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Firma dello studente

*A papà e mamma
che mi hanno sempre appoggiata e creduto in me.*

A mio fratello Martin.

*A tutti quelli che mi hanno sostenuta ed aiutata
per arrivare fino a qua.*

Grazie di cuore!

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Introduction

Traditional economic theories have always assumed that individuals are acting rationally when making their investment choices, in particular these theories from a legislation point of view are underlying assumptions of well-informed market participants, thus market failures and information asymmetries have to be overcome by introducing obligations to inform in order to enhance the information basis of investors. Fundamental problems regarding the traditional approach in finance and securities market regulation were discovered by the financial crisis, which puts into discussion the rationale approach behavior and information obligations. Consequently, for European legislation it was obvious that a revise of the directive in financial instrument markets was needed. Therefore, in the chapter one of this thesis will be analyzed the passage from MiFID (Markets in Financial Instruments Directive) to MiFID II. It will also be seen that the key areas of this new directive are as following: (i) internal control and governance; (ii) market structure; (iii) market transparency; (iv) investor protection; and (v) reporting and market oversight.

The second chapter, instead, is dedicated to the analyses of behavioral finance literature and to affect that behaviors may have on decision making. Behavioral finance is a new field that wants to provide explanations for why people make irrational financial decisions. It can be considered as the outcome of a mix of sciences such as: psychology, finance and sociology. Behavioral finance observes that investors rarely are behaving rational, as the traditional economic theories are assuming, since a lot of factors are affecting our decisions while we are investing. The models used by this field are less narrow than those based on Von Neumann – Morgenstern expected utility theory and arbitrage assumptions. It is important to understand behavioral finance as an integration of classical economics and financial theories, not as a replacement of the standard evolution approaches, technical and market analyses.

The two building blocks of behavioral finance are the cognitive psychology and the limits to arbitrage. Regarding the first will be analyzed the cognitive biases such as: overconfidence, base rate neglect, representativeness bias, loss aversion, anchoring, availability bias, mental accounting, procrastination, and herding. Instead, for the second will be seen in what circumstances arbitrage forces will be effective. Another important issue will be the behavioral portfolio theory.

MiFID legislation in order to comply with the suitability requirement among the information that intermediaries must obtain it includes the clients' risk propensity and risk profile. Therefore, chapter three will be dedicated to risk tolerance. Here the behavioral finance it makes the distinction between risk aversion defined by the Expected Utility Theory and the risk tolerance defined as the degree of variability investment returns than an investor is willing to withstand. Cognitive biases have a crucial importance in determining the risk profile of a client and the factors affecting the risk tolerance are: age, gender, marital status, education, financial knowledge, and income. Understanding the relationship between these factors and risk tolerance of an individual have been interesting for a lot of researches who have made different studies trying to assess financial risk tolerance. From the legislative point of view it has been important the regime of "know your client", therefore suitability and appropriateness tests are needed when firms try to sell a product or service to a client.

The final chapter will be dedicated to a new field developed by behavioral finance and their findings from psychology and neurology, the so-called neurofinance. Neurofinance looks inside the brain for explaining in a better way a wide range of individual economic behaviors and their effects translated into aggregate market phenomena.

Chapter 1: Markets in financial instruments directive

1.1 From MiFID I to MiFID II

MiFID came into force on November 2007, replacing the Investment Services Directive (ISD) which was adopted in 1993. The scope of MiFID was to remove the barriers to cross-border financial services within Europe, promote a competitive and level playing field between trading venues for financial instruments in the European Economic Area (EEA), and improve investor protection across EEA. The aim of MiFID was to design a ‘coherent’, ‘risk-sensitive’, and ‘comprehensive’ regulatory framework for the execution of financial instruments to promote investor protection, and the integrity, efficiency, and orderly functioning of financial markets. With the implementation of investor protection and market efficiency MiFID was aiming at reaching two high-level principles set by the Financial Services Action Plan (FSAP):

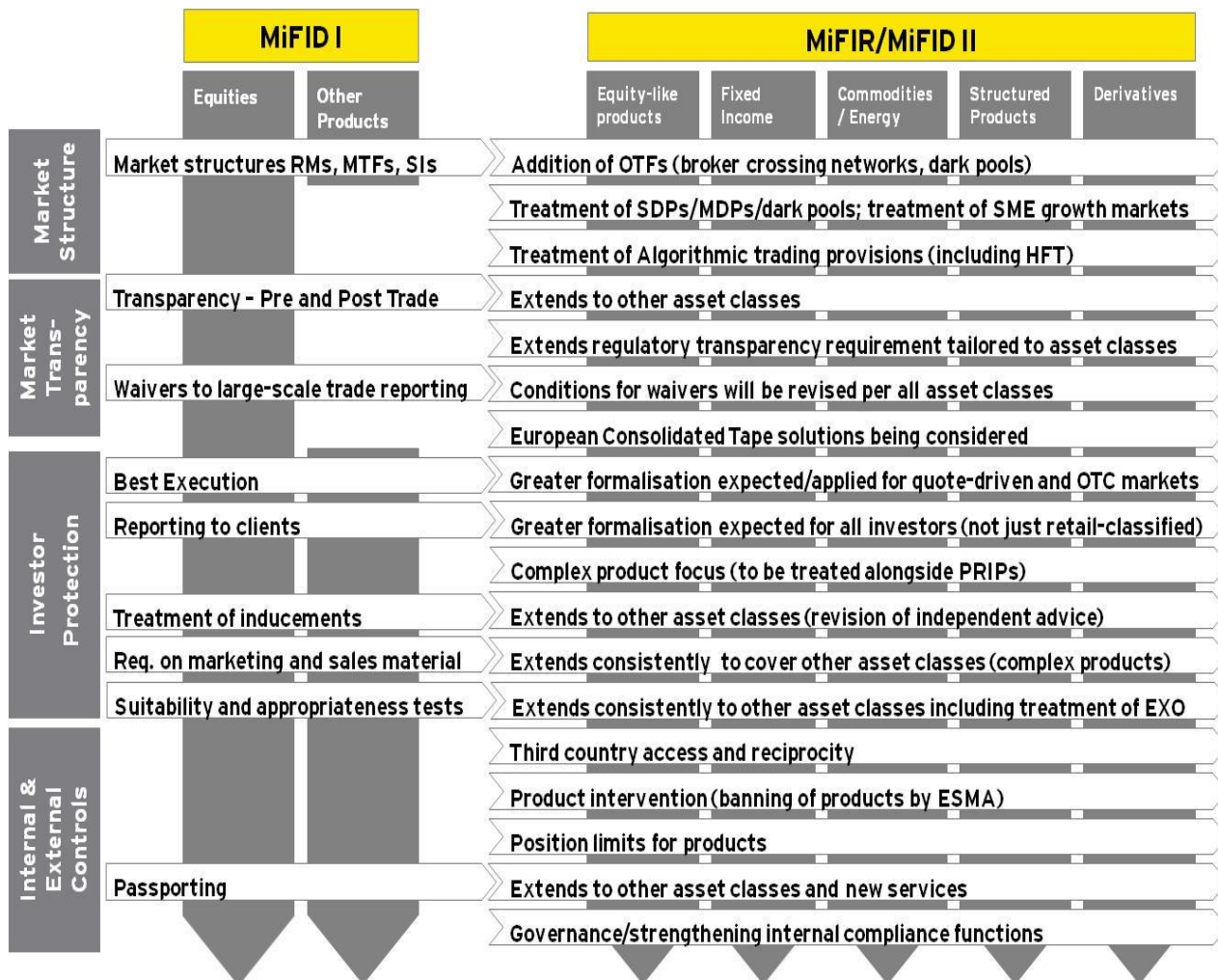
- i. A single market for wholesale financial services;
- ii. An integrated securities and derivatives market.

After the financial crisis of 2008 several factors have called for a more extensive review of MiFID directive. The financial crisis exposed the weaknesses of this directive in the functioning and transparency of financial markets, in front of this the European Commission considered essential to revise MiFID to establish a safer, sounder, more transparent and more responsible financial system. The European Commission noted that MiFID needed to be revised to:

- i. Regulate opaque parts of the financial system to improve the organization, transparency and the oversight of certain market segments, including with respect to those instruments traded over-the-counter (OTC);
- ii. Support the original purpose of efficient and integrated financial markets and consider rapid changes in technological advancements;
- iii. Further strengthen investor protection throughout the EU;
- iv. Where appropriate minimize discretion of national regulators in applying European law to the financial services sector.

In June 2014, the European Commission adopted new rules revising the MiFID framework. This consisted of a directive (MiFID II) and a regulation (MiFIR). The final legislative texts of Directive 2014/65/EU1 (MiFID II) and Regulation (EU) No 600/20142 (MiFIR) were approved by the European Parliament on 15 April 2014 and by the European Council on 13 May 2014. The two texts were published in the Official Journal on 12 June 2014 and entered into force on the twentieth day following this publication – i.e. 2 July 2014. Many of the obligations under MiFID II and MiFIR were further specified in the Commission Delegated Directive and two Commission Delegated Regulations, as well as regulatory and implementing technical standards developed by the European Securities and Markets Authority (ESMA). MiFID II and MiFIR, together with the Commission delegated acts as well as regulatory and implementing technical standards will be applicable from 3 January 2018.

In the picture below we see more in detail the differences between MiFID I and MiFID II.



1.2 MiFID II scope and timeline legislative

MiFID II is the new European discipline for the provision of investment services which reinforces the protection of retail investors with specific measures on financial products, defines the characteristics of independent consultancy services and refines the rules on valuation of adequacy and the obligation of communication to the clients. MiFID II aims at establishing a safer, sounder, more transparent and more responsible financial system that works for the economy and society as a whole. For doing so MiFID II:

- ensures that trading takes place on regulated platforms;
- introduces rules on high frequency trading;
- improves the transparency and oversight of financial markets and addresses the issue of price volatility in commodity derivatives markets;
- improves conditions for competition in the trading and clearing of financial instruments;
- builds on the rules already in place, the revised MiFID rules strengthen the protection of investors by introducing robust organizational and conduct requirements.

The following is the timeline of MiFID II legislative.



1.3 The five key areas of reform in MiFID II

For achieving its own objectives, the main contributions introduced by MiFID II are:

1. Internal control and governance.

A fundamental objective of legislative action within the European supervisory institution continue to be a good corporate governance. Therefore, the aim of MiFID II is to strengthen the role of management bodies of investment firms, regulated market and data reporting services providers, in ensuring sound and prudent management of the firms, the promotion of market integrity and the interest of investors.

MiFID II establishes a strengthened corporate governance regime, enhanced with prescription around governing board and committee composition, fitness and propriety, and time commitment. The role of the compliance officer is also strengthened. MiFID II requires a recording of where senior management deviates from the compliance officer's assessment and recommendations, and an explanation as to the remedial action the investment firm intends to take.

MiFID II sets the overall requirement to store records of all orders and all transactions for a minimum period of five years.

2. Market structure.

The market structure framework introduced by MiFID II closes loopholes and ensures that trading, whenever appropriate, takes place on a regulated platform. All organized trading will take place on regulated trading venues or by systematic internalizers (SIs). One of the most important changes of MiFID II is the introduction of a new type of trading platform, the Organised Trading Facility (OTF)¹. The OTF category applies only to non-equity instruments and allows operators to have discretion over order execution. OTFs must be authorized by the regulator and meet certain ongoing requirements which also apply to regulated markets and

¹ point (23) of Article 4(1) of Directive 2014/65/EU: 'Organised trading facility' or 'OTF' means a multilateral system which is not a regulated market or an MTF (multilateral trading facility) and in which multiple third-party buying and selling interests in bonds, structured finance products, emission allowances or derivatives are able to interact in the system in a way that results in a contract in accordance with Title II of this Directive;

MTFs (multilateral trading facility). However, OTFs will also be subject to certain investor protection rules and may not execute orders against their own capital².

Derivatives contracts that are eligible for clearing under the European Market Infrastructure Regulation (EMIR) by the European Securities Market Authority (ESMA) will be required to be traded on an RM, MTF, or OTF.

3. Market transparency.

For the non-equity financial instruments, such as bonds and derivatives it was established for the first time the principle of transparency. Under MiFID I we had that pre-trade transparency (which requires the publication of the price of real-time orders) and post-trade transparency (which requires the immediate publication of the price and volume of executed transaction) were applied only to equities traded on a regulated market. Instead, under MiFID II, all trading venues (regulated markets, multilateral trading facilities, and organized trading facilities) must publish, on a continuous basis, current bid and offer prices and depth-of-trading interest.

Pre-trade transparency requirements can be waived for:

- Large orders (in relation to normal order/market size) and orders held pending disclosure;
- Actionable indications of interest in request-for-quote and voice trading systems above a specified size that would expose liquidity providers to undue risk; and
- Financial instruments for which there is not a liquid market.

Instead, for post-trade transparency there are no permanent waivers, but reporting can be deferred for up to 48 hours in the case where: i) the transaction is in a security for which there is not a liquid market; and ii) the size of the transaction is equal to or exceeds the relevant large is scale size.

To better monitor the trading activity for market abuse, all trading venues and their members will need to synchronize their business clocks that are used to timestamp reportable events.

² Article 2(1) (7) MiFIR and Articles 5 (2), 18 and 20 MiFID II

4. *Investor protection.*

The rules which are included in the MiFID II regarding the investor protection take into account the type of services and the classification of clients, with higher protection granted to retail clients.

It's important to establish the relationship between intermediary and client, especially when intermediary works with financial instruments. MiFID II list of financial services³:

- i. Reception and transmission of orders in relation to one or more financial instruments;
- ii. Execution of orders on behalf of clients; (Because for example retail clients don't have direct access in market. This is a very basic and naked services)
- iii. Dealing on own account;
- iv. Portfolio management;
- v. Investment advice;

From i. to v. we notice that the regulation is increasing. For the fourth there must be some provisions. The key is to individuate the risk profile of the client. The difference with the MiFID I here is huge since MiFID I for individuating the risk for profile it didn't have a real questionnaire but, just a declaration. The clients were less protected since this declaration was made by firms, and it stated the level of understanding of the client (general declaration of knowledge). In 2007, there was an abuse of this declaration obviously not in the best of the client, which we assume it must be the first guideline, but in the best of the firms. With MiFID II there was a change in the regulation, it was introduced the MiFID questionnaire. To determine the risk profile of the client is very important understanding the skill, the ability and the knowledge that the clients have with respect to financial instruments. When the clients show a high knowledge of financial instruments the effect of questionnaire turns to be the same as the effect of declaration (MiFID I) i.e. less protected.

When the risk profile of the client is determined there should be a perfected matching between client risk profile and the risk of his portfolio. This kind of perfect matching is not

³ Directive 2014/65/EU, ANNEX I LISTS OF SERVICES AND ACTIVITIES AND FINANCIAL INSTRUMENTS, SECTION A Investment services and activities

provided for all types of financial services but only for iv. (portfolio management - the manager is deciding the risk taken) and v. (investment advice – the client is only receiving advice).

Not all financial services are regulated in the same way. The regulation it depends on the nature of the product and on the nature of the client. MiFID II it defines two types of clients:

- a) Retail clients (the most protected), clients which are not professional;
- b) Professional clients (the less protected).

It is very important to keep in mind the relation between the nature of the service and the nature of the client. As shown below the suitability is applied only when we have type iv. and v. of services and only when the client is a retail client. The risk profile and the suitability concept will be better explained in the chapter 3 dedicated to risk tolerance.



5. Reporting and market oversight.

The revised MiFID II proposes to introduce a harmonized third country equivalence regime for the access of investment firms and market operators to the EU. Firms wanting to service retail clients will be required to establish an EU branch, as well as obtain branch authorization from the local authority where the branch is situated. For firms wanting to provide investment services to professional and eligible counterparties only, no mandatory presence with a branch in an EU state is needed.

Developments in the market, products and technology have outpaced provisions of the original directive, with activities such as high frequency trading (HTF) strategies.

HTF are a subject of algorithmic trading (AT), which in turn is defined as trading in financial instruments where a computer algorithm automatically determines individual parameters of orders:

- Timing, price or quantity to trade;
- How to manage the order after its submission, with limited or no human intervention.

HFT will be required to register as investment firm, disclose their algorithms to the regulator and test them in an approved environment. MiFID II it also requires that algorithms have built in circuit breakers that “exit” once certain market relevant criteria are met, which means that venues must be able to halt trading in case of significant price movements in a harmonized fashion. Trading venues will also be required to have robust controls against firms providing direct market access in order to mitigate the risk of markets becoming disorderly, erratic price movements, and capacity overload.

With MiFID II the competent authority can admittedly request information. It is expected that regulators on the strategies of various algorithmic traders will be enhanced, and there will be imposed stricter checks on arrangements whereby members of trading venues allow other firms employing algorithms to access public markets through their systems (direct electronic access). We can have some doubts about the ability of the competent authority to manage the incredible amount of data the AT and HFT trading processes, both in terms of expertise and informatic infrastructure.

Chapter 2: Behavioral finance

Behavioral finance is the outcome of a mix of sciences such as:

- i. psychology, which analyzes how processes of behavior and mind are influenced by physical, psychical, and external environment of human being;
- ii. finances, understood as a system of formation, distribution and use of resources; and
- iii. sociology, referred to a science that emphasizes the influence of social relations on people's attitude and behavior.

The observation that investors rarely are behaving according to the assumption made in traditional finance theory have lead behavioral finance growing in the last years. Behavioral finance is taking insights from psychological research and applying them to financial decision-making. The models used by behavioral finance are less narrow than those based on Von Neumann-Morgenstern expected utility theory and arbitrage assumptions. The two building blocks of behavioral finance are: cognitive psychology, with cognitive referring to how people think, and the limits of arbitrage referring to the prediction in what circumstances arbitrage forces will be effective, and when they won't be. In these models, some agents are not fully rational, either because of preferences or because of mistaken beliefs. We are used to study the traditional finance which assumes that people behave in a "rational" way. But, behavioral finance is saying us to be careful since people are not behaving rational and there are a lot of factors affecting our decisions when we are investing. Note that behavioral finance is not trying to eliminate or replace the standard evolutions approaches, technical and markets analysis but it wants to combine the traditional finance findings with the investigation of social, psychological emotional aspects of the market.

Therefore, we can consider behavioral finance as an integration of classical economics and financial theories within studies investigating psychology and decision making. In general, finance education can be more useful if it turns the lights on active investing by addressing aspects such as (i) what mistakes to avoid while investing, and (ii) what strategies in financial markets are likely to work in terms of earning supernormal returns.

In this chapter, it's going to be analyzed the literature regarding the traditional finance and how behavior biases affect those theories and consequently the investment behavior. An

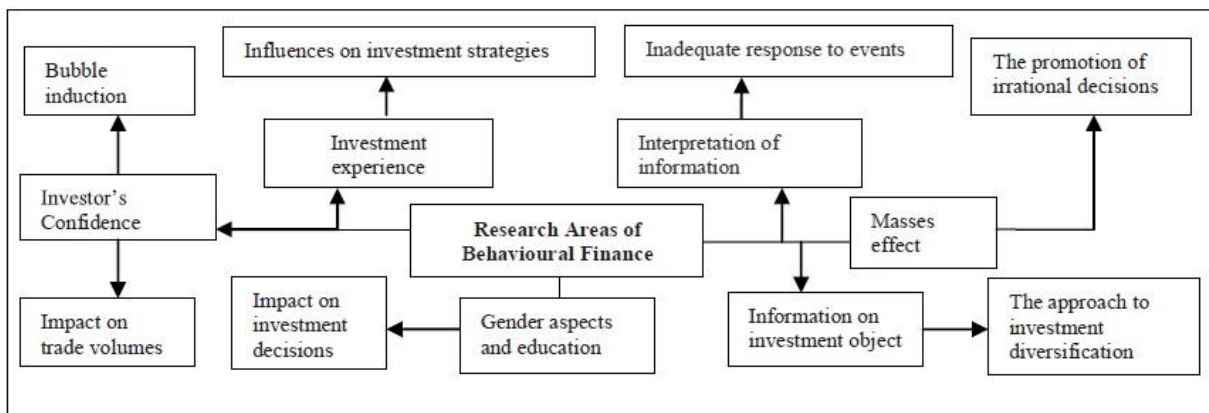
interesting point will be to analyze the point where the behavior portfolio theory it meets Markowitz theory.

2.1 Traditional finance versus behavioral finance

According to economic theories investors should behave rationally when making their investments. They are expecting that when investors make their decisions they will use all available information to form “rational expectations” about the future. Acting rational means: a) when agents receive new information they update their beliefs correctly; b) given their beliefs, agents make choices that are consistent with Savage’s notion of Subjective Expected Utility. According to that, stock prices will accurately reflect the fundamental value, with a respective increase when there are good news and decrease when there is bad news. At these days, traditional finance is no longer solid, as wide cracks have opened between its theory and the evidence. Basically, traditional finance is not responding to the following questions:

- a. Why does an investor trade?
- b. How does an investor trades?
- c. How does an investor compose portfolios?
- d. Why do stock returns vary no due to the risk?

The difficulties crossed by traditional paradigm have led to the emerging of the behavioral finance. In figure⁴ below there are represented the topics of investors’ financial behavior research.



⁴ Bikas, Jureviciene, Dubinskas, Novickyte (2002)

“Investors who always prefer more wealth to less and are indifferent as to whether a given increment to their wealth takes the form of cash payments or an increase in the market value of their holding shares” was the description of Modigliani Miller (1961) for the rational investors. Rational investors are immune to framing errors and to cognitive errors. Normal investors, unlike the rational investors, are not immune to misleading information and cognitive errors. Not all normal investors are alike, the effects of the errors vary along the range of the knowledge of investor. Knowledgeable investors, through science-based knowledge, have learned to overcome their cognitive errors and misleading emotions. The investors that have low knowledge have failed to learn and some of them mistrust scientific evidence.

Even if people are seeing the same thing they are not all interpreting in the same way, the observations of the same empirical evidence may be quite different. The background of the single person is one of the most important factors, financial market participants and researchers have diversified background in education, training, experience, investment objectives, available information, time constraints, capability of analyzing processing data etc.

All investors, despite they are normal or rational, wants from their investments high returns with low risk. The three kinds of benefits wanted are: utilitarian, expressive (what it says this investment about me to others and to me), and emotional benefits. Utilitarian benefits of investments are intended as an increase of our wealth with high returns and low risk. Indeed, the emotional benefits are the way that investment make me feel. The benefits from emotions come with positive emotion such as: exuberance, hope, or pride. But, also negative emotions (fear, sadness and regret) even if unpleasant often are useful. In one hand, we have that perfect rationality cannot deal with surprises, misunderstandings, or irresolvable conflicts, in the other hand we have that emotions enable people to coordinate their behaviors, to find appropriate actions, to improve situations, and enable them to make better decisions. Therefore, emotions can be useful or valuable.

Normal investors, unlike rational investors, are not willing to separate their role as investor from their role as consumers. As investors, they care about utilitarian benefit of investment. As consumers, they are interested in all the types of benefits (utilitarian, expressive and emotional). This implies that their investments are affected by their wants.

Behavioral finance is using models in which agents are not fully rational, because agents are driven by greed and fear, misled by extremes of emotion, whims of the crowd and subjective thinking. According to Shiller (1999), investors do not think and behave rationally. Normal people are not rational. Sometimes normal people are “normal-stupid”, affected by cognitive bias and sometimes they are “normal-smart”.

When a high degree of complexity is introduced with a situation where there is high risk and uncertainty or uncomplete information about an alternative we can't be sure that people or organization will behave rationally. The concept of bounded rationality is introduced. “The term “bounded rationality” is used to designate rational choice that takes into account the cognitive limitations of the decision-maker, limitations of both knowledge and computational capacity. Bounded rationality is a central theme in the behavioral approach to economics, which is deeply concerned with the ways in which the actual decision-making process influences the decisions that are reached”.⁵

Behavioral finance can be a bridge between theory, evidence, and practice. It is trying to look deeper on the investors behavior, understanding why they make some types of investment and why they don't some others. We can see the behavioral finance as an attempt to explain the “market anomalies”, to find the reason why the economic theories are not always working. While in traditional finance we must have portfolios designed by the rules of mean-variance portfolio theory, in behavioral finance we have people that design their portfolios by the rules of behavioral portfolio theory.

2.1.1 Market efficiency

What have driven the market for over 30 years is the efficient market hypothesis (EMH). Theories as: Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory, Cox-Ingersoll-Ross theory and the Black Scholes/Merton option pricing model are predicted in a way or another on the EMH. The Efficient Market Hypothesis is based on the idea of a “random walk theory”, which is used to characterize a price series, where all subsequent price changes represent random departures from previous prices. According to this theory, stocks always trade at their fair value on stock exchanges. Simplifying, market efficiency means that “prices are right”.

⁵Simon, 1997, vol. 3, p. 291

The three arguments of efficient market hypothesis which rely on progressively weakened assumptions are: i) investors are assumed to be rational and hence to value securities rationally; ii) some investors are not rational, but their trades are not affecting the market since they are random and cancel each other; iii) investors are irrational in similar ways, but they will meet on the market rational arbitrageurs who will eliminate their influence on prices.

EMH states that it's impossible to "beat" the market, attempts to outperform the market are essentially a game of chance rather than one of skill, since markets are efficient and current prices reflect all the information. Therefore, there will not be any opportunity of arbitrage (no opportunity of an investment strategy that offers riskless profits at no cost). The three various types of efficient market hypothesis are:

- a. Weak -form efficient if prices reflect all information in past price so that no one can predict future price changes from knowing only past prices;
- b. Semi strong-form efficient if prices reflect all publicly available information so that no one can predict future price changes using only public information;
- c. Strong-form efficient if prices reflect all available public and private information as soon as it is known.

What efficient market hypothesis is stating is that markets are "informationally efficient". Since all individuals can have access to available information, investments cannot be manipulated. It is not always true that agents have access at the same time to the information, different lifestyles and daily routines imply different available times and methods to access information. Also, we have that information may often be known first to a limited group of investors and then it becomes available to the public. According to Grossman (1976) and Grossman and Stiglitz (1980) perfectly informationally efficient markets are an impossibility, for if markets are perfectly efficient, there is no profit to gathering information, in which case there would be little reason to trade and markets would eventually collapse. Therefore, we can see the information availability as a weakness of efficient market hypothesis. Behavioral finance, in this context, holds that stock markets are "informationally" inefficient.

According to EMH, factors such as: experience, gender, friends and family seem to have not a crucial effect when making investments. Investors are treated as uniform (same interests, attitudes,

methods and scope), only interested in maximizing their expected utility. Therefore, emotions aren't influencing their rational investing attitudes.

Getting back to the concept of bounded rationality we can note that when applied, we can modify the theoretically elegant EMH to become more practical and realistic by relaxing the assumption of subjective expected utility theory (SEUT). In this way, instead of assuming that “the decision maker faces a well-defined set of alternatives to choose from”, we assume that alternatives are not fixed but follow some generating process as conditions change. And, instead of the assumption that “the decision maker is able to assign a consistent joint probability distribution to all future sets of events”, it will be assumed that the decision maker may estimate some probability of distributions without assuming the knowledge of probabilities. Considering as uncertain both alternatives and probability distribution about the future, the decision maker is unlikely to have a well-defined utility function and it will be impossible to maximize a not well-defined utility function as SEUT assumes. Therefore, relaxing the assumption intended as limits of human cognitive ability for discovering alternatives, calculating their outcomes and making comparisons may lead the decision maker to settle for some satisficing strategy.

Behavioral finance, on contrary of the beliefs of efficient market hypothesis, emphasizes the correlation of emotional reactions with market and solicit that emotions are the pillars of its theoretical frameworks. The key element of behavioral finance is treating the investors as human-being rather than machines. The complicated and innovative nature of Behavioral finance it seems not to be widely accepted as the EMH. The reason it might be because efficient market hypothesis is characterized by optimism and emphasize the positive outcomes of investing decision making.

2.1.2 The theory of limits to arbitrage

If in one hand, we have Fama (the father of the view that markets are efficient) followers who believes that investors who try to beat the averages will inevitably fail, in the other hand, we have Shiller who argues that markets are often irrational and therefore beatable. A confusion is created when “rational markets” and “hard-to-beat markets” are lumped into “efficient markets” and it's concluded that markets that are not rational are easy to beat. The difference between “rational markets” and “hard-to-beat markets” is that whereas prices always equal intrinsic value in rational markets, in hard-to-beat markets some investors (not ordinary investors) are able to

beat the market consistently by exploiting gaps between prices and intrinsic value. It turns out that both Fama and Shiller agree that markets are not always rational and both accept that markets are hard to beat by ordinary investors. Since rational markets are unbeatable because gaps between prices and intrinsic value are absent, we cannot conclude that vice versa is also true. Therefore, unbeatable markets are not necessarily rational, even if prices are deviating the intrinsic value it might be that deviations are hard to identify in time or difficult to exploit for consistent excess return. Rattner concluded that: *“Fortunately, Mr. Fama’s work on efficient markets did a favor for the small investor: it spawned low-cost index funds that replicate market averages. That’s where the non-expert should park his money...as the commercials say, when it comes to active investing, don’t try this at home”*. But, small non-expert investors are not adopting the Rattner’s advice and traditional finance is not able to give an answer for that while behavioral finance does. Since small non-expert markets are fooled by cognitive errors and misleading emotions they continue their costly attempts to beat the market on their own or by hiring active money managers.

The central paradigm of finance had been: a) the portfolio allocation based on expected return and risk; b) risk based asset pricing models; c) the pricing contingent claims and d) Modigliani Miller theorem. The anomalies that traditional finance fails to explain enters in game the behavioral finance which allows for explanation of financial phenomena based on non-rational behavior amongst investors. One of the biggest goals of behavior finance it might be to show that where rational and irrational traders interact, irrationality can have a substantial and long-lived impact on prices.

According to Friedman (1953) where there is a deviation from fundamental value there are two steps. First, an attractive investment opportunity is created. Second, the rational traders will quickly undo any dislocation caused by irrational traders, thereby correcting immediately the mispricing. In response to that, behavioral finance has no issue with the second step (it is hard to believe that when an attractive investment opportunity comes to light they are not quickly exploited) but it disputes the first. Behavioral finance states that isn’t an attractive investment created since the strategies designed to correct the mispricing can be both risky and costly. Therefore, mispriced assets aren’t creating an opportunity for riskless profit. In other words, “prices are right” it implies that there is “no free lunch” (meaning no opportunity for riskless

profit) but vice versa isn't true since a deviation from fundamental value does not necessarily mean that there is any excess risk-adjusted average for the taking.

The risks that have been identified related to the correction of the mispriced assets are:

- **Fundamental risk:** referred to the risk that new bad information arrives after you have purchased the security. In theory, this risk could be perfectly hedged by buying a closely related product. Unfortunately, is quite impossible to remove the fundamental risk since substitute securities are rarely perfect.
- **Noise trader risk:** referred to the risk that the mispricing being exploited by the arbitrageur worsens in the short run since the pessimistic trades may become even more pessimistic about the future. This type of risk is important since it can obligate arbitrageurs to liquidate their positions early, bringing them potentially step losses.

So, is there any evidence that arbitrage is limited? There is reason to believe that arbitrage is a risky process and therefore it is only of limited effectiveness. Any example of persistent mispricing is immediate evidence of limited arbitrage meaning that the mispricing would quickly disappear if arbitrage were not limited. The only problem is that for claiming that the price of a security differs from its properly discounted future cash flows Fama (1970) dubbed the “joint hypothesis problem”. Therefore, a joint test makes it difficult to provide evidence of inefficiency. Notwithstanding, researchers have found several financial phenomena that are almost certainly mispricing, and persistent ones at that.

2.2 Cognitive errors

As anticipated earlier in this chapter cognitive refers to how people think. According with the psychology literature systematic mistakes are made by people in the way that they think. Cognitive errors or biases can affect all types of decision-making. The biases are relating the way we process information to reach decisions with the preferences we have. In certain circumstances, these biases can be useful. However, if they are there effects are not understood, it may lead investors to unhelpful or even hurtful decisions. Both private and professional investors are affected by these biases whose effects can be reduced only by learning to work around them.

Cognitive psychologists have documented many patterns regarding how people behave. Some of these patterns are as follows:

Overconfidence

Psychology searchings' result is that humans have an inflated view of one's own abilities, affecting most aspects of our lives. When researchers have asked people for their abilities only few of them have rated their self below the average. In other words, people tend to view the world in positive terms. This might be a valuable behavior, but at the same time can cause an ongoing source of bias in money-related decisions. There is a difference between being optimism and being overconfident, for example: if you believe that the stock markets will rise then you are optimist; if you believe that you can forecast the stock market with greater accuracy than you actually can, then you are overconfident.

The humans' overconfidence in their judgements it appears in two forms. First, they assign too prejudiced confidence intervals to their estimates of quantities. Second, people are poorly calibrated when estimating probabilities, for example, for events that they think are impossible occur approximately by 20% of the time, and events that they think will occur 100% occur only 80% of the time. However, overconfidence manifests itself in many ways.

Regarding investments, overconfidence have a direct impact. Traditional finance theory suggests not to keep all our investments concentrated in one area but diversifying our portfolio because doing so risk is also diversified. Since overconfident investors may overestimate their ability to identify winning investments, we can have as consequence investors not following the logic of diversified portfolio. Therefore, the weight of the advice for not concentrating the investments in one area it will be lower than the "misguided conviction" of overconfident investors. Their belief about the good prospects of a given investment, cause them to stand to reason that diversification is unnecessary. Thus, it will be noted a tendency to invest too much in what one is familiar with.

The need for men tend to maximize their rank in the dominance hierarchy lead to greater overconfidence in men than women. According with Barber and Odean (2001) investors with too much confidence in their trading skill trade too much. The more they found that the more people

traded, the worse they did, on average. Thus, the more active traders earned the lowest returns. Hence, men are doing worse than women investors.

“Self-attribution bias”, “self-deception” and “hindsight bias” are other characteristics that feed the overconfidence. “Self-attribution” is intending that when after making their decisions investor face with a positive outcome, will view it as a reflection of their own abilities. But, will blame unsuccessful outcomes on bad luck or misfortune, rather than on their ineptitude. Doing this repeatedly will lead people to the pleasing but erroneous conclusion that they are very talented. “Self-deception” is the process of misleading ourselves to accept as true or valid what we believe to be false or invalid by ignoring evidence of the contrary position, in other words lying ourselves in the way to avoid self-detection. Instead, “hindsight bias” is understood as the tendency of people to believe, after an event has occurred, that they predicted it before it happened. This bias can lead people to believe that an event was more predictable than it actually was, and can result in an oversimplification in cause and effect.

Base rate neglect combined with overconfidence can lead to representativeness bias.

Base rate neglect

Base rate neglect, also called base rate fallacy, is a cognitive error where it is noted a tendency for people to erroneously judge the like hood of a situation by not taking into consideration all relevant data but focusing excessively on new information without being conscious how the new information will affect the original assumption. In the other words, an investor exhibiting base rate neglect its placing too little weight on the base rate since he doesn't consider the probability that new information fit the category into which has been placed. Therefore, when subjected to base rate neglect, Bayesian statics whereby individuals form base rate too little weight is placed on the prior probabilities (base rates) and too much on the new information. Base rate neglect it is the contrary of conservatism whereby the base rate is overly weighted.

Representativeness bias

With representativeness (or similarity) is intended a bias where people underweight long-term averages, and it leads people to form probability judgements that systematically violate Bayes's rule. This cognitive heuristic it reflects the case where decisions are made based on a

situation's superficial characteristics rather than a detailed evolution of the reality, it involves making predictions about unknown outcomes based on similarity. Representativeness bias is essentially stereotyping,⁶ and via underweighting the base rate is likely to cause overreaction. A series of good or bad news can cause the stock market to overreact, causing several implications to investment decision making. Common examples of representativeness are: i) assuming that the past performance of an investment is an indication of its future performance; ii) assuming that shares in a high-profile, well-managed company will automatically be a good investment. The first idea, may lead investors to buy stocks that have recently increased in price. Dhar & Kumar (2001) investigating the price trends of stocks found that investors prefer to buy stocks that had recently enjoyed some positive abnormal returns, consistent with the thinking that the past price trend is representative of the future price trend. While, the second idea even if it sounds reasonable, it ignores the possibility that the shares price already reflects the quality of the company and thus future return prospect may be moderate. Therefore, these glamour companies are often poor investments.⁷

Representativeness also leads to another bias, sample size neglect. Which it means that in cases where people do not initially know the data-generating process, they will tend to infer it too quickly based on too few data points. Consequently, when people judge the probability that a data set was generated by a particular model they often will fail to take the size of the sample into consideration. The belief that even small samples reflect the properties of the parent population is sometimes known as the "law of small numbers".⁸ In the cases where the data-generating process is known in advance, the law of small numbers leads to gambler's fallacy effect.

Communal reinforcement, selective thinking, confirmation bias and self-deception (described above) are other psychological explanations as to why a large number of people have a strong belief in representativeness. The first, communal reinforcement, is intended as a social construction where a strong belief is formed when a claim is repeatedly asserted by members of a community, rather than due to existence of empirical evidence for the validity of the claim. The second, selective thinking, is the process by which one in order to justify a belief it ignores unfavorable evidence and focus only on favorable ones. Indeed, confirmation bias – a type of

⁶ Shefrin (2005)

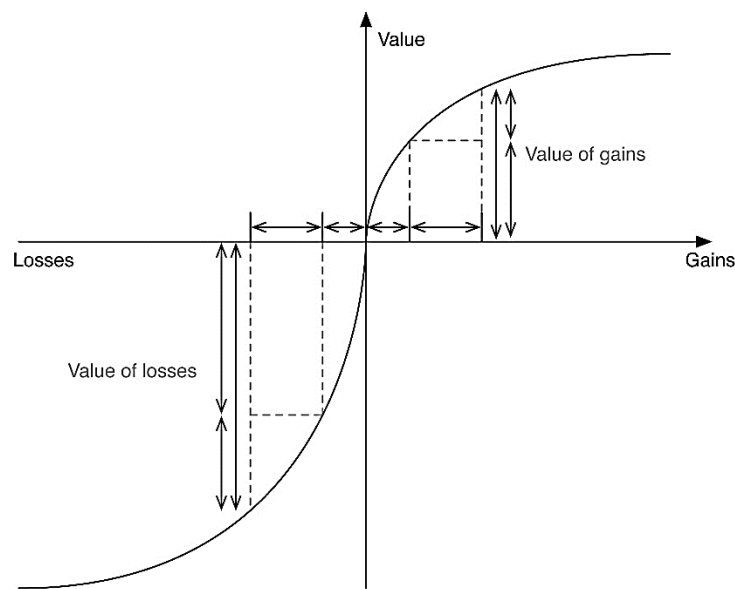
⁷ Lakonishok, Shleifer, & Vishny (1994)

⁸ Rabin (2002)

selective thinking - is intended as the situation where people misinterpret evidence that goes against their hypothesis as actually being in their favor.

Loss aversion

Financial theories states that there is a trade-off between risk and return. From this point of view riskier investments should offer higher rates of return as compensation for higher risk. According with Kahnemand and Tversky's (1979) people get utility from gains and losses in wealth rather that from absolute levels therefore, people are more sensitive to loss than to risk and return. The basic intuition concerning loss aversion is that losses (outcomes below the reference state) loom larger than the corresponding gains (outcomes above the reference state), so the losses and disadvantages have a greater impact on preferences than gains and advantages, as it shown on the picture below.



Some estimates suggest people weight losses more than twice as heavily as potential gains. Since our framework is intertemporal, people make use of more recent evidence on dynamic aspects of loss aversion. Consequently, the degree of loss aversion depends on prior gains and losses. In one hand, we have that losses are less painful than usual when coming after prior gains since cushioned by those. On the other hand, it is more painful than usual a loss coming after other losses since people became more sensitive to additional setbacks.

People that try to avoid locking in a loss is another finding included on the idea of loss aversion. Meaning that investors shows highly risk-averse behavior when facing a profit, but when they face a loss they continue to hold the investment hoping its price rises again, showing in this way risk tolerance or risk seeking behavior. Shefrin and Statman states through their theory “dispositive effect”, which is a development of the idea of loss aversion, that individuals tend to sell winners and hold losers, and that this tendency harmed investment returns.

Loss aversion and risk aversion are both consequences of the status quo bias/endowment effect.

a. Endowment effect

The endowment effect signifies that due to loss aversion an individual value something which they already own more than something which they do not yet own in the sense that they demand more money to give up an object than they would be prepared to pay to acquire it. In other words, they value a good or service more once their property right has been established. Therefore, the loss utility associated with giving up a valued good is greater than the utility gain associated with receiving it. The effect it still holds even if the good or service has not been purchased but received as a gift. Therefore, a tendency of people to stick to their actual strategies and behavior and their unwillingness to change them is reflected. The reflection effect (an occurrence of mental accounting) is another effect which might force during the process the endowment effect.

b. Status quo bias.

The status quo bias is also known as conservatism. Under the status quo bias investors tend not to change an established behavior unless the incentive to change is compelling. Because of the disadvantages of leaving it loom larger than advantages the individuals have a strong tendency to remain at the status quo. The evidence shows that once people have formed an opinion, they cling to it too tightly and for too long⁹. “Conservatism bias” it describes the idea of continuing with the initial decision without considering new contradictory information. It might be that they adjust their position in light of new information but only partially. It has been showed that people are unwilling to search for evidence that contradicts their beliefs, and in the case, they find such evidence, they treat it with excessive skepticism. However, there are several

⁹ Lord, Ross and Lepper (1979)

factors, such as cost of thinking, transaction costs, and psychological commitment to prior choices that can induce a status quo even in the absence of loss aversion.

Conservatism bias is capable of causing the asset price to overreact or underreact to good news or bad news. The status quo bias can lead to anchoring.

Anchoring

Anchoring is another cognitive heuristic which describes the tendency to make decisions based on an initial 'anchor'. According with Kahneman and Tversky (1974) people when forming their estimates often start with some initial and then adjust away from it. Experimental evidence shows that the adjustment is often insufficient. In other words, people "anchor" too much on the initial value. Therefore, anchoring could be understood as the use of irrelevant information as a reference for evaluating or estimating some unknown value or information. Consequently, the market participants with an anchoring bias tend to hold investments that have lost value because they have anchored their fair value estimate to the original price rather than to fundamentals.

When market participants realize that their anchor is imperfect they make some attempts to make adjustments reflecting subsequent information and analysis. However, these adjustments are often nothing more than anchors of a different sort and produce outcomes that reflect the bias of the original anchors. Therefore, anchoring can cause the stock market to underreact to fundamental information.

Availability bias

People often search on their memories for relevant information when judging the probability of an event. This procedure, even if it seems reasonable, it can produce bias since not all memories are equally retrievable or "available" according with Kahneman and Tversky (1974). The evidence shows that more recent events and more salient events will weigh more heavily and distort the estimate. In this way, the recently observed or experienced events strongly influence decisions. For example, investors are more likely to be fearful of stock market crash when one has occurred in the recent past. Availability is also understood as the use of knowledge that is readily available, rather than the examination of other alternatives or procedures.

Mental accounting

People sometimes separate decisions that should, in principle, be combined. Mental accounting¹⁰ is the process through which people think about and evaluate their financial transaction. When thinking about money and risk our psychological self is separating our wealth into various buckets or pools. The mental accounting it might be a “downside protection” or “upside potential”. The downside protection mental account is designed for protection from poverty, which results in conservative investments designed to avoid loss. In this case we have investors behaving as if they are risk-averse when risk is measured by the standard deviation returns. While, the upside potential mental account is designed for a chance at riches, which results in investments in risky assets in the hope of high returns. In this case we have investors behaving as if they are risk-seeking when risk is measure by standard deviation of returns. Therefore, depending on which mental account investors are thinking they can simultaneously display risk-averse and risk-tolerant behavior.

One important feature of mental accounting is framing. According with Ritter (2003) framing is the notion that how a concept is presented to individuals matters. In other words, framing is referring to the way a problem is posed for the decision maker. Traditional finance recommends treating all investments as a portfolio (single pool), and consider how the risks of each investment offset the risks of others within the portfolio believing that people consider its wealth comprehensively. Behavioral finance, instead, notes that people are focusing on individual securities or simply their financial assets.

Numerous experimental studies suggest that people often appear to pay attention to narrowly defined gains and losses when doing their mental accounts. Two types of narrow framing are considered¹¹. First, investors are getting direct utility not only from consumption, but also from gains and losses in the value of individual stocks that they own. Recalling the concept of loss aversion, here we have that the degree of painful from a loss on a particular stock it will depend on that stock’s prior performance. Under this form of mental accounting, called “individual stock accounting” we have that individual stock returns have a high mean, are more volatile than their underlying cash flow, and are slightly predictable in the time series. In the cross section, there is a large value premium. Second, investors are getting direct utility not only

¹⁰ Thaler (1980)

¹¹ Barberis, N., & Huang, M. (2001).

from consumption, but also from gains and losses in the value of their overall portfolio of stock. In this case, the degree of painful from a drop-in portfolio value will depend on portfolio's prior performance. This form of narrow framing, called "portfolio accounting" is not as extreme as individual stock accounting. The aggregate stock returns have a high mean, excess volatility, and are moderately predictable in the time series, while risk-free rate is constant and low. Enlarging the investor's decision frame from individual to portfolio accounting it can be noted that mean value falls, individual stock returns become less volatile, and they become more correlated with each other. Moreover, the value premium in the cross section disappears. Therefore, it could be said that the investor's system of mental accounting affect assets process in a significant way.

Procrastination

Procrastination refers to needlessly delaying taking an action despite being aware that prompt action would be better. In other words, it's defined as the lack or absence of self-regulated performance and the behavioral tendency to postpone what is necessary to reach a goal. Procrastination it is not just a problem of time management but a complex process that involves affective, cognitive, and behavioral components. Being that people are preferring more comfort activities or to avoid emotional distress and therefore inclined to cling (together with endowment effect) to their existing portfolio rather than to sell stocks, procrastination it affects in particular way financial planning and investment strategies. Procrastination it may avoided to some extent by simplification. Moreover, adequate default rules will help investors as they are not obliged to take actions rather than stick to "take it as it comes".

Herding

The herd behavior is the tendency of some individuals to mimic the actions (rational or irrational) of a larger group. In other words, following the "main stream" which is being represented by a peer group or a peer leader, doing so they ignore signs and indicators that would lead them to different assessments of the actual situation, given a rational behavior. Under herding bias, it is notes a natural tendency of individuals to simplify complex decision taking processes leading them to just copy decision of others. The reasons why herd behavior its showed may be different. The first is the social pressure of conformity, showed by people who are very sociable and have a strong desire to be accepted by a group, rather than be branded as an outcast. Consequently, following the group it might be an ideal way of becoming a member. The second

is the common rationale, that it is unlikely that such a large group could be wrong. This is more frequent in the case where an individual has very little experience. The individual follows the herd believing that they know something that he doesn't, even if he is convinced that that particular idea or action is irrational or incorrect. A strong herd mentality can even affect financial professionals. The investment strategy based on herding is not very profitable. Investors affected by this bias, constantly buy and sell their investment assets in chase of the newest and hottest investment trends. But, buying and selling frequently it incurs in substantial amount of transaction cost, which can eat away available profits. Moreover, entering the position correctly when a trend is starting is extremely difficult, since by the time the investor has known about the newest trend, most other investors have already take advantage of this news. Herding can, also, lead to bubbles and crashes in markets.

Therefore, even if in general groups are used to make decision to benefit from the range of knowledge and experience, the desire for social acceptance may encourage individuals with conflicting views to fall into line or those with opposing views may start to doubt their own convictions. It has been showed that groups of unrelated persons, crowds, are often able to identify correct answers to problems. This because it is a wider range of knowledge and experience and individuals give their opinion independently of the opinions of others. Therefore, we can deduce that for group behavior being positive it is needed to make sure that the committee is appropriately diverse because if both heads think in the same way than two head aren't better than one. And, individuals must be encouraged to give their own opinions rather than following the views expressed by one or a few dominant individuals.

2.3 Behavioral portfolio theory

Economist have been motivated to develop alternative models by observing the human behavior because of the failure of the classical expected utility theory (EUT). For several decades, Markowitz's Mean Variance Theory (MTV) has been considered as the starting point of modern portfolio theories. Mean variance investors choose portfolios by considering mean and variance. The variance, portfolio risk, depends on the correlation between the returns of the assets in the portfolio. The covariance and the correlation coefficient provide a measure of the way the two assets move together. The portfolio with least risk will be the portfolio that has the minimum variance that is the portfolio composed of the risky assets that has the smallest deviation. The

mean-variance theory, considered as construction theory, provides the necessary tools to construct a portfolio for investors who only care about the expected returns of their portfolios and their risks. The mean-variance theory prescribes the optimal mean-variance portfolio to investors who accept its assumptions.

According to Shefrin and Statman (2000), the behavioral portfolio theory optimal portfolio is typically not mean-variance efficient, since when confronting the behavioral portfolio efficient frontier with the mean-variance efficient frontier they do not coincide. They developed the behavioral portfolio theory on the foundation of SP/A theory (Lopes (1987)) and prospect theory (Kahneman and Tversky (1979)). Both SP/A theory and prospect theory are theories of choice under uncertainty.

The SP/A theory was developed by Lopes as a psychological theory of choice under uncertainty. It can be regarded as an extension of the safety-first portfolio model. Investors in safety-first portfolio theory aim to minimize $\Pr \{W < s\}$, the probability to ruin.¹² In other words, when investors' wealth W falls short of a subsistence level s the investor is ruined. Under normally distributed returns in Roy's safety-first model an investor chooses a portfolio P to minimize the objective function: $(s - \mu_P)/\sigma_P$. Therefore, safety first is a general concern about avoiding low levels of wealth. According to Roy, even if the returns are not normally distributed the same objective function is applied since all optimal safety-first portfolios lie on the mean-variance frontier. But, according to Shefrin and Statman, this is not true since optimal safety-first portfolios are not mean-variance efficient. In SP/A theory, the S stands for security (analogous to safety in safety-first), P for potential (a general desire for reaching high levels of wealth), and A for aspiration (a generalization of the safety-first concept of reaching a specific target value, such as s). In Lopes' framework, fear and hope are the two emotions that operate on the willingness to take risk. Fear is underlying the concern for security, and underlies the concern for potential. In one hand, fear operates through an overweighting of the probabilities attached to the worst outcomes relative to the best outcomes, in this case individuals are acting as if they were excessively pessimistic when computing $E(W)$. In other words, individuals understate the probability of achieving the highest level of expected utility. On the other hand, hope has the inverse effect of fear, optimism causes hopeful investors to overstate the probability of achieving the highest level of expected wealth. Lopes concluded that emotions of fear and

¹² Roy (1952)

hope reside within all individuals, and that each emotion serves to modify the decumulative weighting function D .¹³ She suggests that the final shape of the decumulative transformation function h is a convex combination (shaped like a smile) of h_s (for fearful investors worried about security) and h_p (for hopeful investors looking for maximum potential), reflecting the relative strength of each.

The second theory used as a foundation for the behavioral portfolio theory is the prospect theory from Kahneman-Tversky. This theory describes how individuals make a choice between probabilistic alternatives where risk is involved and the probability of different outcomes is unknown and it tries to capture people's attitude to risky gambles as parsimoniously as possible. Kahneman-Tversky argued that normative approaches are doomed to failure, because people routinely make choices that are simply impossible to justify on normative grounds, in that they violate dominance or invariance. Prospect theory also simultaneously explains preferences for insurance and for buying lottery tickets. Prospect theory can explain mental accounting which it's combined with the Lopes' SP/A theory for developing the behavioral portfolio theory.

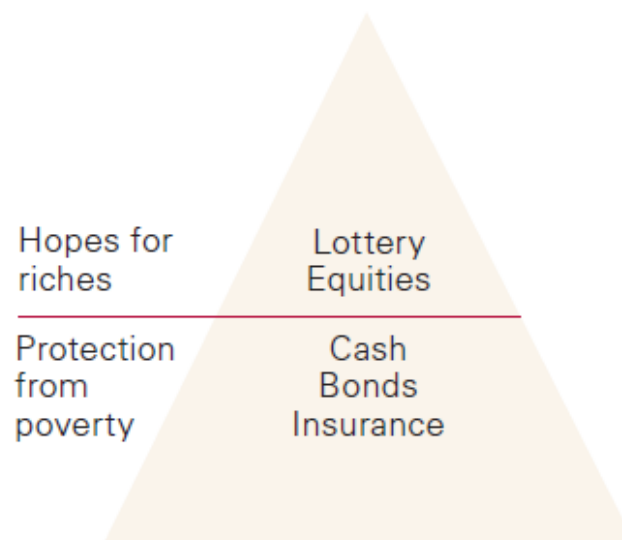
2.3.1 Behavioral portfolio with a single account version (BTP/SA) and behavioral portfolio theory with multiple accounts (BTP/MA)

Shefrin and Statman presented two versions of behavioral portfolio theory. First, a single mental account behavioral portfolio theory (BTP-SA) which considers the portfolio as whole. The framework of BTP-SA is like portfolio selection in mean-variance framework. The BTP-SA frontier is obtained by maximizing $E_h(W)$ for fixed $\Pr \{W < s\}$, where $E_h(W)$ is the expected value of W under the transformed decumulative function $h(D)$. BTP-SA investors select the optimal portfolio along the BTP-SA efficient frontier by maximizing $U(E_h(W), D(A))$, where $D(A)$ is the probability that the payoff will be A or higher, and corresponds to $\Pr \{W < s\}$ on the safety-first model. Under the behavioral portfolio theory with multiple accounts (BTP-MA) investors, in contrast with the BTP-SA, isolate their portfolios into mental accounts and overlook covariance among mental accounts. As described above, mental accounting is the tendency of people to separate decision that should, in principle, be combined. Investors have different level of aspirations, there are some that have low aspirations and others that have high aspirations. But,

¹³ The decumulative weighted function is basically 1 - cumulative distribution function, it measures the curve to the right (instead of the left) of a given point.

most of them are trying to combine low and high aspirations, doing in this way they want to avoid poverty and want also a shot at riches. Shefrin and Statman watched the BTP-MA as a layered pyramid, with each layer a separate mental account, where the bottom layer is designed to avoid poverty which results in conservative investments, and a top layer designed for a shot at riches which results in investments in risky assets in the hope of high returns. Therefore, investors in their portfolio will have bonds for their low aspirations, which resemble risk-free or investment grade bonds, and lottery tickets for the high aspirations which resemble speculative (junk) bonds.

Shefrin and Statman concluded that investors in BTP/MA match mental accounting with goals and their mental accounting are desegregated. Consequently, it might be that they combine a short position in a security in one layer with a long position in the same security in another layer. In other words, investors may borrow for leverage in their aspiration accounts, while lend in their low aspiration accounts.



Source: Adapted from Statman (1999) 'Foreign Stocks in Behavioural Portfolios' *Financial Analysts Journal*, March/April 1999, p14.

2.3.2 Where behavioral portfolio theory meets Markowitz theory

As it noted above, Shefrin and Statman (2000) showed that the BTP optimal portfolio is typically not mean-variance efficient. In the recent years have been some studies providing some evidence that some features of behavioral portfolio theory and mean-variance theory almost make

their assets allocations coincide, but this evidence have not been sufficient to conclude that investors can use BTP and MVT interchangeably. The assumption of normally distributed stock returns it was the weakness of all these studies. A study made on 2016 by Pfiffelmann, Roger and Buorachnikova try to find the point where the behavioral portfolio theory meets the Markowitz theory.

For constructing their model, they used the dataset of the daily stock prices of 1,452 U.S. stocks from the CRSP database for the period 1995-2011. Since BPT investors determines their optimal portfolio by maximizing an objective function based on subjective expected portfolio returns, they assumed a single period economy and generate a series of expected returns from historical returns. They built a set of 100,000 portfolios and added a limit of 80 of the stocks than an individual can hold, ensuring in this way a good level of portfolio diversification. Two situations were considered. First situation, the investors cannot short stocks. In this case, for a good diversification among different portfolios it was needed to generate portfolios with different number of stocks and different weight distributions. Second situation, short sales are possible. In this case, the algorithm generates portfolios that contain more stocks that they do when sales are constrained.

For determining the optimal behavioral portfolio and allocating it in the mean-variance space, they made an empirical estimation of the efficient frontier with the generated portfolios. It was checked, for each portfolio, if there was another portfolio with a higher expected return and a lower variance. If no other portfolio in the sample with that characteristics was found than the portfolio was considered to be located on the efficient frontier. The behavioral portfolio theory optimal portfolio satisfies the sequent function: $\max E_{\pi}(W)$ u.c.p $(W < A) < \alpha$, where W is the final wealth distribution of the investor, A is the aspiration level and α the acceptable probability of ruin. The set of portfolios that satisfies this constraint is denoted by S^* . The S^* portfolio that maximizes the expected return with subjective decision weights $E_{\pi}(W) = y' \pi$ (with y equal to the value of portfolio and π as the vector of decision making), is the BTP optimal portfolio. Checking whereas this portfolio was part of the set of portfolios located on efficient frontier S^{ef} was the final step. It was found that the Shefrin and Statman's portfolio it was mean-variance efficient in over 70% of cases. In their model, Shefrin and Statman, consider an investor who transforms probabilities into decision making, but investors also make decisions based on change of wealth rather than on total wealth and can exhibit risk-seeking behavior when faced with losses.

Therefore, individuals determine the subjective value of each monetary outcome via a value function. Their aim was to check if the same results occur for a Cumulative Prospect Theory (CPT) investor who subjectively transforms monetary outcomes via a value function. Hence, the BPT_{CPT} optimal portfolio is the portfolio that maximizes the inner product $E_{\pi} [v(W)] = v' \bar{\pi}$ (where v is the vector of modified outcomes, the vector of decision making has also been modified). It was showed that this new portfolio leads to similar results in terms of mean-variance efficiency. Despite the assumption were different, they showed that mean-variance theory and behavioral portfolio theory lead to similar portfolios in the mean-variance space.

The way investors define their optimal BTP and BPT_{CPT} portfolios leads to portfolios characterized by a high level of risk and a high level of returns. Investors initially satisfy the safety-first criteria, deciding whether will invest and enter the market. Then, investors use probability weighting to invest remaining wealth in securities characterized by a high potential payoff. Consequently, the BTP optimal portfolio is absent during financial crisis. It was noted that for almost entire period of study these portfolios displayed highly positive skewed returns.

Another investigation made by Pfiffelmann, Roger and Buorachnikova was to find whether efficient BTP and BPT_{CPT} would be chosen by typical Markowitz investors by examining the location of these portfolios on the mean-variance efficient frontier. They found that the typical Markowitz investors would typically avoid investing in such portfolios, because these portfolios having high level of risk and high return lie on the extreme upper right part of the frontier. And, the risk aversion coefficient associated to BTP and BPT_{CPT} optimal portfolios are up to 10 times lower than the degree of risk aversion shown by typical individual mean-variance investors. Investor that exhibit risk-seeking behavior when potentially high gains are reachable and are attracted by positively skewed returns will chose the BTP and BPT_{CPT} portfolios.

2.4 Behavioral asset pricing models

Asset pricing models can be characterized as theoretical or empirical. The first, begin with theoretical for investor preferences as well as investor cognitive errors, and misleading emotions and proceed with an examination of empirical evidence about associations between asset returns and features reflecting preferences, cognitive errors and misleading emotions. Indeed, the second, make the inverse, it stars with empirical evidence and proceed with an examination of possible

theoretical rationales for the associations. Market efficiency, explained above, must be tested jointly with an asset pricing model, such as the CAPM or the three-factor model.

The capital asset pricing model (CAPM), introduced by Sharpe (1964) and Lintner (1965), is the traditionally asset pricing model widely used for the pricing of risky securities. CAPM, built on Markowitz's mean-variance portfolio theory with the added assumption that all investors accept the mean-variance prescription, defines the trade-off between the existent risk and the expected returns. According with this model, an investment should be taken if the expected return meet or beat the required return, and the expected return is defined as the rate on a risk-free security plus a risk premium. The results for all the different risks (betas) are plotted on the security market line. Indeed, Fama-French three-factor model expand the CAPM by adding size and value to the market risk factor in CAPM. Therefore, if in CAPM the expected returns are presented as a function of the objective risk, which is based on the probability distribution of investment outcomes, in the three-factor model the expected returns are presented as a function of beta, a measure of objective risk, but also as a functions of market capitalization and book-to-market ratios. But, how if non-rationality/ cognitive errors affecting these models?

There is a considerable evidence that affects play a role in pricing. When we hear a name of a stock, before thinking about its price-to-earning ration or the growth of it's company's sales, we admire or despise it just by the feeling that occurs rapidly and automatically, often without consciousness. According with Statman, Fisher, and Anginer (2008), affects mislead the investors to favor stocks of admired companies exuding positive affect over stocks of despise companies exuding negative affect even when the expected returns of admired companies' stocks are lower than the expected returns of despise companies' stocks. Statman (1999) described a behavioral asset-pricing model that includes utilitarian factors, such as risk, but also expressive or affect characteristics. Where the utilitarian benefits are including low risk and high liquidity, and expressive and emotional benefits are including the virtue of socially responsible mutual funds, the prestige of hedge funds, and the trill of trading. As noted before, emotions can be useful or valuable, and the reliance on emotions will increase with the complexity of information and with stress. Since stocks are especially complex and their evaluation is stressful the emotions plays a crucial role, even if investors try to overcome emotions/affects through a systematic examination of relevant information. There are two types of affects, integral affect and incidental affect, that

influence the decision-making of investors. The first, is associated with the characteristics of a particular object, and the second it arises from an unrelated event.

Statman, Fisher, and Anginer (2008) developed a four-factor analysis. They showed that companies in the admired portfolios have lower objective risk than companies in the despised portfolios, and the characteristic of small, value and low short-term momentum are associated with the despised portfolios. Two factors of behavioral asset pricing model are the objective risk measured by beta and the subjective risk measured by affects. The expected return, under the behavioral asset pricing model, are high when objective risk is high, and also when subjective risk is high. Whether the CAPM, based completely on objective risk, it expects a positive correlation between risk and expected return (the higher the risks the higher the expected return), in behavioral asset pricing model, which considers also the subjective risk, this correlation it's expected to be negative. This indicates that investors assessment of risk reflects subjective risk associated with affect. Hence, when affect is positive benefits are judged high and risk is judged low, and if affect is negative benefits are judged low and risk high. Therefore, markets with high expected returns were perceived to have low risk. Short-term momentum is another factor of this analysis, which is positively correlated with affects and generally is associated with high returns. But, this association is not due to the role of short-term momentum as a proxy for affect. Since, either market capitalization is positively correlated with affects but generally is associated with low returns. It was also noted that if the effects of typical investors on stock returns are nullified by arbitrage the subjective risk stemmed from affects will play no role in asset pricing model.

Chapter 3: Risk tolerance

Cognitive biases have a crucial importance in defining the risk profile of a client. Therefore, in this chapter, there will be an analyzation of the literature regarding the risk tolerance in the first part. While in the second and third part, there will be an analyzation of the measurement of risk tolerance and how MiFID questionnaire is designed.

3.1 Literature review

In the rational theories, Von Neumann Morgenstern developed the theory that measured how much an individual is desirous of return by the size of the risk he is willing to take for getting it. MIFID legislator, which was explained in the first chapter of this thesis, among the information that intermediaries must obtain it includes the client's risk propensity and risk profile in order to comply with the suitability requirement when providing financial advice or portfolio management. Another important legislation that has the power to impose the advisors to understand a client's risk tolerance is the U.S. Securities and Exchange Commission (SEC), which enforces the "know your client" rule.

In order to avoid client mistrust and create a solid relationship between client and intermediary it must be identified the accurate client's risk attitude. Where risk attitude is defined as a psychological attitude, which regards the individual's economic and financial position.¹⁴ In other words, the risk attitude is the risk one chooses to incur. Indeed, the risk tolerance of a client is defined as the level of financial risk that an investor is willing to take. Grable (2008) defined the financial risk tolerance as the maximum uncertainty someone is willing to accept when making a financial decision, and (Irwin, 1993) defined it as the willingness to engage in a financial behavior in which the outcomes are uncertain with the possibility of an identifiable loss. Moreover, Gibson (2013), defined the financial risk tolerance as a comfort level that an individual is willing to accept while risking their current wealth for future growth. Financial advisors, by accurately assessing risk tolerance, can properly allocate a client's portfolio and balance the client's perceived trade-off between risk and return. According with Callan and Johnson (2002), understanding the risk tolerance can be instrumental for identifying any mismatches between a client's psychological and financial needs. Even if sometimes the risk

¹⁴ Cordell, 2001

tolerance might be considered as the risk aversion formulated by classical economic theories, the most recent contribution refers to a more structured definition which combines the classical notion of risk aversion with risk propensity, risk attitude, risk capacity and risk knowledge. Where risk propensity is understood as the investor's financial decisions or allocation predisposition. Risk capacity refers to how much risk one can afford to incur, and risk knowledge measure how well an investor understands both risk and the risk/return tradeoff.

Individuals having different levels of financial risk tolerance are expected to act differently when making investment decisions, and those having a high level of risk tolerance, i.e., low aversion risk, are investing more aggressively. The risk tolerance is also influencing the way individuals invest their resources for short- and long-term objectives, such as saving for a significant purchase and retirement. The measure of risk tolerance has had a particular attention not only in the field of economists but also in the field of finance, business, natural hazard and natural and man-made disasters. In the recent times, the idea of better understanding the risk tolerance a household financial and costumer psychological perspective. The researches of all fields through normative and descriptive models have searched to clarify the likelihood of taking risks, and outcomes form risky actions. While the first normative model is the Expected Utility Theory (EUT), the descriptive models are based on behavioral and/or psychological viewpoint.

The EUT developed by Von Neuman and Morgenstern suggested that customers should select choices with the highest expected outcomes. Weber and William (1997) stated that risk preference, in the expected utility framework, is operationalized as risk attitudes that are descriptive labels for the shape of the utility function presumed to underlie a person's choices, and a person will be classified as risk averse if he/she choices sure amount of money over a lottery with equal expected value. As noted early, the expected utility theory in its basis is assuming that consumers are rational and the risk preference remains constant over time. Consequently, a consumer, despite the situation or event, is expected to make the same choice in terms of riskiness. An extension of EUT was originated by Markowitz (1952), the so-called Modern Portfolio Theory (MPT), which predicts that investors should be willing to take additional risk if the return associated with the risk is high. It has been showed by Hanna and Chen (1997) that risk aversion has little impact for consumers investing for the long run, but it makes a significant difference for those investing with shorter time horizon. Being that the utility

function shape is measured using an individual's response to a series of hypothetical income gamblers, the risk tolerance is important within the Expected Utility function.

Researches of psychologies, behavioral sciences and financial planning have pointed out some discrepancies with EUT, even if the Expected Utility Theory has been a favorite method for conceptualizing risk tolerance and risk-taking behaviors. Furthermore, it has been showed that "few people have a constant risk aversion throughout the entire domain of wealth".¹⁵ Damasio (1994) in respect with the traditional economic theories states that to obtain the best results the emotion must be kept out. However, the emotions don't necessary damage the thoughtful decision-making. Some empirical studies have shown that investors having difficulties in associating their emotions with decision make very poor decisions in some context and take risk even when they result in disastrous losses. As noted before, the behavioral finance argues that investors are not fully rational and the cognitive bias can be used to explain the deviations from fully rationality. According with behavioral economists, risk is multi-dimensional and it's affected by psychological characteristics, emotional factors and cognitive limitations. However, Loewenstein, Weber, Hsee and Welch (2001) observed limitation of both classical economics and behavioral finance, since the decision making under uncertainty was based also on the affective response rather than only on "cognitive/rational" assessment of the risk. Therefore, they proposed the "risk-as-feelings hypothesis" which relies on the concept that emotions often overcome rationality when taking decisions under uncertainty. The risk-as-feelings hypothesis is positioning in the front the notion that emotional reaction to risky situations often diverge from reasoned assessments, and when this is happening emotional reaction, such as worry, fear, dread, and anxiety, directly influence behavior. Consequently, the framework of risk-as-feeling it helps to better understand both risk tolerance and risk-taking behaviors.

Affective and cognitive aspects make the perceived risk different from the objective risk. Therefore, all the cognitive errors explained in the chapter two can lead to a different perception of risk. According with MacGregor (2000), also the positive or negative judgement based on mental association, that has nothing to do with the economic or financial assessment, may affect the risk perception. Risk tolerance is also changing according to the context. Consequently, the people's actual attitude to financial risk must be measure explicitly in the financial context.

¹⁵ Friedman and Savage, 1948

Two are the categories including the tools used to discover the risk attitude and risk preference. While the first category relies on economic/quantitative measurement, the second is based on psychology and psychometrics.

The quantitative analysis techniques, based on the specification of a utility function and on the estimation of the parameters for that function, is the foundation of economic/quantitative approach. The parameters of the estimation for the utility function correspond to risk aversion and to a subjective discount rate. The data collected for these estimates it might be from controlled experiments (where people make hypothetical choices within an appropriately designed context), or from an uncontrolled environment or by survey data. One of the most popular tools for making these estimates is the Multiple Price List (MPL)¹⁶. The main vantage of MPL is that it is transparent to subjects and provides simple incentives for truthful revelation. People are asked to make a series of consecutive choices between two outcomes, where the expected value of one outcome increases at a higher rate than the other. It is used as a measure of risk aversion the point where an individual switch from choosing one outcome over the other.

The theory and technique of psychological measurement, which includes the measurement of knowledge, abilities, attitudes and personality traits, are the basis of psychological approach. In the 1960s, Zuckerman developed the “sensation-seeking scale” with the purpose of better understanding personality traits such as neuroticism, antisocial behavior, and psychopathy. The questionnaire was designed by Zuckerman for measuring how much instigation a person demands and the degree to which he/she enjoys the enthusiasm. This questionnaire, through investigating individual’s past experiences and their goals with respect to the future, can be used to assess their attitude to take risk. Another psychological approach is the “Iowa Gambling Task” (IGT), which is a psychological task thought to simulate real-life decision making. IGT was originally used to analyze the ability to choose of patients with prefrontal lesions and orbital cortex, because of their incapacity of remembering the past events they will choose randomly and make decisions without benefiting from past experience. However, this approach applied to decision-making process, by measuring the “somatic signals”¹⁷ experienced by people when making the choice, it allows to obtain an unbiased measure of their risk aversion. Then this measure can be brought into comparison with the self-assessed risk attitude and their

¹⁶ Holt and Laury, 2002

¹⁷ Damasio in the Somatic Marker Hypothesis (SMH) assumed that somato-visceral from the body (affective reactions) ordinarily guide individuals’ decision-making and risk engagement process.

real risk attitude in the real-life choices of people. Characteristics as self-confidence, difficulties in representing oneself, socio-demographic characteristics, and the expected returns associated with a certain self-representation will determine, according with Lucarelli and Brighetti (2010 and 2011), the gaps between these measures (simulate real-life decision making versus real-life decision making). Expect in the situations of crisis or bubbles in financial markets where emotions wake up as a sorting of sleeping factor and gain the upper hand leading to excessive risk-taking, it was noted that in normal condition individual would take financial risk based on self-assessment rather than emotional tolerance of risk.¹⁸ It was also observed that investors who makes use of advisory service would seem to be more balanced on taking risk than investors making choices autonomously.

Psychometrics also suggest some test for measuring the validity and reliability of a questionnaire. The first is verified by calculating the correlation between the measure obtained through the questionnaire and the measure of other relevant instruments, so-called concurrent validity test. Indeed, the questionnaire is reliable according with Roszkowski (2005) when it measures a construct consistently across time, individuals, and situations. Reliability is connected to the margin of error of the measurement, which depends on how many questions there are (smaller the number of questions less reliable is the questionnaire) and how clearly are written. The concept of clearness is important since questions related to a complex subject such as investment choices can lead to misunderstanding and confusion.

3.2 The determinants of risk tolerance

As mention before the factors affecting the risk tolerance are: age, gender, marital status, education, financial knowledge, and income. The two more influential factors on risk tolerance are education and financial knowledge. However, following these factors will be explained briefly.

Age

Different studies have lead to different results regarding to the effect that age has on risk tolerance level. However, it was widely accepted that the hypothesis of costant life-cycle risk aversion is not true. Different age groups are showing different choice of investemnt. Wang and

¹⁸ Lucarelli, 2011

Hanna, noted that the effect that age has on the risk tolerance increases as the ages increases. Also, Gramble (2000) stated that older persons would be more risk tolerant than younger persons. Instead, the findings of the Morin and Suarez's (1983) stated the contrary, risk aversion is increasing with age and therefore risk tolerance will decrease as age increases. According with Riley and Chow (1992), and Hallahan, Faff, McKenzie (2004 and 2009), there is a not-linear relationship between age and relationship, finding which was support also by Lucarelli and Brighetti, (2010). It was noted that the level of the risk self-evaluation was mainly the same until 60 years of age and then this level sharply decreases.¹⁹ A reason it might be the self-confidence, which is decreasing at the end of normal working activity life cycle. Lucarelli and Brighetti also find that the trend of the emotional risk attraction it shows high levels in the under-30 cluster then it reaches the lowest level when actual financial choice is the highest (the 30-45 cluster) and then, unpredictably, it increases regularly and sharply arriving at the top for individuals over 60-years. It seems that individuals in retirement are more risk-seeking in their behavior. But, since in real life retired people can recognize the interests of a prudent behavior, it can be deduced from the low level of the risk self-evaluation for over-60 years that their unbiased attraction risk is strongly unconscious.

Gender

Gender in contrast with age is less debatable, in general all agree that males are more risk tolerant than females. Sung and Hanna (1996) made an estimation on the effects of financial and demographic variables on the risk tolerance for household with an employed and found that households headed by a female member are less risk tolerant in comparison to a male head or a married couple. According with Barber and Odean (2001), the reason why male are more risk tolerant than women is simply due to the overconfidence since when it comes to investing men are more confident than women. Indeed, Powell and Ansic (1997) found through a computer-based experiment that females regardless of the degree of familiarity, frame or cost have a lower level of risk tolerance (higher risk aversion). Comparing the ratio of risky assets to net worth for the same age categories Coleman (2003) found that there was no significant difference for women and men younger than 40 years, instead for the age over 40 years women had a lower ratio than men in the same age category. Lucarelli and Brighetti (2010) confirmed that females tend to assume real life decisions at a level of risk much lower than men, but surprisingly females

¹⁹ Luccarelli and Brighetti, (2010).

emotional risk attraction is somewhat higher than those of males if females are considering themselves as someone who is risk averse and takes very cautious financial decisions. The reasons why researchers have concluded that men are more risk tolerant than women have been diverse, for example Chen and Volpe (2002) suggested that this may be because individual's understanding of financial knowledge, while Bernasek and Shwiff (2001) argue that this might be since women are more exposed to poverty when they are older than men because their accumulated wealth doesn't reach those of males.

Marital status

Marital status because of its interaction with gender and age has been increasing the interest of the researchers. There are some controversial conclusions according to the effect/influence that marriage status has on the level of financial risk tolerance. While, Grable (2000) has concluded in his study that married respondents were more risk tolerant than single respondents. Hallahan, Faff, and McKenzie (2004), Yao (2004), and Fan and Xiao (2000) have stated that single individuals are more financial risk tolerant, and the reason it might be the tendency that married individuals have greater need for wealth protection. Increased responsibilities that are accompanying marriage and children will have as consequence the reduction of risk tolerance level.²⁰ The estimation made by Luccarelli and Brighetti, (2010) have shown that there is a distinction between single individuals and widowed or divorced people. While the first possess the lowest capability may however, even if their emotional risk attraction is not noticeable relevant, develop a high self-evaluation of risk tolerance with corresponding high financial risk choices in real life. Whereas the second, widowed and divorced people, show the highest level of emotional risk attraction even if they reveal a good capacity.

Education

Education is a very important factor in understanding the process of an investment and therefore the risks it brings. According with Grable (2000), respondents with higher attained education were more risk tolerant than others. Different other studies have also shown that a higher level of achieved education tends to increase an individual's capacity to evaluate risks intrinsic to the investment process and therefore endows them with a higher financial risk tolerance. in general, almost all researchers concluded that education was positively correlated

²⁰ Daly and Wilson (2001)

with risk tolerance. It was also found by Bellante and Green (2004) that differences in education level accounted for larger variations in asset allocation more than any other variable they examined. Instead, Hallan, Faff and Mckenzie (2003 and 2004) stated that education, as marital status, have no significance in explaining the individuals risk attitude.

Financial knowledge

The behavior of an individual is obviously influenced by its knowledge. Two important components of financial knowledge are: objective knowledge and subjective knowledge. The first it might be understood as what an individual actually know (accurate stored information), while the second is an inclusion of individuals degrees of confidence in his/her knowledge (belief about that state of knowledge). These two categories are affecting in different way the behavior. A high level of objective knowledge induces investors to employ a category based process, in this way they could process the information at category level rather than based on individual attributes. While, subjective knowledge is confidence-driven, evaluating newly information acquired with the confidence of knowing. Different researches have proposed an interplay between these two categories of financial knowledge, since a positive relationship exist between objective knowledge and self-accessed knowledge the result is that objective knowledge may enhance the subjective knowledge. Wang (2009) showed that investors objective knowledge, subjective knowledge and risk taking are highly correlated.

According with Chen and Volpe (1998) financial knowledge is affected by factors such as: age, gender, and amount of experience. Grable (2000) concluded that respondents with higher level of financial knowledge were more risk tolerant that respondents with less knowledge. Instead, Davey (2004) suggested that educating the individual investors about financial market and instruments will not necessarily increase their financial risk tolerance since even the most knowledgeable and educated individual could potentially have a low risk tolerance.

Income

As for the gender, there is widely accepted that income has a positive correlation with risk tolerance. a greater level of wealth ensures access to more resources for investment and serves as a cushion against caprices of financial markets. Therefore, a higher level of income should encourage greater risk tolerance.

Table 1²¹ is a summarize of the determinants of risk tolerance and the way they are affecting it. As noted the widespread consensus is for gender and income. All researchers in their results seems to agree that: i) males are more confident and undertake riskier behaviors than females; ii) a higher income induces people to be risk seekers.

	Status of the art	Positive with RT	Negative with RT	No-relation
Age	Controversial	Palsson, 1996, Wang and Hanna, 1997; Grable 2000; Frijns, Koellen, Lehnert (2008)	Wallach and Kogan, 1961; McInish, 1982; Morin and Suarez, 1983; Riley, Chow (1992); Hallahan, Faff, McKenzie, 2003, 2004.	
Gender	Consensus: Riley, Chow (1992); Grable (2000); Barber, Odeam (2001); Hallahan, Faff, McKenzie, (2003); Frijns, Koellen, Lehnert (2008)	Males: within the finance domain, males are overconfident and undertake riskier behaviour than females.	Females	
Marital status - Single	Controversial	Hallahan, Faff, McKenzie, 2004	Grable 2000	Riley, Chow (1992); Hallahan, Faff, McKenzie, 2003
Marital status – married	Controversial	Grable 2000	Hallahan, Faff, McKenzie, 2004	
Education	Controversial	Riley, Chow (1992); Grable (2000); Hallahan, Faff, McKenzie, 2004		Hallahan, Faff, McKenzie, 2003
Financial knowledge/ expertise	Controversial	Grable 2000; Frijns, Koellen, Lehnert (2008)		Hallahan, Faff, McKenzie, 2004
Income	Consensus: Morin and Suarez, 1983; Riley, Chow (1992); Grable 2000; Hallahan, Faff, McKenzie, 2003, 2004	Higher income induces people to be risk seekers.		

²¹ Lucarelli and Brighetti, (2010). “*Risk tolerance in financial decision making*”. Springer, 2010.

3.3 Measuring risk tolerance

Given the presence of uncertainties on the financial markets, researchers and policy makers have considered the assessment of risk tolerance in the process of financial decision-making as an important factor. For this reason, researchers have long been interested in understanding the relationship between personal financial risk tolerance and factors as diverse as the life cycle and asset allocation choice decisions. However, the role of risk tolerance is not seen in the same way by all the stakeholders involved in the regulatory reform of financial services industry.

Regulators are increasingly taking steps to bring the financial services industry to fiduciary standards. In order to achieve this goal, they are requiring advisors to utilize method that justify the suitability of their recommendations. Being that the objective of regulators is achieve prudent investment management standards, they are also requiring to advisors to measure the risk tolerance of their client. On the other hand, investors need to mitigate adverse reactions to market oscillations, therefore they need valid and reliable estimates of risk tolerance.

Even if an accurately and efficiently measure of financial risk tolerance has been seen as a significant component of the financial counseling and planning process their supporters haven't agree on an unanimously method for measuring an individual's tolerance for investment risk. Therefore, there have been diverse ways for measuring the financial risk tolerance. A popular method for assessing the financial risk tolerance have been the Utility Theory. However, as noted early the utility theory cannot adequately represent the risk-taking preference and tolerance because according with Statman (1995) people tend to be consistently more willing to take risks when certain losses are anticipated, and are more willing to settle for sure gain when absolute gains ate anticipated. Given the difficulty of measuring and assessing the individuals risk tolerance some researches have suggested to only focus on the objective risk measurement. But, as noted before people are not acting rational and the asset allocation is a result of personal choice rather than the advice of a third party. Consequently, objective measures tend to be descriptive rather than predictive, do not account for the multidimensional nature of risk, and often fail to explain actual behavior.

In order to assess the financial risk tolerance, the literature suggested that at least five elements must be included: i) some central concept of risk; ii) relevance to respondents; iii)

allowance for the derivation of a risk measure; iv) ease of administration; and v) adequate validity and reliability.

3.3.1 The Survey of Consumers Finance Risk-Tolerance Item and the multidimensional risk measure

For obtaining an estimate of an individual's willingness to engage in risky financial behaviors a "multidimensional risk measure"²² has been used. This measure is especially useful for researchers using large dataset or for generating the estimates of risk aversion as an extension of expected utility theory. However, the Survey of Consumer Finances (SCF) and a 13-item financial risk-tolerance scale²³ have been more extensively used for assessing the financial risk tolerance since they are: i) available in the public domain, ii) easy to administer, and iii) relatively easily for responders to answer.

The Survey of Consumers Finance Risk-Tolerance Item

This survey attempted to measure risk tolerance directly through a combination of closed- and open-ended questions. Among family and consumer economists and personal finance researchers there is a question that continues to be used widely in most surveys for assessing the willingness of individuals to take financial risks. The question reads:

Which of the following statements on this page come closest to the amount of financial risk that you are willing to take when you save or make investments?

- 1. Take substantial financial risk expecting to earn substantial returns.*
- 2. Take above average financial risk expecting to earn above average returns.*
- 3. Take average financial risk expecting to earn average returns.*
- 4. Not willing to take any financial risk.*

There are several factors that have made this question so popular: i) the item is one of the only risk-tolerance questions asked in national surveys of consumers; ii) the wide use have been associated to high degree of validity measure.²⁴ However, the popularity of this measure has not gone without criticism. For example, Hanna, Gutter, and Fan (2001) criticized the fact that the survey of consumer finances question was "not rigorously linked to the concept of risk tolerance

²² Barsky, Juster, Kimball, and Shapiro (1997); Hanna and Lindamood (2004);

²³ The 13-item financial risk-tolerance was developed by Gramble and Lytton (1999);

²⁴ Grable and Schumm (2007)

in economic theory”. Instead, Gramble and Lytton (2001) conducted a study to determine the current validity of the item. By making a comparison between the 13-item risk tolerance measure and the SCF item they found that item does not fully represent the spectrum of financial risk tolerance and the measure was most likely a proxy for the narrower aspects of investment risk tolerance within the broader concept of financial risk tolerance. Gramble and Schumm (2007) conducted a study to examine the SCF item’s reliability by performing five tests in an effort. With reliability understood as how free an item or scale is from measurement error, in other words how consistent is a measure from one use to another. They concluded that the reliability of the single-item measure tends to be “relatively low”. However, Gramble and Schumm doesn’t rejected the use of the item based on the reliability test but finished saying that researches whenever use the SCF item should take prudent measures to account for standard error variance.

A multidimensional risk measure

Gramble and Lytton (1999) began the development of a measure that would consider multiple dimensions of financial risk measure. It was started from the method of Babbie (1983) which included 100 items, then were removed the question than measured construct other than financial risk tolerance (e.g., preferences for general risk seeking, tolerances for physical pain, etc.) and arriving in this way at 50 questions. Then it was collected data to conduct bivariate and multivariate item analyses to examine relationships between the remaining 50 assessment items. Therefore, all the question that showed inconsistency in correlation’s and those having a very strong relationship between items were eliminated from the pool of items, in this way the bivariate item analysis lead to 30 assessment items. Then, the multivariate item analysis it removed other 10 questions by conducted two tests: i) was eliminated each item that offered respondents a risk-free alternative or a non-response choice; ii) index scores were developed for each respondent using the remaining items. The final set of 20 question was measuring eight dimensions of risk, including: guaranteed versus probable gambles, general risk choice, choice between sure loss and sure gain, risk as experience and knowledge, risk as level of comfort, speculative risk, prospect theory, and investment risk.

Later a principal component factor analysis was performed on the 20 items to further investigate the issue of multidimensionality in the instruments and to assure a parsimonious measure. The purpose of this factor was to reduce and summarize data by identifying the underlying, or common interrelationships, which can then be conceptually explained as factors.

The result was a 13-item measure that tests the constructs of investment risk, risk comfort and experience, and speculative risk. It was also conducted a test of reliability by comparing scale scores to the SCF measure. Gramble and Lytton (1999) concluded that financial service providers, educators, and researchers are encouraged to use the instrument as a tool for quickly and accurately assessing the financial risk tolerances of clients and other respondents.

3.3.2 The five-factor model for measuring risk tolerance

During the financial crisis, a lot of criticism were made to the risk tolerance questionnaires since it was noted that they do not work as advertised. It was also noted that the current risk tolerance questionnaires were not consistent with one other. Therefore, Holzhauser, Lu, McLeod, and Wang (2016) made a study in order to obtain a more valid and reliable model for measuring risk tolerance. They used the factor analysis in the framework of the multi-item approach originally developed by Churchill (1979), since this approach was very useful for decreasing measurement difficulties for four reasons: i) the specificity of items can be averaged out; ii) precise distinctions can be made about clients; iii) reliability tends to increase; and iv) measurement error decreases.

They used the definition of risk tolerance defined by Cordell (2001) - the risk tolerance is a combination of four risk tolerance factors: risk propensity, risk attitude, risk capacity and risk knowledge. Therefore, they compared the Cordell's four factors to the risk tolerance they isolated using factor analysis. Other than the four factor of Cordell they included a variety of questions to test for other potential risk tolerance factors established in academic literature.

In this model, it was also taken account of the prospect theory by Kahneman and Tversky (1979 and 1984) by including questions referring to the three pervasive effects that they listed as violations of expected utility theory and by controlling the behavior that the investor's wealth is changing compared to the investor's reference wealth rather than how much wealth an investor has. The list of the violations of expected theory by Kahneman and Tversky was as follows: i) the reflection effect states that investors do not weight gains; ii) the isolation effect states that investors often disregard components that alternatives share; iii) the certainty effects states that investors may overweight probable outcomes.

Holzhauser, Lu, McLeod, and Wang (2016) developed an 85-item risk tolerance questionnaire categorized into five-factors based on the four factors in Cordell (2001) and an

additional personality factor. The questions were structured in this way: from 1 to 48 were referred to risk attitude factor, from 49 to 55 to risk propensity factor, from 56 to 66 to risk personality factor, from 68 to 70 to risk knowledge factor, and from 74 to 84 to risk capacity factor. Instead, the question 67 and 71 to 73 are referred demographic variables and the question 82 to 85 to dependent variables, those questions are not used in the factor analysis but were included in this model to obtain dependent variables for multiple linear regression analysis and for future research opportunities.

The goal of this model was to isolate the factors that influence the risk tolerance by performing the factor analysis on the risk tolerance questionnaire. Therefore, they eliminated the variables that cross-load on more than one factor and those variables that do not load highly on any specific factor. Thus, factor analysis reduced the questions from 85 to 25 questions. Holzhauer, Lu, McLeod, and Wang (2016) model for measuring the risk tolerance was called riskTRACK, the acronym TRACK was used to collectively identify the five individual risk factors that they found for measuring risk tolerance: traditional risk factor, reflective risk factor, allocation risk factor, capacity risk factor and knowledge risk factor. In addition to factor analysis, validity and reliability check were accessed to ensure that the five riskTRACK factors are robust.

3.4 Designing a questionnaire

Empirical studies have shown that financial investments, career paths, and health practices which are considered as choices under uncertainty have as common weakness the inability to take into account heterogeneity in preferences. Some studies, in order to take account of this heterogeneity have developed a quantitative proxy for risk tolerance based on responses from a large- scale survey.

According with Holzhauer and McLeod (2009) risk tolerance is identifies by five factors: generic risk attitude, risk capacity, loss aversion, risk knowledge and risk preferences. Therefore, for a questionnaire being valid each of these factors must be measured separately, including also the investment time horizon and investment objectives. It is necessary identifying with respect to each item the relevant questions, finding the right balance between reliability and the need for brevity. Where reliability is needed to be positively correlated with the number of questions. Here enters into the game the quantitative techniques which are a good help for making possible the

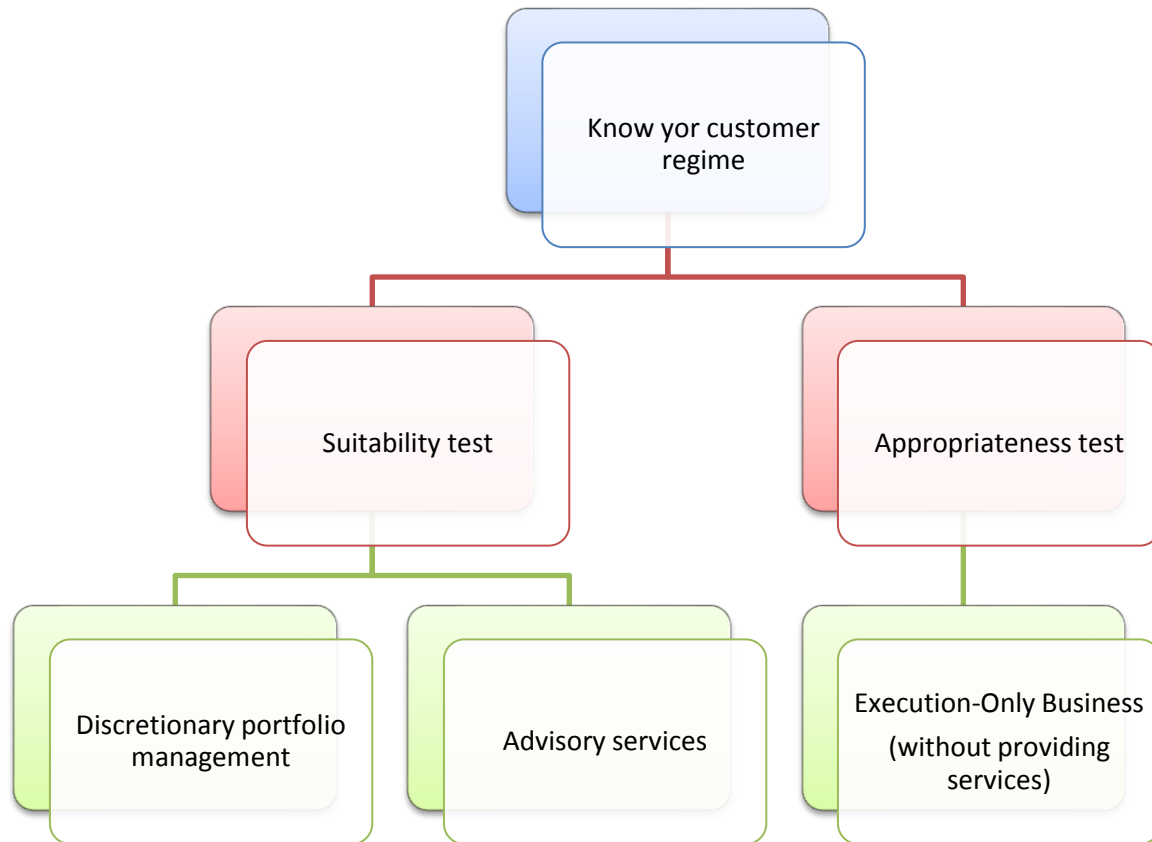
selection of questions on the basis of their significance and correlation with the quantity to be measured. While variable such as race, age, and gender are easily plotted, it is not the same for all questions. For example, wealth and income are only measured with a certain degree of approximation. Instead, overconfidence can only be proxied. The way questions are written is very important since wording can influence the reliability of questionnaires. Therefore, the questions must be clear and comprehensible and also must contain the errors in perception which might be driven by behavioral biases and cognitive distortions.

3.4.1 Questionnaire according with MiFID

The main objective of MiFID is to further integrate the European financial markets, for reaching this objective an appropriate level of transparency and information as well as investor protection against the complexity of the market is needed to be guaranteed. The confidence that consumers has on the financial markets is determined by the approach that financial firms follow for selling financial products and services. Successively, the consumer confidence in financial markets has implications for financial system stability as well as investor protection. Therefore, financial firms before selling any financial product or service to consumers have been considering the preferences and need of their clients. The function of revealing the consumer's needs and preference is a work of questionnaires. From this point of view, questionnaires may be seen as a better know one's client and as a tool for reducing the misunderstanding and as a protection for financial firms against possible complaints in the case of an unexpected loss. For firms providing investment services with the introduction of MiFID this practice become compulsory.

Thus, for avoiding the misunderstandings in the matter of Know Your Customer regime the investments firms when providing product and/or services to the clients should differentiate between two types of assessments to be undertaken: suitability and appropriateness test. To assess the suitability of financial instruments recommended to customers MiFID II is identifying the information that intermediaries must obtain in the cases they are providing investment advice or portfolio managements. MiFID directive requires that the products or services offered to a client must be appropriate and suitable. Where suitability is understood as the degree to which the product or service matches the client's situation, investment objectives, level tolerance, financial need, knowledge and experience. Instead, appropriateness is a sub-case of the suitability and is

defined as the point where the product or service offered by the intermediary matches the retail client's knowledge.



The points where suitability and appropriateness differ are as following: the field of application, the set of information, and operational effect. Regarding the first the advised services, investment services and portfolio management, a suitability questionnaire is needed while for non-advised services an appropriateness questionnaire is needed. The difference is also noted on the set of information required to the client. While the suitability questionnaire should be deeper and organized in three sections: the first dedicated to the investment objectives of the client, the second with focus on the financial capacity of client and it is linked with his financial ability to incur risk, and the third is intended to examine the experience and knowledge of the client aiming to understand if the client is able to recognize the risks absorbed in the product or investment service offered or demanded. The other field where suitability and appropriateness questionnaires is the compulsoriness (or not). The suitability questionnaire is compulsory meaning that it is a preliminary test of knowledge the firm cannot do without since it works as stopping step for the service provision. Instead, the appropriateness questionnaire is not a compulsory questionnaire. In this case if the client doesn't provide the needed information or the

information is incomplete/insufficient the firm is required to signal to the client that they cannot determine if the product or service is appropriate being that they are not in possess of the necessary information. Therefore, if the client refuses to give some information, the service may be provided all the same, but under disclosure obligation by firm.

Summarizing, the type of information required for a suitability test is as following: i) client's knowledge and experience; ii) overall financial situation; iii) investment objectives; and iv) other relevant circumstances. Instead, the information required for an appropriateness test is only point one of suitability test Client's knowledge and experience with regard to: a) the types of service, transaction and financial instrument with which the client is familiar; b) the nature, volume, and frequency of the client's transactions in financial instruments and the period over which they have been carried out; c) the level of education, and profession or relevant former profession of the client or potential client. In the following section, a deeper look will be given to these information's.

3.4.1.1 Suitability and appropriateness

As anticipated early, the suitability test should be performed by investment firms when offering a service or transaction that involves an element of recommendation such as: investments advice or discretionary portfolio management. The article 19 (4) of MiFID states that intermediaries must obtain "*the client's or potential client's knowledge and experience in the investment field relevant to the specific type of product or service, his financial situation and his investment objectives*".

The client's or potential client's knowledge and experience

The article 37(1) of directive 2006/73/EC (so-called MiFID Level II directive) states that "*the information regarding a client's or potential client's knowledge and experience in the investment field includes the following, to the extent appropriate to the nature of the client, the nature and extent of the service to be provided and the type of product or transaction envisaged including their complexity and the risks involved:*

- a. the types of service, transaction and financial instrument with which the client is familiar;*
- b. the nature, volume, and frequency of the client's transactions in financial instruments and the period over which they have been carried out;*

c. the level of education, and profession or relevant former profession of the client or potential client”.

The purpose of point (a) of this directive is to estimate the ability of the clients to understand the risks in all their dimensions that are correlated with a certain investment and the related consequences. In the cases where clients overestimate their financial knowledge or are taciturn in admitting their lack or learning the answers of the questions designed to evaluate knowledge of specific financial instruments may be unreliable. The elements differing the suitability requirements are as follows: type of investment, client’s classification, and type of financial intermediary.

According to the type of investment provided it is the defined the level of knowledge required. The advice services – portfolio management and investment advice – are the services with greater protection to the client, wider information exchange and risk tolerance assessment.

Depending on while a client is “retail client” or a “professional client” the amount of information required is changing. While for retail clients (not a defined category / not professional clients) the sources of information are more numerous, for professional clients (clients who possess the experience, knowledge and expertise to make decisions and properly assess the risks that incurs) the data requirements are more essential. The professional clients are expected to be able to identify by themselves the information that is necessary for them to make an informed decision, and to ask the service provider to provide that information. Retail clients, not being able to identify what type of information they need for making their investment decision, are more protected by legislation. Therefore, depending on the client classification a different treatment is foreseen. A firm when providing a product or service is given permission to assume that a professional client has the necessary experience and knowledge for understanding the risk associated to the investment services or transaction, or types of investment, for which they are classified as a professional client. In this case, the service provider has no duty to collect the information needed to judge if an investment is appropriate or not, but has the duty to warn the client if he is about to make an investment decision that the firms actually knows it to be an inappropriate decision.

There are also some differences regarding the financial services sector: banking, securities and insurance. Whereas for the insurance sector there is only a partial application of MiFID suitability, for banks and financial firms, instead, a full application is required.

Regarding to point (b) “*the nature, volume, and frequency of the client's transactions in financial instruments and the period over which they have been carried out*” behavior finance studies have shown that besides experience the outcome of past information also matters. It has been noticed that more experience associated with past positive results can lead to overconfidence and optimism, consequently clients are more willing to take risk without considering their risk capacity. Hence, for determining a clearer picture of consumer’s perception of his/her experience it is important also evaluating his/her overconfidence and optimism.

The point (c) “*the level of education, and profession or relevant former profession of the client or potential client*” are the only socio-demographic characteristics which MiFID legislative takes into consideration. Characteristics such as: client’s age, gender, current and expected household composition, and planned retirement age, which are excluded by MiFID are taken into consideration by economic literature arguing that such characteristics affect investment choices, both in terms of their impact on risk attitude as well as the constraints on risk capacity.

After receiving all the information provided by the client the firm is expected to warn the client or potential client if it considers that the product or service is not appropriate to this client or potential client.

The client’s or potential client’s financial situation

The article 35 (3) of the directive 2006/73/EC states that the information on the client’s financial situation could include “*information on the source and extent of his regular income, his assets, including liquid assets, investments and real property, and his regular financial commitments*”.

As seen before, income and wealth have a significant effect on risk tolerance. Consequently, they require particular attention when evaluating the client’s financial capacity, income and wealth also require to be measured precisely in order to overcome any possible reticence and to mitigate any consequential errors of measurement. It has been suggested from empirical studies to consider the income of entire household rather than just the individual’s income. This because the spending and investment choices of individuals are also depending on the level and distribution of total income among family members. Therefore, also factors such as:

the household's significant expenses, factors having an impact on the regularity of income, and factors affecting the background risk should be taken into consideration.

Investment objectives

In the section of investment objectives, the client has to express his/her preferences regarding the holding period and the risk profile of the investment that is going to make, this for recognizing those investment products that matches his/her preferences about risk, return and length of time. Three are the most important elements of the investment objective: i) holding period; b) risk propensity and risk profile; c) purpose of the investment.

Factors such as: expected return objective, investor's degree of impatience, and the foreseen need for liquidity are crucial in determining the holding period. Therefore, such element should be assessed to appreciate how reasonable the holding period is. For example, in cases where the client has a high degree of impatience his expectation of return in the holding period are unrealistic or at least incompatible with the market conditions and/or liquidity needs and/or client's risk tolerance.

For European regulation, the difference between risk profile and risk preferences is not that clear. In the sense that MiFID is making a distinction between the preferences regarding risk taking and the client's risk profile but does not explicitly specific the meaning of each of them and is not giving any indication on how measuring these variables. While "risk preference" may refer to the preferences in investing in a financial instrument with a given risk-return characteristics. In other words, it is related to the risk and return characteristics of the investment that the client is willing to undergo, in other terms the objective-risk. Instead, the "risk profile" may refer to the emotional capacity to assume risk, the so-called risk subjective. The legislation by including both risk profile and risk preferences on the section of investment objectives it seems to agree with the prevailing industry method which in literature is criticized because it confuses and overlaps the assessment of risk tolerance with the evaluations of other elements when formulating an investment recommendation.

As noted before the third element of investment objectives is the purpose of investment. The traditional economic theories suggest that the single investment choices should be picked in a process of global portfolio optimization. As noticed in the chapter two of this thesis the

behavioral bias such as for example: loss aversion and mental accounting have an important impact on what investor consider to be an efficient portfolio. For a better assessment of individual's attitude in adopting safer or riskier investment strategies is fundamental understanding how extreme are these biases and how ambitious the goals and their time horizons are.

Once again, the two tests appear to be significantly diverse regarding the implications that have for financial firms. While, the appropriateness test, provides that clients receive the required warnings, will never impose limitations on the trading for clients, the failure to pass the suitability test may represent a serious obstacle to the client being handled by a portfolio manager.

3.4.2 The supervisory authority point of view

Supervisors authorities are paying a particular attention to the questionnaires used by intermediaries. The Autorité des marchés financiers (AMF), has a made a study by using as benchmark a “standard” questionnaire based on the quantitative measurement. They found that the tools used by intermediaries are unreliable, meaning that firms are often are collecting irrelevant information, also these questionnaires result to be inconsistent since they profile the same client in different ways.

The Financial Services Authority (FSA), instead, focuses on how firms establish and check the level of investment risk that retail clients are willing and able to take in the wider context of the overall suitability assessment. FSA and European Securities and Markets Authority (ESMA) have been publishing guidelines on assessing the suitability of questionnaires. From analyzing the evidence FSA has observed that: i) from 11 risk-profiling tools reviewed 9 of them were so weak as to invalidate client classification, ii) there are critical weakness in how risk categories are described, and iii) the asset-allocation procedures are not strong enough. On these points, the FSA indicates poor and good practices. According with FSA guidelines when assessing the risk, a customer is willing and able to take firms should ensure that have been taken consideration the customer's capacity for loss, the responses of customer to questions should be appropriately interpreted and weighted, also the wording of questionnaires must be fear, clear and nor misleading. Therefore, The Financial Services Authority emphases that the investment

recommendations must be based on a complete and thorough knowledge of the products and should be consistent with the diversification principle.

The guidelines published by ESMA, which concern certain aspects of assessing suitability, are detailing the information that the intermediaries should collect and define the principles on which client classification, product classification and asset allocation procedures should be based, without focusing on the methods of assessment of risk attitude. These guidelines were produced since the supervisory authority noted that the tools used by intermediaries when gathering information about clients and when classifying financial products were representing critical shortcomings. According with European Securities and Markets Authority guidelines, the investment firms must help investors understand the importance of information and encourage them to provide information as accurately and completely as possible. Concerning the risk profile procedure, ESMA states that the internal policies must help investment firms understanding the fundamental facts about the client and the features of the financial instruments available for that client. Instead, with reference to the amount of information gathered a certain amount of discretion is left to the firms, which should adopt a principle of proportionality regarding the service offered, the characteristics of product, and the amount of the investment. ESMA guidelines affirms that intermediaries must consider not only the suitability assessment but also the reliability of the information collected. Therefore, the investment firms according with these guidelines should at least define procedures that guarantee orderly and transparent record-keeping concerning the suitability assessment process.

3.4.3 The reliability and validity of questionnaires used by Italian investment firms

Several shortcomings are noted when analyzing the questionnaires used by Italian investment firms. The more important is referring to the risk tolerance assessment where in most of cases is deduced only by requesting the risk-return expectations for the future investments with respect to hypothetical investment situations. These questionnaires are prepared and based on business model of investment firm, the characteristics of the products offered and the level of knowledge of the staff involved in the assessment and recommendation process, without considering the past financial investments and current financial constraints. As a result, a client could be classified differently by different firms. A study was made by Linciano and Soccorso, which partly overlaps and partly extend the work made by Marinelli and Mazzoli (2010),

analyzing a sample of 20 questionnaires regarding the way they are structured and given and to the contents and certain reliability features.

Linciano and Soccorso (2012) examined: i) how investment firms were defining the questionnaires; ii) what validity and reliability checks were done; iii) how the questionnaires were administrated; and iv) how the clients' profile was updated. They found that:

- 14 out of 20 investment firms prepare their questionnaires internally without involving specific professional figures;
- Referring to the validity test, 14 out 20 banks states that have undertaken it but not all firms performed a pilot test;
- Only three banks provide the distinction between questionnaires for professional and retail clients, the others were making a difference regarding whereas the client was legal person or natural person;
- Even if investment firms are organizing specific training for staff managing questionnaires, in most cases training doesn't include modules expressively devoted to the questionnaires and almost never make explicit reference to the potentially significant cognitive behavioral bias;
- No bank was imposing limits regarding to the frequency updates of the client profiles, but some were checking that the frequency of updating is not anomalous.
- Most questionnaires have question which are relevant for suitability assessment such as: question on preferences in terms of time horizon and investment objectives.

Regarding the validity test, it was checked whether the client's risk attitude and financial capacity had been identifying as distinct items by different questionnaires or questions. instead, regarding the reliability test it was examined: the number of questions, the layout (format and reading features), the structure (was checked the presence of introduction and the way question were grouped by subject area and by degree of complexity), question type (quantitative versus qualitative; closed versus open-ended and open-ended guided), and wording (it should be simple and not ambiguous). By investigating these aspects it was found that: i) the layout does not always clearly identify the sections or areas reserved for the answers; ii) even if the literature suggest to place the sociometric questions at the end, almost all the questionnaires open with them, however since these questionnaires are generally not overly long probably this is not

affecting the outcomes of the interview, iii) the section dedicated to experience and knowledge represented the most critical shortcomings, since none of questionnaires contain questions designed to test knowledge of basic notions.

Linciano and Soccorso (2012) concluded by saying that only 2 out of 20 questionnaires examined can be considered sufficiently clear, effective and “valid”, since they precise and unambiguous questions.

3.5 Financial literacy and overconfidence as determinates for financial advice seeking

The European regulatory framework wants to prevent poor financial outcomes and for this purpose it encourages the development of independent and high-quality advice services. Investor education and financial advice have been on the center of the regulation; however, their effectiveness may be challenged by individuals’ behavior and reactions. Gentile, Linciano, and Soccorso (2016) analyzed the relationship between the propensity to seek for professional advice, financial knowledge and self-confidence, as well as the determinants of financial knowledge and self-confidence. Given that investor education might exacerbate overconfidence and given that higher levels of knowledge can go along with a higher attitude towards behavioral biases a special attention is needed to be payed to the interaction between self-confidence, financial literacy and the propensity to seek for advice. If in one hand we have that higher levels may improve one’s own perception of his/her abilities, possibly raising overconfidence by exacerbating the gap between self-assessed and actual competencies. On the other hand, higher levels of knowledge may reduce the attitude to overstate one’s own competencies, thus decreasing overconfidence.

The studies suggest the following relationship between the financial literacy and retail investors:

- It has been noted that the women are less literate than men, and this isn’t depending on the country of residence, marital status, age, education level, and their possible role as decision makers. Women also appears less confident that men and more conscious of their own limits;
- Education, wealth and family size tend to be positively correlated with the degree of financial knowledge;

- A higher risk tolerance and more patience is noted on high financially literate individuals;
- Financial experience is positively associated to financial knowledge.

Instead, the *overconfidence* can be defined as the unmotivated confidence in one's own knowledge and abilities. As noticed early, the overconfidence can significantly affect financial decisions by raising risk taking because of upward biased forecast, and by feeding the belief of beating the market or being more informed than others. Therefore, the effects that overconfidence has on financial advice seeking are crucial. It has been noticed that overconfidence may discourage advice seeking and that overconfident investors are inclined to accept suggestions from friends and relatives, the so-called informal advice. This tendency to rely on informal advice is more frequent among men, individuals with lower financial knowledge and higher self-confidence, declaring to have experienced a worsening of their economic conditions and to have difficulties in saving.

The determinants of demand for advice are multiple. Theoretical and empirical literature has shown that the financial seeking is more frequently among financially sophisticated individuals. However, not all agree on this result, others have shown that there is a negative or an insignificant relationship between literacy and propensity to ask for professional help.

The disaccord on the result have push to further investigation. Some researchers have focused on the interaction between financial literacy and behavioral biases showing that behavior biases can drive sub-optimal choices. Behavioral attitudes and biases may be relevant determinants of financial competence, since they may distort risk perception and, by this way, trigger mistaken investment choices in spite of knowledge. Therefore, to avoid investment mistakes, the knowledge alone may be insufficient. For example, framing do play a role in portfolio choices, as shown before, and in advice seeking. Also, regret aversion combined with low-literacy, in cases where investors are anticipating the possibility of advisors to highlight mistakes in their previous decisions, may deteriorate from demanding for professional help.

Other researchers have focused on socio-demographic variables showing that wealth and age have a positive effect on advice seeking. Instead, gender, education, self-employment and experience may have ambiguous effects, which may increase the willingness to rely an expert or decrease it as well as no relation at all. Other factors determining the demand for advice may be

the trust in advisors, the appreciation of consultants' competencies and the impression by advisors' perceived experience, language, jargon and confidence in judgements.

Gentile, Linciano, and Soccorso (2016) results show that the regulation of financial advice is not enough to protect investors who need it most. Most consumers in Italy illustrate a very low degree of financial knowledge and competency and a strong attitude towards informal advice. Therefore, the key to the investors' correct access and use the predicted tools for helping them in making good financial decisions is the financial education, which may be implemented through investor education programs focused on the investment decision processes, the relationship with the subjects involved and the rules predicted to protect investors in every step of such process. A special attention, in order to prevent unwanted reactions potentially hampering the investors protection polices, should be dedicated to the control of overconfidence.

Chapter 4: Neurofinance

Over millions of years *Homo sapiens* have evolved and adapted certain brain mechanisms which are largely maladaptive for today's complex world of trade and finance.²⁵ Our autonomic processes were evolved through natural selection, but unfortunately some of these adaptive traits serve us poorly in navigating in the today's complexities of economics. As mentioned early in the theories guiding us in the investment world were focused on rational expectations, thus assuming that on average human beings are able to properly weight the probabilities of future outcomes and form a logical conclusion as to the appropriate decisions to undertake. In this way, rational expectations are also assuming that economic actors possess the requisite cognitive capacity to make such calculations without taking into considerations the innate complexity in employing such an algorithm.

However, as noted on the chapter two, behavioral finance in the past twenty years has made progresses in introducing theories regarding the way human behaviors are affecting investment decisions. Unlike the rationalists, who assumed the optimal behavior as predicted by expected utility theory, the behaviorists first observed actual behavior and subsequently drew conclusions as to the appropriate axioms to describe revealed actions and choices. The evidence suggesting that human beings are not acting as predicted by expected utility theory is growing day by day. What once it was considered as irrational today is simply considered as human.

In 1759, in the *Theory of Moral Sentiments*, the philosopher Adam Smith showed what today psychology and neuroscience is discovering, i.e. human beings are struggling between “passions”, which are describing our wanting's, and “impartial spectator” describing our uniquely-human prefrontal brain regions which have the ability to suppress our more reptilian instinct. Therefore, the diversity of human behavior is characterized by the interaction between wanting's and the parental override of our prefrontal cortex.

In order to understand how people are making economic decisions behavior finance have developed a new field from the findings by psychology and neurology, the so-called neurofinance. This new science is looking inside the brain for having a more realistic model of decision-making, and for explaining in a better way the individuals' economic behavior and their

²⁵ The fundamental human dilemma described by Shermer (2007)

effects translated into aggregate market phenomena. The science of neurology is teaching that specific brain structures are responsible for different characteristics of human behavior, and that the actual behaviors and decisions of individuals are depending on the interaction between brain regions. Thus, introducing sciences of psychology and neurology can lead to a better understanding of actual behaviors, particular with respect to economic decision making. Economist have taken advantage by the findings of neuroscience – which discovered that a significant portion of human behavior is dictated by brain processes which take place largely away from our consciousness (automatic mechanisms) – to try to explain why human behavior defies the prediction made by rational choice models. The consequence of these attempts was the field of neuroeconomics.

Rocha (2011), based on knowledge provided by neurosciences, proposed a neuroeconomic based decision-making model (represented in the figure below) that is dependent on the evaluation of expected rewards and risks in two decision spaces: the personal decision spaces (PDS) and the interpersonal decision space (IDS).

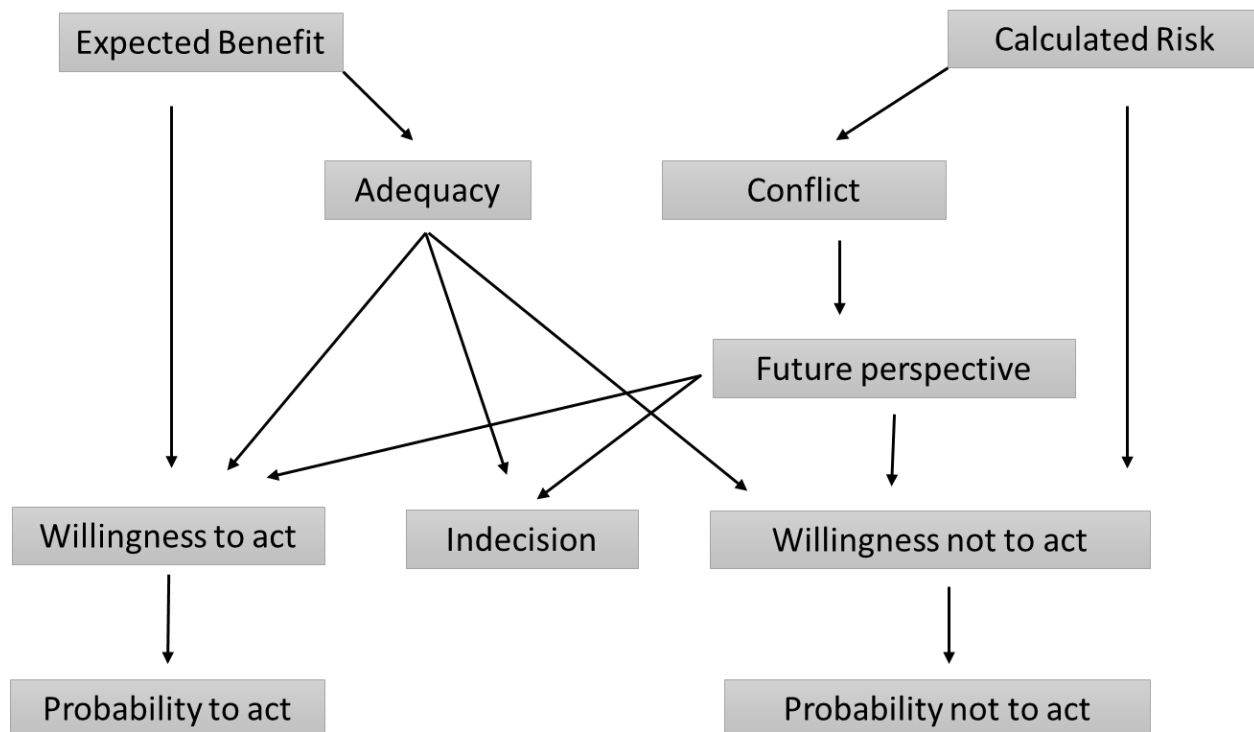


Figure - The neuroeconomic model for decision making

4.1 Neurofinance and financial decision making

In economics, the concept of expected utility describes a process by which a rational agent makes economic decisions in the presence of uncertainty, considering not only the expected outcome, but its variance as well. According to that, an individual will only assume a risky gamble if its expected utility exceeds the utility one derives from an alternative riskless outcome, also known as a certainty equivalent. Expected utility theory is also assuming that an economic agent knows with certainty the relevant outcomes and their associated probabilities. Neurofinance is showing, contradicting the traditional finances theories like Efficient Market Hypothesis, that investors use different strategies to make their trading decisions instead of behaving as an ideal rational decision maker. Therefore, neurofinance is considering that investors do not always try to maximize their profits and the emotional influence on decision- making has been proposed to explain the irrationality of the investor's decision.

The financial collapse of many large companies was caused by a liquidity shortfall from US subprime lending system. Consequently, in the mid 2007 world started to face the financial crisis, from which we are still recovering. The classical economic theories, which assumes that a rational agent has emotion as enemy, were tested by US subprime crisis, and this crisis have shown that investors are not acting like models such as Markowitz, CAPM etc. are assuming. It has been noted that emotions have an important role in financial decision making, their influence have used to explain the deviation from optimization. According with Rocha (2011), the market sentiments (financial market emotions) are influenced by numerous factors such as market indices, expert decisions, government decisions, etc.

Neurofinance from this point of view is a rapidly advancing field which uses the neural mechanisms in order to better understand the dynamics of decision making in normal times as well as crisis. While financial theories consider benefit assessment as an analytical variable neurofinance consider them as a subjective variable, function of dopaminergic circuits. Instead, the risk assessment is including both quantitative and qualitative components. Neurofinance want to estimate the risk in circumstances where the information about the probability of occurrence of the events is limited and the opportunity for analytical analysis is imaginary. In other words, what matters for neurofinance isn't the expected return or the probability of loss but the subjective evaluation reward provided by the expected return and the perception about the intensity and the

likelihood of the losses. According to that neurofinance shows that the relationship between perception of the benefit and risk, as well as the relation between stock and its reliability towards markets are determining the attractiveness of a stock. Thus, the intention to trade is a complex psychological construct that requires estimating benefit and risk of acting in order action suitability to be calculated.

The intention or the willingness of trading is calculated by neurons that collect all the pieces of information calculating by different areas of brain. Some of these areas are involved in calculating risks and benefits, while others are in charge of evaluating conflict generated by these perceptions of benefit and risk that determines the cognitive effort for making a decision.

In the following section, there will be represented some techniques for measuring cerebral activity.

4.1.1 The electroencephalogram (EEG) and the functional Magnetic Resonance Imaging (fMRI)

The heuristics described by behavioral finance may be justified from a neural perspective as a rational tradeoff between the benefits of deliberation and the biological costs associated with such deliberation. Neurofinance is one of the interdisciplinary areas that combines neuroscience knowledge and techniques to investigate the psychology of neural circuits that are engaged in the decisions that investors have to make. A distinguish is made between experimental techniques that studies human brain by how cerebral activity is measured. These techniques use advance statics in order to allow researchers to make judgement about brain functionality. By using the science of neurobiology which studies the nervous system, it can be taken pictures of specific parts of the brain while a decision is being made and this give an insight of what is going on in the brain.

Scientific advances in the field of electrophysiology and human genetic analysis combined with sophisticated experimental techniques from cognitive psychology allow neuroscientist and psychologist to address abstract questions, such as how human cognition and emotion are mapped to specific neural substrates. The electroencephalogram (EEG) and magnetoencephalogram (MEG) are the most ancient techniques used to map the brain, these techniques are measuring the electrical or magnetical fields by ionic currents generated at the

neurons involved in a given brain processing. Instead, the more recent techniques are measuring the magnetic field variation caused by movements of water molecules that were disturbed by a very strong and short magnetic field perturbation. A static picture of the brains anatomy is provided by this technique, named Magnetic Resonance Imaging (MRI) which is used to disclose possible brain lesions, or functional MRI (fMRI) used to identify brain areas that are activated during a given brain processing. By using these imaging and measurement tools, experiments can be conducted to determine how human cognition and emotion are mapped during decision-making.

In general, the functional magnetic resonance imaging (fMRI) experiments have to be done in special facilities (hospitals) since fMRI uses strong magnetic field perturbations and depends on very sensitive sensors. A very precise information is provided by statistical analysis about sets of neurons activated at both cortical and subcortical areas during a given processing. For providing reliable information about these areas, statistical analysis requires at least two seconds of data sampling because fMRI has a very low temporal resolution given that measurements are about blood influx transients. According with the studies that uses fMRI the process of financial decision making is involving the participation of areas such as: the orbitofrontal cortex (COB), the medial prefrontal cortex (MPFC), the amygdala, insula, the nucleus accumbens (NAC), Striatum (Str) and other neural structures.²⁶ For example, according with Kuhnen and Knutson (2005) risky choices as well as risk-seeking choices are preceded by the activation of nucleus accumbens, instead the activation of anterior insula preceded riskless choices as well as risk-aversion mistakes.

The sets of neurons activated at different cortical areas is generating the weighted sum of electric currents, which is the electric activity recorded by a set of electrodes e_i (EEG). The EEG recorded activity is used by LORETA (Low Resolution Brain Electromagnetic Tomography), which is a technique that aims to calculate the location of the sets s_i of neurons activated during a brain processing. Correlation analysis is providing information about the different sets of neurons enrolled in solving a given cognitive task. Three different patterns of brain activity (P_1 , P_2 and P_3) are identified by the Principal Component Analysis (PCA), which discloses the quantification of

²⁶ McClure (2004); Breiter (2001); Frederick, Loewenstein and O'Donoghue (2004); Camerer and Loewenstein (2004); Kuhnen and Knutson (2005); Knutson (2003 and 2007).

information patterns that are associated with the activity of the different neural circuits involved in decision making.²⁷

- ✚ The first pattern is proposed to observe the activity of the neural circuits engaged in recognizing the possible problem solutions and evaluating their associated risks and benefits;
- ✚ For observing the activity of neural circuits engaged in calculating the action adequacy, fairness and willingness considering the results calculated by first pattern neural networks, the third pattern is proposed;
- ✚ Pattern two, instead, is proposed for observing the activity of the executive neural systems in charge to trigger decision making process and selecting the action to be implemented considering information provided by pattern one and pattern three neural networks.

The electroencephalogram (EEG) has a high temporal resolution and a reasonable spatial discrimination to localize sets of neurons located at the cortex, but not subcortical areas. Therefore, the neurofinance chooses this technique if the purposed of the experiment is to understand the cortical activity associated with the financial decision making, but a combination of both fMRI and EEG is needed if location of subcortical sites are also interest.

²⁷ Rocha (2010 and 2013).

Conclusions

This thesis has focused on the cognitive bias and risk tolerance of the investors. It was noted that the behavior of investors has a crucial role in decision making, since there are a lot of factors – overconfidence, representativeness bias, base rate neglect, loss aversion, endowment effect, anchoring, availability bias, procrastination, herding - affecting the financial decision making. It was observed that investors are rarely behaving according to the assumption of traditional economic theories such as: Von Neumann-Morgenstern expected utility function, Markowitz, Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory, Cox-Ingersoll-Ross theory and the Black Scholes/Merton option pricing mode etc...

A lot of researches made in the field of behavioral finance are suggesting that investors are not fully rational since they are driven by greed and fear, misled by extremes of emotions, whims of the crowd and subjective thinking. In my opinion, it is quite important to note that the important findings of traditional economic theories may not be vanished, even if in the real finance world, we observe that the assumption made are often unrealistic. The behavioral finance maybe it should be considered as an integration of those theories, a bridge between theory, evidence and practice. In other words, behavioral theory could be seen as an attempt to find the reasons why the economic theories are not always working. Therefore, finance education should not only focus on traditional economic theories but also on aspects such as mistakes need to be avoid while investing and strategies in financial markets for earning more.

The behaviors are affecting the decision made by investors and their risk profile, since affective and cognitive aspects make the perceived risk different from the objective risk. The risk tolerance of a client is defined as the level of financial risk that an investor is willing to take, in other words as the maximum uncertainty someone is willing to accept when making a financial decision. In order to identify the mismatches between a client's psychological and financial needs is crucial understanding the risk tolerance. Different studies observed that individuals having different levels of financial risk tolerance are expected to act differently when making investment decisions. Taking into consideration the findings of behavioral finance it may be a good idea since all the cognitive bias can lead to a different perception of risk. Other factors affecting risk tolerance are: age, gender, marital status, education, financial knowledge, and income.

From the perspective of legislations, it was observed the importance of “know your client” regime and as a consequence the importance of suitability and appropriateness test. By different studies made by supervisory authorities it was observed that questionnaires made by investment firms for defining the client risk profile were presenting important weaknesses such as: wrong client classification, not optimal description of risk categories etc.

A conclusion though - Technology can help lessen the negative impact of common decision-making mistakes on personal finance outcomes. For example, it can contribute on tackling these three-behavioral finance bias: (i) salience, (ii) present bias and procrastination, and (iii) loss aversion.

The first bias is referring to how noticeable an event or information is. Technology help lessening the negative impact of this bias by creating a number of budgeting apps aim to help users address this bias by collating debt, bills and spending information in an easily accessible interface. The idea is that having all of this information readily available can make it easier for people to be proactive about their finances. Regarding the present bias and procrastination, technology may help by setting apps aim to address this bias by helping users stay on track with their goals via frequent reminders, penalties, peer pressure and game-like features. For the third, instead, technology creates apps aim to encourage saving through having users set up explicit goals or automatic savings triggers.

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