -48,00	\$ 2.844,31

Considering that in the no synergy scenario the FCFF of HP after the acquisition was equal to \$2.878,10, no synergies were produced through this operation.

The stock market always thought that this deal would have not brought significant synergies to HP, in fact the stock price of HP has almost always been below the one prior the announcement of the merger.

Figure 12: HP stock price



Source: Hp daily price from 2001 to 2005

2.2.3 Conclusion

So, after all this analysis, it is possible to say that the decision of undertaking this merger was wrong: not only almost no synergies were created but it also made the stockholders poorer than before. This was an example first of all of how overconfidence can destroy value and bring to wrong decisions: during the decisional process, the board of directors was convinced to pay Compaq more than its market value just because they were too sure that everything would have gone well, and value would have been created.

Secondly, the board of directors made the wrong decision because the most important factor for them to be considered was just how big with respect to the other PC companies was HP. In fact, right after the three questions posed by Carly Fiorina, every director decided that the merger was good: they considered the fact that HP could have become the number one in the PC selling field more important than the value this merger would have brought to the shareholders.

Then, this merger is an example of how the anchoring heuristics works: the CEO Carly Fiorina just wanted to do a merger, independently from the fact that it did not make any sense. The merger had to be done, and that was her anchor: the target could change but

not the deal. She was not thinking of whether the HP-Compaq deal was profitable, she just thought of how to convince everyone that her idea was correct. This regards in fact the confirmatory hypothesis testing: she just considered the reports in favor of undertaking the merger and brought those as arguments to convince the other directors of the goodness of the deal.

3. BEHAVIORAL CORPORATE FINANCE ANALYSIS OF M&A

3.1 BIAS AND HEURISTICS IN VALUATION AND M&A DECISIONS

3.1.1 Biases associated to growth opportunities, P/E, PEG and P/Sales

In practice, equity valuation is much more related to heuristics than it should be: valuation by comparables is, in fact, a heuristic technique. It depends on similarity judgement which reflect the degree of representativeness of a certain firm with a class of comparables: this is, by definition, a representativeness heuristic.

Both P/E, Price/sales and PEG ratio rely not only on the fact that in order to obtain the price of the stock for the next year, it is necessary to forecast earnings of the next two years, but also that all the companies have the only things that matter in valuing a company are sales and earnings of the first year.

But even in the DCF analysis there might be some systematic errors analysts made: one main case is the growth rate in the long-term period and in the terminal horizon. For example, during the Ebay analysis of stock value made by Mary Meeker's team in Morgan Stanley, they assumed that eBay's free cash flow would have grown at 7 percent forever. Considering that GDP growth was about at 4 percent and GDP deflator at about 2 percent (<http://data.worldbank.org/indicator/NY.GDP.DEFL.KD.ZG?page=2>), they estimated that the company would have grown better than the whole economy forever; which is a quite hard argumentation to sustain. If eBay in fact were to grow 1 percent faster than the U.S. economy forever, it would directly become the US economy (Shefrin, Behavioral Corporate Finance, 2018).

But the fact that the growth rate in the terminal horizon is higher than the GDP is just the most evident mistake done. The Present Value of Growth Opportunities in the long term should go to zero; for instance, during the first years of the 2000s, eBay was experiencing rate of returns higher than the one of its competitors. But the competitive advantage in the long-term period should go to zero. Another characteristic of PVGO is that in order to be zero in the terminal horizon, the fraction of after-tax EBIT allocated to the change in net working capital and the sum of CapEx must be equal to the ratio between the growth rate and the cost of capital, as considered in the analysis made in chapter two. The fact that analysts systematically avoid considering this simple and obvious relationship is called "growth opportunities bias" (H. Shefrin, Free Cash Flow, Valuation and growth opportunities bias, 2014). Baker and Wurgler (Investor Sentiment and the Cross-Section

of Stock Returns, 2006) showed how cross-section of future stock returns depends on the starting proxies for sentiment (optimism for a stock): when the sentiment about a certain stock is high, these are attractive to optimists and unattractive to arbitrageurs. From this starting point Shefrin (2014) noted how the growth rate opportunities bias is significantly higher for stocks with high Baker Wugler sentiment: investors tend to consider companies with few or no history about earnings but with the presence of apparently unlimited growth opportunities, as able to growth at higher rate than it is mathematically possible.

One recent example about this is the Twitter analysis made in 2013 due to the upcoming IPO, where all the phenomena related to IPO and valuation discussed in this paper are present. On November 7, 2013 after an offer price of \$26 per share, stock price went up until \$50.09 per share, with a closing price of \$44.90. On August 4, 2014 Twitter stock price had fallen by 3,2%, while the S&P500 gained 11%. So, in this case both initial underprice, hot issue market and long-term underperformance can be identified. But the most interesting thing is to look at how analysts arrived at the target price: Shefrin (2014) analyzed most of the reports justifying prices around \$30 per share, and found out how some of the reports did not even consider PVGO as a restriction for long term growth rate. Other reports however did consider it, but they just used different growth rate values for the restriction and for the growth rate of cash flow during terminal period: Cantor Fitzgerald considered for example a growth rate of 4% during terminal period but a value of 0,7% for the PVGO analysis. Also the in Wunderlich report, firstly they consider a growth rate of 4 percent, and then they use a 1,6% growth rate for the PVGO. Every time in fact the growth rate assumed in the analysis is below the implied growth rate of the PVGO, there is a growth opportunities bias.

Table 28: Canton Fitzgerald and Wunderlich estimates about Twitter in 2013

Twitter	Cantor	
	Fitzgerald	Wunderlich
g	4%	4%
k	12%	13%
$T + 1$ —date terminal horizon begins	2020	2024
EBIT : T	3,600.2	2,393.2
Taxes : T	1,260.1	815.0
FCF : T	2,200.3	1,387.0
EBIT(1 - t) : T	2,340.1	1,578.2
EBIT(1 - t) - FCF : T	139.8	191.2
EBIT(1 - t) - FCF : $T + 1$	145.4	198.9
[EBIT(1 - t) - FCF]/ EBIT(1 - t) : $T + 1$	6.0%	12.1%
$k[EBIT(1 - t) - FCF]/$ EBIT(1 - t) : $T + 1$	0.7%	1.6%

Source: Free Cash Flow, Valuation and growth opportunities bias, H. Shefrin, 2014

3.1.2 Impact of heuristics and biases on the M&A decisions of managers

Managers who are overconfident about their knowledge, will be more prone to underestimate risk: as shown by a survey made by Graham, Harvey and Puri (Managerial attitudes and corporate actions, 2013), the managers most inclined to make acquisitions are those who have the highest tolerance for risk. Risk averse CEOs have 24,6% of lower probability of undertaking an acquisition with respect to risk tolerant CEOs. In the same way, also risk tolerant CFOs are more disposed to make acquisition; they in fact are 159 percent more prone to be active than risk averse CFOs. During the decision process of an M&A, several heuristics can be observed; one of the most common is the reference point effects. This effect happens every time the board which have to decide whether the merger is convenient to the company, focus on the peak price of the target's stock. In order to justify a certain price, they in fact take, as reference point of the market value of the company the 52 week high. This is consistent with the so-called peak-end-rule, which consist on the fact that people tend judge an experience taking into consideration mostly its ending and its peak (Duration Neglect in Retrospective Evaluations of Affective episodes, Fredrickson and Kahneman, 1993).

In order to take into consideration also the possible mispricing of the market and all the managerial biases we can observe, economists Malcolm Baker and Jeffrey Wurgler proposed a behavioral extension to the classical corporate finance theory (Behavioral Corporate Finance: Un Update Survey, 2012). Consider a perfectly rational manager operating in a market where sentiment creates distortions between intrinsic value of the firm's stock and its market price: when the firm's securities are mispriced, managers have to face a conflict between which investor they have to serve. Some investors in fact have long term horizon, other have short term horizon: managers have to weigh the importance of the two groups. In estimating the value of the firm, perfectly rational manager will then have to divide the value in two part: one value according to long-term investors, and another one according to short term investors. He then combines these two with the relative importance of short term with long term investors: $Behavioral\ APV = V_L + aV_S$ where a represents the weighting parameter which reflect the importance of the value for short term investors with respect to long term investors. Behavioral APV, or BPV represents the true value of a firm in presence of distortion between prices and intrinsic value; the higher will be the parameter a , the higher will be the myopia of managers. This value can help in the M&A analysis: estimated synergies and financed side effects put an upper limit to the premiums acquiring firms should pay. The APV is in fact the difference between the synergies that the deal generates and the premium paid, plus the associated financing side effects; when it is higher than zero the acquisition is made.

3.2 THE ROLE OF OVERCONFIDENCE IN M&A

3.2.1 *Introduction*

One of the biggest field of analysis about behavioral corporate finance is how overconfident CEOs tend to overpay bids and undertake more mergers than they should. In order to find that, Malmendier made an empirical analysis in 2008 (Who makes acquisitions? CEO overconfidence and the market's reaction, Malmendier, Tate, 2008): first they decided that it was necessary a way to detect an overconfident CEO. Most of the time in fact CEOs show themselves as overconfident right after the deal is done; so how it is possible to detect a systematic overconfidence about future cash flows?

Secondly, Malmendier statistically tested whether overconfident CEO undertake for real more mergers and acquisitions than the non-overconfident ones. Lastly, are acquisitions undertaken by overconfident mergers convenient or they just destroy shareholders value? Acquiring shareholders in fact lost over 220 billion at the announcement of mergers bid from 1980 to 2001. Does overconfidence explain these losses?

3.2.2 *Empirical predictions*

For this part of the analysis we consider just two types of companies, those with excess internal resources, and those with a low level of available cash who need external financing. In the second type companies the overconfidence of the CEO does not bring to a single result: an overconfident CEO that need external resources tends to ask for a lower interest rate to the lenders and higher issuance prices to the market, since he consider his company better than what it really is due to the higher cash flow he predicts. Therefore, it is not always true that overconfident CEOs make more mergers, since they can avoid good mergers, but which are too costly for them to finance. When instead the overconfident CEO has sufficient internal resources and does not need external financing to make the merger, they are more likely to conduct mergers than the non-overconfident CEO.

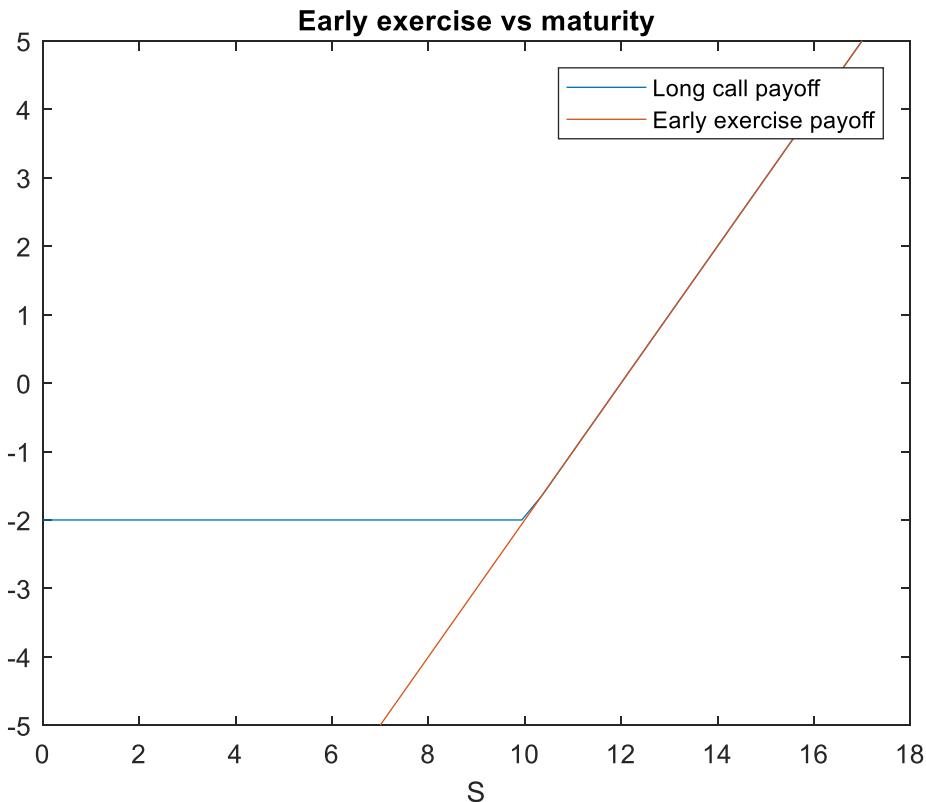
Overconfident CEOs tend to overestimate the synergies coming from the mergers, so they are more likely to undertake projects with negative NPV rather than rational CEOs.

3.2.3 *How to measure overconfidence*

According to Merton (Application of option-pricing theory: Twenty-five years later, Merton, 1998) an investor should never exercise an option prior to its deadline: if the

price of the underlying rises, the price of the option will be still fixed so the investor will gain the same amount of money than the early exercise strategy.

Figure 13: early exercise vs long call payoff



If the price of the underlying goes down, the option will be exercised only if at maturity the price of the stock will be higher than the strike price; in the early exercise strategy instead, the investor loses the difference between the strike price and the spot price at maturity. In the figure above, we see an example of a long call option with strike price 10€ and payed 2€ by the investor: the early exercise strategy is always equal or worse than the strategy where the investor keeps the option until maturity.

This is however not always true for executive options: CEOs cannot trade them or hedge the risk by short-selling the option. According to Lambert (Lambert, R., Larcker, D., Verrecchia, R., 1991. Portfolio considerations in valuing executive compensation. Journal of Accounting Research 29, 129-149) and Hall and Murphy (Hall, B., Murphy, K., 2002. Stock options for undiversified executives) CEOs have the convenience to exercise the option early, but only if the marginal benefit to keep the option (option value) is lower than the marginal cost of keeping the option (risk exposure). “We use a certainty-equivalent approach to derive the risk-adjusted “Executive Value” of a non-tradable

option, and compute the “value:cost” ratio by dividing this value by the company’s cost. We show that value:cost ratios are lower for more risk-averse and less diversified executives, and that value:cost ratios are higher for options that are in-the-money or have provisions allowing early exercise.” (Stock Options for Undiversified Executives, Hall and Murphy, 2002).

When the value of the stock price is sufficiently high, a risk adverse CEO should exercise the option and sell the stock since the expected utility of the secure gain is higher than the utility of keeping the option for another period. The threshold for exercising depends on different factors, such as the remaining duration of the option, how much diversified is the portfolio of the CEO, its risk aversion and its individual health.

At this point it is useful to divide CEO in 2 macro categories: Longholder and non-longholder. A longholder CEO is defined as one who keeps an option until the year of maturity, although the option is at least 40% (optimal threshold calculated by Hall and Murphy (2002)) in the money entering in its final year. A Longholder CEO can be then a Post-longholder or a Pre-longholder. It is defined as Post-longholder a ceo who holds for the first time a 40% in the money option until expiration, instead a pre-longholder is a CEO who has already kept the option until maturity.

Another indicator of late exercise is called “Holder 67”. Since most of the options considered in this analysis have a 10-year duration and are acquired only after four years, the earliest point we can consider to detect a late exercise of the option is five years before expiration. The threshold for the in the money option is 67% (instead of 40% of the longholder indicator): if a CEO has in its portfolio an executive option which will expire in 5 years and it is 67% in the money, then the CEO is a Holder 67 CEO. This value has been decided since all the CEOs considered in this analysis experienced at least one time an appreciation of the stock higher than 67%.

3.2.4 Empirical analysis

Now I refer to the econometric analysis in “Who makes acquisitions? CEO overconfidence and the market’s reaction” (Malmendier, Tate, 2007) in order to discover the real behavior of “overconfident” CEO and the potential damage they generate. First of all, it is necessary to test whether longholder CEOs effectively undertake more mergers than non longholder CEOs. Secondly, we see how the different availability of internal

resources may impact on mergers decisions. Then it will be shown whether Longholder CEOs are more likely to undertake value-destroying mergers with respect to non Longholder CEOs. Lastly it is necessary to understand how the market reacts to the deals carried on by the two types of CEOs defined before.

The regression specification used in this analysis is the following:

$$\Pr[Y_{it} = 1 | O_{it}, X_{it}] = G(\beta_1 + \beta_2 O_{it} + X'_{it} B)$$

Where O is the overconfidence measure, Y a variable which is equal to 1 if the CEO undertook a successful merger in a year, X a set of controls. The null hypothesis tested is that β_2 is equal to zero, so the overconfidence does not impact on the mergers made by the CEO. This equation is estimated by using three procedures:

- Pooled logit regression
- Logit regression with random effect
- Logit regression with firm fixed effect

Table 29: fixed effect vs random effect logit

	Fixed-effects logit			Random-effects logit		
	(1)	(2)	(3)	Baseline	Cash rich	Cash poor
Size	0.6537 (2.50)**	0.6600 (2.42)**	0.3278 (3.42)***	0.9022 (1.49)	0.9480 (0.50)	0.9177 (1.03)
Q	0.7135 (2.20)**	0.7154 (2.18)**	0.9062 (0.45)	0.7019 (2.96)***	0.7686 (1.25)	0.6839 (2.70)***
Cash flow	2.0231 (1.72)*	2.0377 (1.72)*	1.6607 (0.67)	1.5427 (2.07)**	0.9948 (0.01)	1.8719 (2.35)**
Stock ownership	0.3840 (0.95)	0.3813 (0.96)	0.0418 (0.70)	1.4084 (0.36)	21.4335 (1.80)*	0.7232 (0.29)
Vested options	0.4566 (3.97)***	0.4595 (3.93)***	0.6384 (0.51)	1.2165 (0.46)	4.2168 (0.91)	1.3186 (0.63)
Efficient board size	1.0817 (0.40)	1.0811 (0.40)	1.8488 (2.10)**	0.8012 (1.55)	0.575 (2.44)**	0.9184 (0.48)
Longholder	2.1891 (2.70)***			1.7447 (3.21)***	1.9728 (2.53)**	1.5471 (2.10)**
Post-longholder		1.8642 (1.91)*				
Pre-longholder		2.3305 (2.72)***				
Holder 67			2.5159 (2.49)**			
Firm fixed effects	yes	yes	yes	no	no	no
Year fixed effects	yes	yes	yes	yes	yes	yes
Observations	2,568	2,568	853	3,540	1,227	2,313
Number of firms	225	225	124	322	282	314

z-statistics in parentheses. Constant included.

* significant at 10%; ** significant at 5%; *** significant at 1%.

Source: Who makes acquisitions? CEO overconfidence and the market's reaction, Malmendier, Tate, 2008

The firm-level controls are the following:

- Size = logarithmic of the asset at the beginning of the year

- $Q = \text{Tobin's Q} (\frac{\text{Market value of the firm}}{\text{Asset value}})$ at the beginning of the year
- Cash flow = earnings before extraordinary items plus depreciation
- Stock ownership = part of the company owned by the CEO or his family
- Vested options = CEO's holding of options exercisable in 6 months as a fraction of common shares multiplied by 10
- Efficient bond size = binary variable equal to 1 only when the Board has between 4 and 12 directors

3.2.5 Fixed-effects logit

Considering at the moment only the fixed-effect, we can see in the table above (table 1) the various effect that each variable has in the merger frequency:

- CEO of firms with low tobin's Q are more inclined to undertake mergers. This means that the more asset they have with respect to the market value, the more mergers they will do.
- The higher is the cash production of a firm, the more frequent will be mergers
- The higher the number of vested options, the lower the mergers

Longholder indicator (both pre and post longholder) and Holder 67 as expected predict the number of mergers: the higher are these indicators the more mergers those CEOs will do. It is interesting to note, even for further analysis, that pre-longholder indicator does not predict an increase in mergers activities as much as the post longholder one: especially those who persistently fail to exercise their options are considered overconfident.

3.2.6 Random-effects logit

The second effect it is useful to study is whether there are differences in this overconfidence between cash rich and cash poor firms: as stated before overconfidence predicts more mergers intuitively only when the firms does not need much external resources, while the net effect for the firms who need to raise capital externally is ambiguous.

Looking at the right side of the table we can see that only for cash poor firms an increasing in cash flow bring to more mergers and acquisitions. The effect of the vested options and stock ownership factors are not statistically significant (except for stock ownership in cash rich firms). The efficiency of the board predicts a lower tendency to undertake

mergers and acquisitions only for cash rich firms. Longholder factor predicts more acquisitions both for cash rich and for cash poor firms.

According to Malmanidier, “*managers who are overconfident about the returns they generate overestimate both the value they create in their own firm and the value they create by taking over other firms. [...] In times of high market valuation [...] the CEO is less likely to perceive his own company to be undervalued. In this case even overconfident managers are willing to finance deals using equity.*”

3.2.7 Value consequences of overconfident CEOs

The second question it is necessary to answer is: does overconfidence destroys shareholder value? In order to find that, we refer to the economic literature (Effects of corporate diversification on productivity, Schoar 2002) to link a value destroying deal to the diversification: it is proven in fact that the diversification via acquisitions have negative impacts on shareholders' value.

It has been found that longholder CEOs have a higher tendency to do diversified mergers with respect to other CEOs. And this is true both in cash rich and cash poor firms. This means that overconfident CEOs destroy shareholder values through unprofitable diversified mergers

The market reaction to a merger gives the idea of what is the perception in the financial world about that deal: a negative reaction to a merger announcement means that the price paid was too high, a positive reaction instead suggest that the synergies and the value of the company bought is higher than the price paid. This gives us a quite strong indicator about whether or not the longholder CEOs are perceived as agents who destroy value: do they see negative market reaction more frequently than non-longholder CEOs? And, if this is true, is this related to the merger they undertake (overpaid) or due to their status in the financial market?

Table 30: relationship between longholder CEOs and merger reaction

	Average CAR [-1,+1]		
	All bids	Cash bids	Stock bids
Full sample	-0.0029 (808; 1.73)*	0.0045 (354; 1.82)*	-0.0087 (454; 3.94)***
Longholder = 0	-0.0012 (611; 0.62)	0.0070 (265; 2.21)**	-0.0075 (346; 3.03)***
Longholder = 1	-0.0090 (178; 2.73)***	-0.0032 (78; 0.88)	-0.0135 (100; 2.64)***
Pre-longholder = 1	-0.0052 (115; 1.26)	-0.0033 (48; 0.81)	-0.0066 (67; 1.02)
Post-longholder = 1	-0.0160 (63; 2.91)***	-0.0031 (30; 0.45)	-0.0277 (33; 3.49)***

Number of observations and t-statistics in parentheses.

Source: *Who makes acquisitions? CEO overconfidence and the market's reaction*, Malmendier, Tate, 2008

By using a sample of 477 large publicly-traded us firms from 1980 to 1994 it is possible to see that the average market return after a merger announcement is -29 basis point. Longholder CEOs however are the ones who see a reaction to their mergers much more negative (-90bp) with respect to the non longholder CEOs (-12bp, not statistically different from 0). So we can say that, in this sample, longholder CEOs undertake on average mergers that are valued more negatively by the financial market than the non longholder CEOs.

When the bid has been made by cash the reaction to the announcement of the merger is on average positive only for non longholder. For stock bids the reaction is always negative, even though mergers undertook by longholder CEOs see a much worse reaction by the market (-76bp vs -135bp). So, on average, cash deals are seen in a better way by the market.

There is however another interesting behavior to notice: mergers made by Post-Longholder CEOs are viewed more negatively by the market with respect to pre-longholder. This means that the market needs a signal by the CEO: when a longholder who kept an option until expiration undertake a merger, the market considers him as an overconfidence CEO, so he discounts immediately the lower value he brings to his firm. In fact, 10,8% of CEOs in fact causes 44% of value destruction around merger bids and for every bid, Longholder CEOs on average destroys \$7.7 more than non longholder CEOs.

3.3 WINNER AND LOSER'S CURSE AND ASYMMETRIC INFORMATION

Asymmetric information is something that acquiring managers almost always have to deal when they want to undertake an acquisition. Not knowing the exact value of the firm willing to buy, and being not fully aware of the value of the assets and technology of that particular firm is something that can bring to a so called winner curse. The winner curse consists of an overpayment of target firm, which can be caused both by the overconfidence of the CEO and asymmetric information about that company. KPMG found out that among the 700 largest acquisitions from 1996 to 1998, over half of them destroyed value. According to a Harvard Business Review article of 2011 “*study after study puts the failure rate of mergers and acquisitions somewhere between 70% and 90%*”.

But how can asymmetric information give rise to a consistent overprice of the acquired companies?

Let's consider an example where the value of the target firm is \$1 million. The managers of the acquiring company however only know that the value of the target is somewhere between \$100,000 and \$10 million. In order to simplify the discussion, let suppose that the distribution is uniform (the probability that the firm's value is \$10 million is equal to the probability that the value is \$5 million). Suppose also that the synergy factor is equal to 1.85 (for every dollar of “intrinsic” value, 0.85 dollar is the value of the synergies).

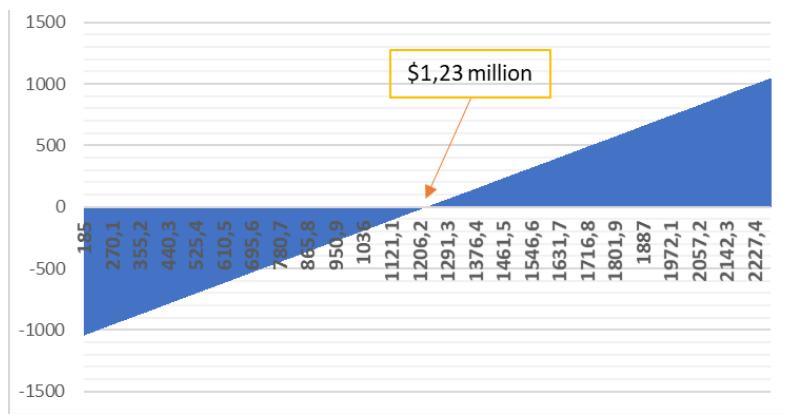
According with these data the best prediction it is possible to make is that the value of the target company is equal to the expected value (i.e. the mean), which is \$5.05 million. Adding to this the synergies estimated, the total value expected by the acquirer is equal to $\$5.05 \times 1.85 = \9.34 million. So the deal will be worth only if the price paid for the company will be lower than \$9.34 million. But the managers of the acquiring firm still do not know what the real value is: if the target managers accept \$9.34 million, the value will be somewhere between 100,000 and 9.34 million, with a mean equal to \$4.7 million. So for the acquiring managers this 4.7 million adding the synergies become 8.7 million. On average, so, by paying \$9.34 million for a firm, the acquiring company gets only \$8.7 million. This is the so-called winner curse.

This of course is just an example, to show how asymmetric information can lead to a significant uncertainty about target price and to a power in the hands of the “target managers” that they can use to obtain almost always more than the real value of the firm.

The only way the acquiring managers can avoid this winner curse is by taking into account that the maximum “true” value of the target company is the one that is accepted. So their expected value will be $1.85*(100,000*P)/2$, considering P as the price effectively paid. Then, they will pay at maximum this amount, which is equal to $P=1.85*(100,000*P)/2$. The maximum amount they will pay in order not to lose (on average) is \$1.23 million.

If the buyer is extremely unlucky, the true value of the firm will be 100,000 which by adding the synergies value becomes \$185,000; if he is lucky the value will be 1.23 million which becomes 2.28 million. In the first case they lose 1.04 million, in the second case they gain 1.04 million.

Figure 14: Expected value



This is however just a theoretical example about how asymmetrical information can affect the price of a company, and how by knowing this effect, the buyer can protect himself from the loss caused by this phenomenon.

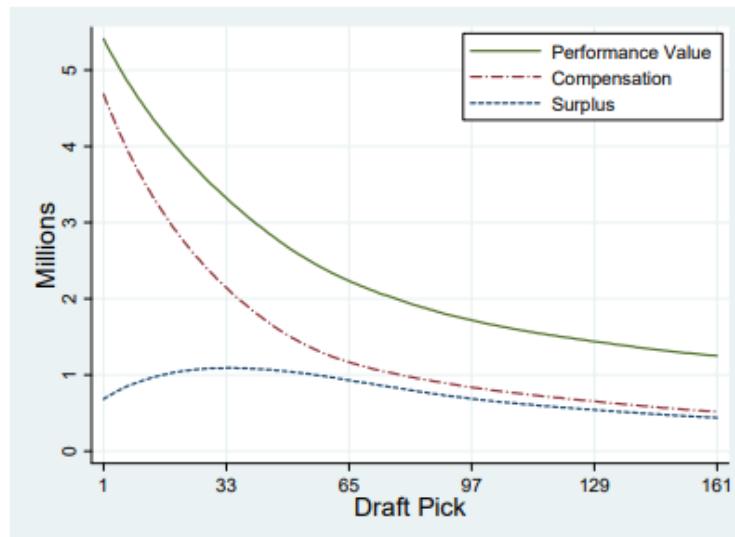
Several empirical studies have been made in the last few years about asymmetric information and premiums paid in M&A. One of which is “Does Asymmetric information affect the premium in Mergers and Acquisitions?” (Dionne, La Haye, Bergères, 2010), which tested 1026 acquisitions in the United States between 1990 and 2007 looking for the difference in the premium paid between bidders who had “privileged” information and those who did not. The premium is calculated as the ratio between the final price paid and the price of the shares 42 days before the announcement, as stated by Betton, Ekcbo and Thorburn (2008).

The first thing they observed was the fact that the buyers who hold at least 5% of the target stock before the announcement, pay a lower premium (almost 70%) than the buyers

that do not have internal information. According to Weverbergh (1979), Milgrom and Weber (1982) this difference in the premium is due to the fact that uninformed players have the fear to incur in the winner's curse, so informed participants can win the auction at lower price. Hernando-Veciana and Troge analyzed this aspect in 2004 and found out that uninformed participant, when they do an auction with an informed bidder, fear that this one has a high private value and so quit from the auction too early.

The uninformed participant in fact can incur in two different biases: the winner and the loser's curse. While the winner's curse is the overpayment, the loser's curse is the opposite: the bidder fear to "overbid" and so loses the bid with a price too low. One famous example of the loser's curse is the first pick in the NFL draft: according to an analysis undertaken by Thaler and Massey (*The Loser's Curse: Overconfidence vs. Market Efficiency in the National Football League Draft*, 2012) the pick with the lower relative is the first one. So losing the bid (not having the first pick in the draft) is somehow a win: the difference between the compensation of two first round pick is much higher than the difference of their performance value

Figure 15: performance value of each NFL draft pick



Source: The Loser's Curse: Overconfidence vs. Market Efficiency in the National Football League Draft, 2012

"Focusing Failures in Competitive Environments: Explaining Decision Errors in the Monty Hall Game, the Acquiring a Company Problem, and Multiparty Ultimatums" (Tor, Bazerman, 2003) showed that bidders who answer correctly to the two Monty Hall problems are more likely to avoid the winner's curse. The first and most known Monty

Hall problem is the one who comes from the television program “Let’s Make A Deal”. In a game with 3 boxes, there is just one prize inside one of them. In the first stage of the game the competitor has to choose one of the three, after the choice the game host opens one of the other two that has not the prize inside and offer to the competitor the possibility to change box. What should the competitor do? To change or he should keep the box?

The second Monty Hall problem (Mean Monty) is quite similar, the only difference is that the game host may offer the possibility to change, and it is not automatically. The host will decide with the goal to minimize the likelihood that the competitor get the prize. In this situation, would it be better of to switch the box?

The correct behavior for the first Monty Hall problem is to always switch, while in the Mean Monty game don’t switch is always better off.

Table 31: Monty Hall problems

Conventional Monty Hall Problem			Result if You Switch	Result if You Don't Switch	Win Indicator	
You Pick	Chance Picks	Monty Shows You			Switch	Don't Switch
2	1	2 or 3	Lose	Win	0	1
	2	3	Win	Lose	1	0
	3	2	Win	Lose	1	0
	1	3	Win	Lose	1	0
	2	1 or 3	Lose	Win	0	1
	3	1	Win	Lose	1	0
3	1	2	Win	Lose	1	0
	2	1	Win	Lose	1	0
	3	1 or 2	Lose	Win	0	1
			Probability of winning		66.67%	33.33%
Mean Monty Problem						
2	1	2 or 3	Lose	Win	0	1
	2	Nothing	Lose	Lose	0	0
	3	Nothing	Lose	Lose	0	0
	1	Nothing	Lose	Lose	0	0
	2	1 or 3	Lose	Win	0	1
	3	Nothing	Lose	Lose	0	0
3	1	Nothing	Lose	Lose	0	0
	2	Nothing	Lose	Lose	0	0
	3	1 or 2	Lose	Win	0	1
			Probability of winning		0.00%	33.33%
Mean Monty will not give you an opportunity to switch when you've guessed wrong, only when you've guessed correctly. The thing is, Mean Monty knows what's really behind those doors.						

Source 1: Focusing Failures in Competitive Environments: Explaining Decision Errors in the Monty Hall Game, the Acquiring a Company Problem, and Multiparty Ultimatums, Tor and Bazerman, 2003

This is in fact a problem where the asymmetric information can change the game: having less information than the game host, when both want to maximize their outcomes, forces

the competitor to always keep its box. Only 24% of the participants (graduate and undergraduate students of Boston-area universities) of the experiment made by Tor and Bazerman (2003) successfully answered to both the Monty Hall problems and more than 70% of the students gave the same response to Monty Hall and Mean Monty problems.

4. CONCLUSION

This work began by the assumption that traditional corporate finance is no more able to explain how managers and investors take their decisions. After having seen all the possible biases and heuristics they can face, the main and most important part of this paper is related to the HP-Compaq deal and how this highlights almost all the different behaviors that traditional economics is not able to explain. It has been shown how CEO tend to be excessively overconfident, and stick with their ideas of undertaking mergers: HP's CEO was not interested in finding good investment opportunities, instead she just wanted to do a significant deal in order to consolidate the position of HP in the market. She used many tricks to convince all the other directors that the merger was good, and because of the confirmation trap she almost never doubted that the deal would not be profitable. In this work it was shown how not only the merger did not generate any additional value to the shareholders, but it also costed them some millions of dollars. The price paid for Compaq was unnecessary higher than the market value, there was no real economic reason to undertake such a deal and, indeed, focusing on the unprofitable PC sector was a way to reduce even more HP's profitability. It was then shown how all the estimates about future synergies and increases in cash flow, were wrong; analysts in fact tend to incorrectly estimate and use the growth rate in the long term and in the terminal horizon. The bias of growth rate opportunities in fact is a bias that theoretical models do not take in consideration, even if, as seen in this work, is something real that significantly impact the every day analysis about investment decisions. Behavioral corporate finance is then necessary not only to explain all these behaviors, but also to prevent and to contras them: in the last chapter we have seen how it is possible to foresee overconfident CEOs, and then possible bad deals. Every single behavior of both investors and managers can be subject of analysis, and by detecting all the heuristics they daily face, you can see how the traditional approach about the rationality of the subjects and the market efficiency can be really wrong. The presence of significant earning guidance in the market, along with the obstacles an arbitrageur has to face, can make the market price far from their intrinsic value. And even when a firm decide to go public, many heuristics are observed, such as the initial underpricing, the hot issue market and the fact that after six months, newly issued stocks tend to underperform with respect to the market. So, starting from the theoretical assumptions firstly made by Adam Tversky and Nobel Prize Daniel Kahneman, analyzing works by Thaler, Baker, Wurgler, Graham and considering latest

researches by Malmendier and Shefrin, now an important and comprehensive literature about behavioral corporate finance is present and able to explain every kind of phenomena that traditional theory was not able to explain.

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