ADJUSTING CLASSICAL PORTFOLIO THEORIES WITH BEHAVIORAL PRACTICES

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Abstract

This paper represents a study of the concepts and practices defined by the up-and-coming research field, namely Behavioral Finance. In addition to presenting these concepts and practices, the work incorporates behavioral issues in an attempt to build a portfolio model that is based and tailored to a particular investor profile. The paper also presents a brief description of an analysis of the investment funds on the Romanian market, and the emphasis is on the observation of the correlation between the fund allocations strategies in relation to the yields obtained. Therefore, this paper wishes to study the methods and concepts by which Behavioral Finance helps an investor make better decisions. This new direction of research helps discover those aspects that lead to irrational decisions, and by knowing them, corrective measures can be taken upon irrationality. To capture investor behavior correlated with the yields obtained, a sample of mutual funds have been analyzed for the period of Dec 2007 – Apr 2017. This part of analysis reveals the importance of risk perception, and how different perspectives upon risks, drive completely different conclusions. With this observation in mind, we then simulate a portfolio that is tailored to a specific investor profile and his goals, applying along the way portfolio optimization techniques and adjusting it with behavioral finance practices. The end result is a simulated portfolio strategy allocation that can be used as a basis for investment decision.

Keywords: behavioral finance, irrationality, diversification, portfolio optimization, margin of safety, separation property;

JEL Classification: G02, G11, G41

Introduction

Many of us are looking for the Perfect Model: of the morning routine, of relationships with friends and family, of learning, of winning, of dressing, of eating, etc. There is a natural tendency for people to look for the simplest and most accessible solutions and models to solve their problems. But not all problems have simple solutions. All industries are developed around this human need, around the development of models and practices that "work" and that are easy to apply.

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Even though these industries seem to cover a diverse range of needs, all of them are trying to solve the universal and timeless fear of human nature: uncertainty. The politician promises over-optimistic achievements, fashion houses promise validation and social status, cosmetic companies promise youth, insurance houses promise financial aid in times of disasters. All these industries promise security in some future moments, when the individual will feel the emotions of pressure, insecurity, fear etc. The only problem is that in such moments, emotions usually take control of the human machinery (the brain), and make us take decisions that prove themselves irrational most of the times.

Neither the fund management industry (portfolio management) is exempt from this algorithm. On one hand, there is a need for the individual to manage and multiply the available wealth, with apparently diverse purposes. On the other hand, there are fund managers who promise excess returns and performance of portfolios. In other words, these managers promise that they have models that bring the solution sought by the investor.

This paper proposes to analyze classical portfolio management models in comparison to new portfolio management techniques, and strives to build a portfolio tailored to a specific individual profile. Chapter 1 of this paper presents the Literature Review that is relevant for this study. Chapter 2 presents the methodology through which all necessary data was retrieved, and Chapter 3 discusses the Case Study and its results.

1. Literature review

Traditional financial paradigm seeks to understand financial markets, assuming that all its market players are rational human beings. Even though many financial theories existed and have been developed over the time, investor rationality is the highlight of classical theories. The classical Finance theories also considers that the individuals are usually unbiased and they act always in their interest, being able to fight against the external factors of decision (Nofsinger, 2001). A rational investor is defined as one that: (a) updates his beliefs in a timely manner and according to the new information received; (b) takes decisions that are considered to be normal by the majority of the crowd (Thaler, 2005).

Nowadays, we can state firmly that the science behind Behavioral Finance overcame the phase of "experimental" research. The fundamental argument that justifies the existence of Behavioral Finance, is the numerous empirical proofs that the price isn't a relevant indicator of value, and that the price-value difference, rarely converges to zero (Mitroi & Stancu, 2007). As long as the price is considered an indicator of investors' expectancies, and as long as there are consistent discrepancies between price and value, it is irrational to base financial decisions on such premises. Behavioral Finance helps individuals mitigate these decisional errors by creating a framework that allows separation of general accepted market expectancies, from the individual portfolio goals of an investor and his psycho-emotional profile. Under this new stream of research, the risk is usually redefined as the probability of underperformance related to the individual portfolio objective, rather than price volatility of assets (Howard, 2014).

The risk aspect is thoroughly researched in the work of Kahneman and Tversky through which the "Prospect Theory" was developed. According to their paper, the authors observed that the big majority of investors are risk adverse (Kahneman & Tversky, 1979). They concluded that the expected returns of the investors should be approximately 2.25 times higher than the potential losses, in order to be motivated to risk their investment capital.

These series of observations have been condensed in the Prospect Theory utility graph, which is illustrated in fig. no. 1.

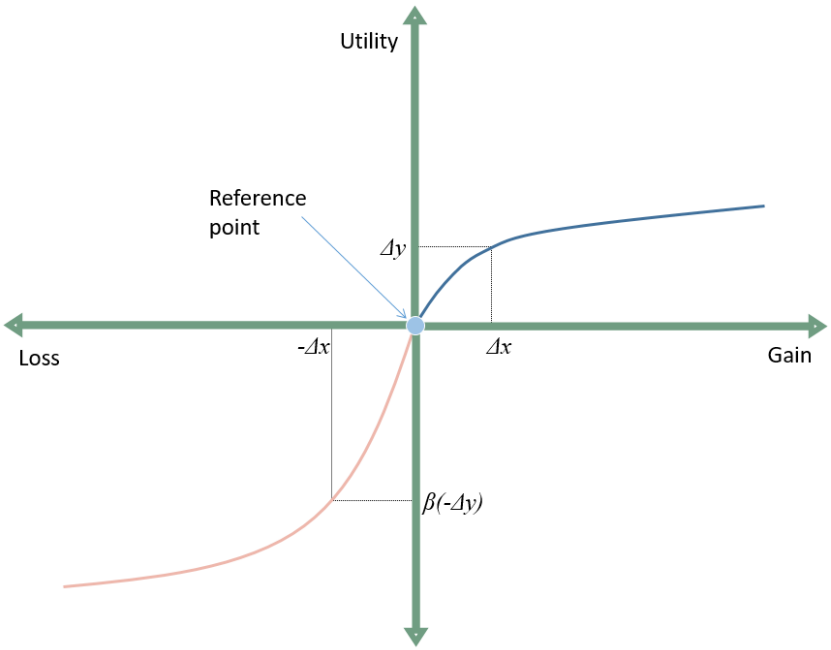

Figure no. 1. Utility function under Prospect Theory
Source: (Kahneman & Tversky, 1979)

Prospect Theory puts a bigger emphasis on the impact of losses upon the utility of an individual, rather than the same amount of gain has on the utility. The research concluded and reconfirmed the fact that the majority is risk adverse. The new aspect highlighted by the theory is the "reference point" (e.g. acquisition price of an asset), that in consequence, changes perception upon the evolution and performance. The risk aversion is reflected in the graph via the fact that the area determined on the "loss" quadrant, has bigger variation on the utility axis, rather than on the "gain" quadrant, for the same amount of impact on the `. The only thing that Prospect Theory inherits from the classical theory of utility is the decreasing marginal rate of utility.

The utility function in the "loss" quadrant plots a sudden increase in utility as the evolution of one's portfolio approaches the reference point. Reaching a break-even state, after loss circumstances, brings a bundle of positive emotions and relief. As the old adage goes, "The easiest way to make someone happy, is to create a situation worse than the current one, and then fix the things back to normal". The point highlighted here is that the present situation is always perceived by a human being in contrast with his past condition.

Behavioral Finance can explain with ease the decisions taken by the individual in hindsight, but has troubles foreseeing the behavior of the individuals in future environments and economic circumstances (Mitroi A. T., 2016). History has shown that humans are rather poor fortune tellers, so the emphasis under Behavioral Finance is put on the "protection from", rather than "projection of" the future. Margin of Safety concept and Diversification are only a few ways to overcome such difficulties. (Graham, 1949).

The major difference drawn under such portfolio management style is the perceiving of the term *investment*, as different from *speculation*. Graham defines an investment (as opposing term to speculation) in the following form:*" Investment is an operation which based upon thorough analysis, promises safety of principal and an adequate return on investment. Operations that do not correspond to this definition are considered to be a speculation.*" (Graham, 1949). This fundamental concept, defined the first time in the specialized literature by Ben Graham, draws a border between intelligent investments and speculative activities. The author describes three main ingredients for an investment operation:

- Thorough and sound analysis (fundamental analysis)
- Safety of principal
- Adequate return on investment

The author suggests two approaches to the investment process:

- *Active approach* – the investor dedicates a significant amount of time and effort to build investment decisions. Requires considerable physical and mental engagement in the process of analysis.
- *Passive approach* – the investor is concerned primarily with the safety of capital and is willing to devote little amount of time and effort for investment decisions. Requires a sound psycho-emotional framework to withstand against the volatility of the markets.

1.1. Mr. Market

Another major contribution of Ben Graham into the specialized literature and his investment philosophy, is the allegory between the financial markets and a fictional character called *Mr. Market*. Imagine that in the whole universe there are only two tradable companies on a market, out of which one belongs to the reader, and the other belongs to his partner *Mr. Market*. This partner has, what is considered today, a manic-depressive behavior with wild estimations of the businesses that vary drastically over a short period of time (Mr. Market, Morningstar, 2017).

We can notice from the start that only due to his behavior and perceptions, Mr. Market has following characteristics:

- is emotionally unstable, with alternating periods of depression and enthusiasm
- is irrational
- offers that the transactions happen only when his market partner agrees
- exists there to serve you, not to guide you
- is a voting machine, not a weighing machine
- is sometimes efficient
- offers the chance to buy low and sell high

This allegory describes in a simple manner the fact that the only big reason of the market's volatility is usually due to perceptions and emotions on the market participants. These perceptions are often manipulated, hence the decisions taken ultimately by the investors are far from being rational. A rational investor would only sell an asset if the offered price is considerably higher than the intrinsic price of that asset. A rational investor would not buy because prices started to go up, or sell because they have started to roll down (follow the trend). He would buy or sell only when the offered prices are considerably lower or higher than the intrinsic value of the asset. As a result, the author puts emphasis on estimating the value of a company and its assets through a fundamental analysis, making the extrapolation that the performance of the company will be reflected in the overall performance of its stock.

Due to the unstable behavior, this *Mr. Market* offers daily quotations that do not have necessarily valid and logic explanations behind. For a rational investor, the moments of depression can only be the opportunity to buy good companies at low prices, as these are the moments when good bargains occur. Key to the success is to have patience to wait for such bargains and have enough cash to purchase them.

1.2. Margin of Safety

Another concept that is considered to be a cornerstone of fundamental way of investing is the concept of Margin of Safety. This concept is built around the arithmetic of the probabilities. The purpose of creating a Margin of Safety, is to increase the odds of overperformance. An investor should buy a specific asset that he desires, only when the market price is well below the value of the asset.

Due to the probabilistic nature of chaotic events, we know from the start that an asset priced at $1 has the same probability to be valued in the future at $0,50 as well as at $1,50. Current price of $1 may as well be an inaccurate value estimator of that financial instrument, which is another risk-increasing factor. However, if the investor decides to purchase that instrument only at a discount from its current price, his risk of incurring losses can be substantially decreased. Even though there is no guarantee that the price of that asset will rise in the near future, the low acquisition price ensures the investor with limited loss impact. Just to correlate this insight with the Prospect Theory utility function, purchasing at a discount means that we set a lower reference point for our utility, and chances are higher that we will be above the reference point, in the gain quadrant.

In the context of using the Margin of Safety as a discount applied to the price, we can use it as a threshold for purchasing a specific asset. To exemplify this concept in action, let's consider following situation: as a result of personal estimations, the value of company ABC is valued by a potential investor to be around $162/share. Current market price for that specific share is $192. By applying the Margin of Safety formula proposed by Graham:

$$Margin\ of\ Safety = \frac{current\ price}{intrinsic\ value} - 1 \qquad (1)$$

results that:

$$Margin\ of\ Safety = \frac{192}{162} - 1 = 0.1851$$

*Purchasing Price = 162 $ * (1-0.1851) = 132 $*

A purchasing price of $132 would guarantee the investor a good buying price, in case that the price drop is not due to fundamental factors such as a drop in the company's revenue generating power (Investopedia, 2015).

1.3. Impact of losses

Another important aspect of Behavioral Finance investment, is to understand the impact of losses upon the overall value of portfolio. This seems like an obvious truth, but the true impact of losses can be showcased through a highly probable scenario.

Consider following portfolio evolution scenarios:

As a result of thorough analysis, an investor identifies a potential stock investment that is expected to generate an average of 10% annual increase in value, and that the market will increase on average by 5%. (fig. no. 2)

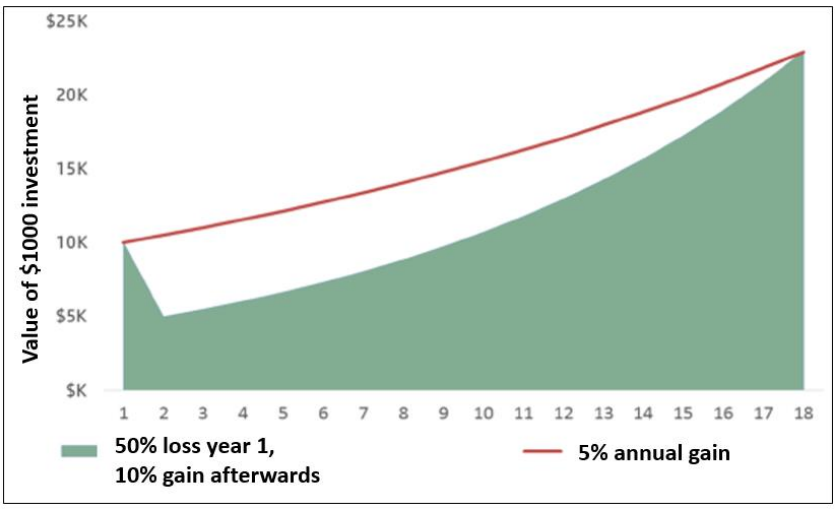

Figure no. 2: Cost of Losses
Source: (Graham, 1949)

Unfortunately, the investor is too eager to purchase the share of that company, so he decides to pay the current market price to acquire the asset. Shortly after, due to overall pessimistic forecasts of the economy, the price of that share drops by 50%. Even under the condition that this share will generate double the return of the market over the next years, it will still be required a period of 16 years to cover the loss and opportunity cost of investing safely in a market fund (e.g. ETF). All this situation is due to one small decisional error that was based on emotions, rather than a sound concept such as margin of safety, that would have created space for absorbing market risks.

1.4. Behavioral biases

Typical investing process cycle consists of the following steps:

- Information acquisition about financial instruments and potential investments
- Definition of a capital allocation strategy
- Selection and acquisition of financial instruments
- Rebalancing
- Sale of financial instruments

From this simplified model, we can observe that there is a multitude of operational steps where a decisional error can lurk in and cause portfolio losses. Besides the financial and strategic aspects that the setup of a portfolio implies, this process is accompanied by strong emotional influences. *Figure 3* exemplifies the usual emotional rollercoaster which a beginner investor is riding along with the price evolution of an asset, and the decisions and errors that accompany these emotions.

The market is on an upward trend, new points of high are registered, and mass-media spreads the news with the speed of light. Financial reporters and economic experts talk on the TV about new financial horizons, innovation, creative companies that make unforeseen profits. It's worth mentioning that mass-media usually brings to the attention of its spectators only companies with exceptional performance or losses, those 5% tails from the normal distribution of the total population of companies. These news fuel the thirst of those investors that are eager to enter the market, but they need any information that would confirm their positive assumptions. Such investors fell prey to the **confirmation bias**. News and headlines are so invasive that they can be hardly ignored, and they leave a trail on the investor's subconsciousness, attracting in particular beginner investors.

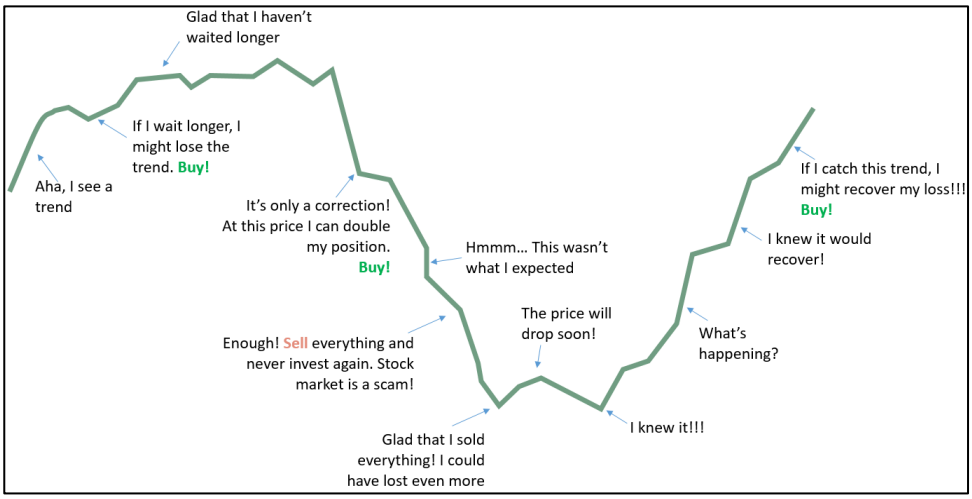

Figure no. 3. Decisions of an irrational investor
Source: (Hens & Meier, 2010)

A state of enthusiasm and hype is created around few companies and their shares, and some of the side-players decide that it is time to enter the market, usually paying a high price.

Having too many options from which to choose, they filter their search options to those companies that are familiar to them as a brand, or companies about which they have heard good stories. This way, the amateur investor commits another cognitive error called **availability bias**. These investors tend to limit their analysis only to the first acquired investment ideas and companies that are easily accessible in their subconscious, without employing a further critical analysis of the situation. Moreover, information that is presented in an easily digestible format (images, videos etc.), tend to have a bigger impact on the availability of information. Just think about the fact that the frightening images displayed on the pack of cigarettes, were proven to have a more profound impact on smokers, rather than the ever-increasing death statistics of the smoking individuals. Maybe this little trick helps fighting this bad habit, but this way of presenting information is hindering the need to think and employ a critical analysis of the facts, in order to take coherent decisions. Usually investors evaluate new information in relation to the latest information they can easily recall. This way the investor ends up correlating and matching different series of events without looking from the other side of the situation, and the final conclusion that is drawn is usually incomplete or/and erroneous. Affirmative information is added to the dossier, whereas the disconfirming information is categorized as irrelevant and omitted.

Another behavioral bias that hinders the investor to expand his investing horizon is the **home bias**. According to this bias, the selection process of the financial instruments is limited to the domestic companies and assets, because usually these are companies that are familiar to the investor, the investor thinks that being in closer proximity to them has some relevance to the company's performance. There is a higher probability that local companies have been mentioned earlier in the media, which in turn fuels the availability bias discussed earlier, hindering a proper diversification.

The price of financial instruments is due, in a big proportion, to unknown factors. Even though we might be able to estimate some of these factors, the combination of factors, timeframe and random elements makes it impossible to develop a rigid mathematical model that would describe the process. From the psychological point of view, the key element consists of managing emotions, which in turn manages decisions. Major problem of a mediocre investor is the instability of perception, usually based on the hope that the price will rise in the long run, being constantly dominated by the fear of price drop. As such, a strategy based on hope and fear, is a fallible strategy from the start.

After an upward trend during which the investor joined the game, the probability is high that a correction follows. Once the price drops below the acquisition prices (reference point, or **anchor**), two scenarios are most probable. Pessimistic investors cannot take anymore and decide to assume the loss by selling the assets. The optimistic crowd considers that this is only a temporarily drop, and might even increase their position in those instruments. Being optimists, they consider that on the long-run the prices will rise (due to inflation, growing economy etc.), and fell prey to the **long-term bias**. Unfortunately, these investors tend to forget that extreme long-run horizons cancel the utility of profits. Even though it is better for investments to have a long-time horizon, it is worth analyzing if the long-term favoring is due to a heuristic or due to relevant investment objective.

Another bias mentioned earlier is the **anchoring**. When a human being is taking decision in conditions of uncertainty, the brain is wired to cling on to the first information that is made available to him, and is somewhat correlated to the solution he is looking for. During an experiment, some individuals were presented the same information in a slightly different way

(framing). One control group was asked to guess whether some random Mr. Smith died before or after the age of 90. The other group, was asked to guess whether the same Mr. Smith, died before or after the age of 40. After countless results, this experiment showed that the majority of individual from the first group, guessed an average death age of 80, and the second group responded with an average death age of 40.

Another behavioral bias found that, by default, people tend to have a short-term perspective, and that they completely forget about consequences on the mid and long-term period. Benartzi and Thaler (1995) exemplified that investors would risk more money by purchasing shares, if they have a short-term investment horizon. The so called **myopic loss aversion,** hinders the investor to understand that current risks and short-term losses, affects long-time profitability as well.

Another bias that reduces the probability to expose to higher returns is the **mental accounting**. Many investors make financial distinctions in their minds, which do not exist naturally. For example, the losses or gains incurred on paper are considered to be separate from the losses or gains assumed through the sale of assets. This bias leads to an interesting and unfavorable situation, in which the investors tend to hold in their portfolio losing assets (with the hope that they will recover in the long-run), and sell on winning assets just to cash in the profit. This way the winning assets are sold, and losing assets are kept. This bias is correlated with the **disposition effect**. This effect states that the money in different accounts are perceived differently in terms of risk. Money invested in stock market are considered to be exposed to higher risk than money that are hidden under the pillow, even though the money under the pillow are exposed to the inflationary risks, theft risk and opportunity cost. This fact makes us think that a dollar isn't worth a dollar in various circumstances, which is a fallible disposition from the start.

Moreover, the impossibility to witness objectively the investment process during the moments of downtrends in the market, makes the investor perceive the process as a fraudulous scheme. Due to lack of patience for better times, these investors tend to close on positions that are usually on the verge of a trend reversal. Those that are following the brokers mantra of" Follow the trend", tend to forget that once you find investment advice via media channels, most probably the trend is already close to its finish. Under such conditions, the capacity of assuming market risks is at the lowest level, and still individuals do it. By following the trend, such investors tend to buy high and sell low.

Continuing the series of cognitive errors, it is worth mentioning the **overconfidence bias.** Individuals tend to overexaggerate their personal contribution to the successful events, and to disassociate themselves from the unsuccessful. (Mitroi A. T, 2014). **Retrospective bias** is another trap that is typical to the amateur investor. The sentence" I knew this was going to happen" is the most obvious symptom of it. The problem here is that drawing such conclusion hinders learning from the past mistakes. Analyzing the past experience, the individual reconfirms some of his suspicions (confirmation bias), and being anchored to the old acquisition price, he might do the same mistake of following the trend and repurchase shares.

Human behavior has adapted over millennia to its natural environment with the sole objective of surviving. The reactive part of the brain has done amazing work to achieve this goal. However, the success on the financial markets cannot be achieved with the same natural instincts. The way people behave on the financial markets can be described in any way, but it is far away from being rational. The market is a complex system that is hard to understand, which is responding slowly to stimuli and factors of influence. Applying natural human

behavior to a complex system, that is governed by different laws, we usually find ourselves buying high and selling low. Having the capacity to learn from past experiences, we try to repeat doing the things that have been working in the past, and avoid doing things that have failed, falling down the behavioral spiral of repeating same behaviors over and over again.

2. Research methodology

First part of this research consisted of analyzing a database containing information about Romanian mutual funds, retrieved from the site of Romanian Association of Fund Managers (www.aaf.ro). The goal of this part of research was to identify a strategy allocation that rendered highest returns over the analyzed period.

The database contained monthly data about Romanian Investment Funds, for the period of December 2007 – April 2017.

Only local investment funds have been selected to be part of the sample. All remaining investment funds have been classified in order to represent the type of management employed:" active" or" passive". Active funds are those that have reported an allocation of capital of above 50% in stocks category. The funds that have been categorized as "passive", were the funds that invested below 50% of their capital in shares of companies. This discriminant categorization was carried this way, because a fund that is highly exposed to shares, requires more active management and interventions (e.g. rebalancing) rather than a fund exposed primarily to bonds and other low volatile assets.

Based on the evolution of management type of funds, net subscriptions, allocation strategy, we analyzed the generated returns on investment. Moreover, these funds have been compared between them through the Sharpe and Sortino ratio.

The funds that registered highest Sharpe and Sortino ratios were analyzed further to explain the main reasons behind higher returns, and to derive allocation strategy insights for simulating a portfolio of investment, which is the second part of the Case Study.

The portfolio simulation wants to build up upon the empirical observations and incorporate behavioral practices into setting up a portfolio. The portfolio is tailored to the objectives and risk profile of an investor profile.

The investor profile definition starts with identifying the primarily investment goal, age, investment horizon, disposable income etc. Then, a generic capital allocation model is applied, that is corresponding to the objectives of the investor. The generic model is diversified on three main categories of assets: shares, bonds, cash. The allocated proportion within these three categories is changing with the passing of time, so that it adapts to the capital security requirements of the investor.

In addition to this generic investment model, we then apply further diversification methods, such as the Markowitz portfolio optimization, which helps us diversify the biggest capital allocation category, which is the "Shares" category. Also, Markowitz optimization helps us identify the portfolio combination that generates highest expected Sortino ratio.

In order to incorporate the behavioral aspect into the portfolio creation, we apply the Separation Property (Bodie, Kane, & Marcus, 1999). Separation property states that there are two simultaneous objectives that a portfolio allocation decision should target. First objective

is the optimization of the portfolio against the risk that we carry out through the Markowitz optimization. Second objective is the allocation of capital between that optimized portfolio and a risk-free investment option. This allocation is based upon the risk adversity of the investor. To be able to reach the second objective, we compute the y* indicator as follows:

$$y^* = \frac{E(r_p) - r_f}{A\sigma^2_p} \quad (2)$$

y* - proportion to be allocated between a risk-free asset and the optimized portfolio

A – risk aversion indicator (usually this indicator is chosen by the financial analyst)

Er – expected return of the optimized portfolio

Rf – free risk return

σ – standard deviation

3. Results and discussions

3.1. Market observation

In the first part of the case study, the correlation between allocation strategy and returns of the investment funds have been analyzed, by comparing Sharpe and Sortino ratios for the analyzed period (Dec 2007 – April 2017). This insight helps us understand the importance of perspective upon the risk. With the insight in place, we then proceed to simulate the optimized portfolio that is ultimately adjusted with a behavioral practice of Separation Property. This portfolio will be built upon an investor profile and will target two main objectives at the same time: security of capital and growth potential.

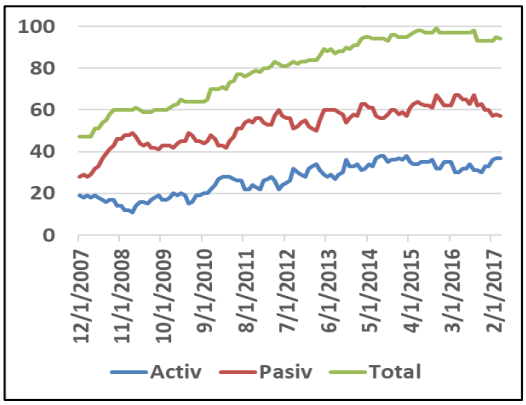

Figure no. 4. Total number of Mutual funds *Source:* Excel computation
data source: http://www.aaf.ro/statistici-fonduri-de-investitii/

In Fig.4 we can observe the total number evolution of the existing mutual funds on the Romanian Market. We can observe that the overall number of funds has doubled over the

analyzed period, which clearly shows increasing interest in the Romanian capital market over last 10 years. The fact that majority of funds have employeed a passive investing approach, shows that the investors are typically prudent on the Romanian Market. Passive funds invest mainly in bonds, which are less price-volatile. Another interesting observation is that over the time, the market was dominated by passive funds, and that the passive funds have been almost constantly in perfect inverse correlation with the active ones, as if there was a constant fight between the two. After the crisis of 2008 we can witness a drastic increase in the number of passive managed funds, a fact which again shows prudent behavior of the investors during times of recession. Another interesting results is that **92%** of the passively managed funds, have never registered a change in the management type of the fund, whereas **50%** of the actively managed funds, have registered at least once, a change in the type of management. These numbers suggest that the active managed funds are usually adapting to the market conditions and are more flexible.

FOND	SHARPE	SORTINO
Pioneer Stabilo	6.333	-0.321
Certinvest Tezaur	6.087	-0.319
Matador RON	3.414	0.869
Hermes RON	2.028	0.457
STK AG Capital	2.847	0.427
Matador EUR	3.217	0.395
AVIVA Leader	3.271	0.301
AVIVA Everest	3.205	0.209
BT Invest	1.367	0.456
Certinvest Absolute Return	-3.266	-0.477
FDI SAFI Obligatiuni	-20.320	-0.317
Omninvest	-1.912	-0.301
BRD Simfonia 1	5.084	-0.296

Figure no. 5: Mutual Funds Comparison
Source: Excel computations
data source: http://www.aaf.ro

In Fig.5 we can see the results of Sharpe[1] and Sortino[2] ratio estimations. The interesting thing is that when analyzed through different types of ratio, some funds showcase completely different results. This is due to the fact that mutual funds such as **"Pionner Stabilo"**, have registered low volatility in price over the period analyzed. However, if we analyze the same evolution through Sortino Ratio, these fund failed to meet the Minimum Required Return of 10% during the analyzed period.

[1] Rf – Risk Free rate used in the estimation is 2% Anually
[2] MRR – Minimum Required Return used in the estimation is 10% Anually

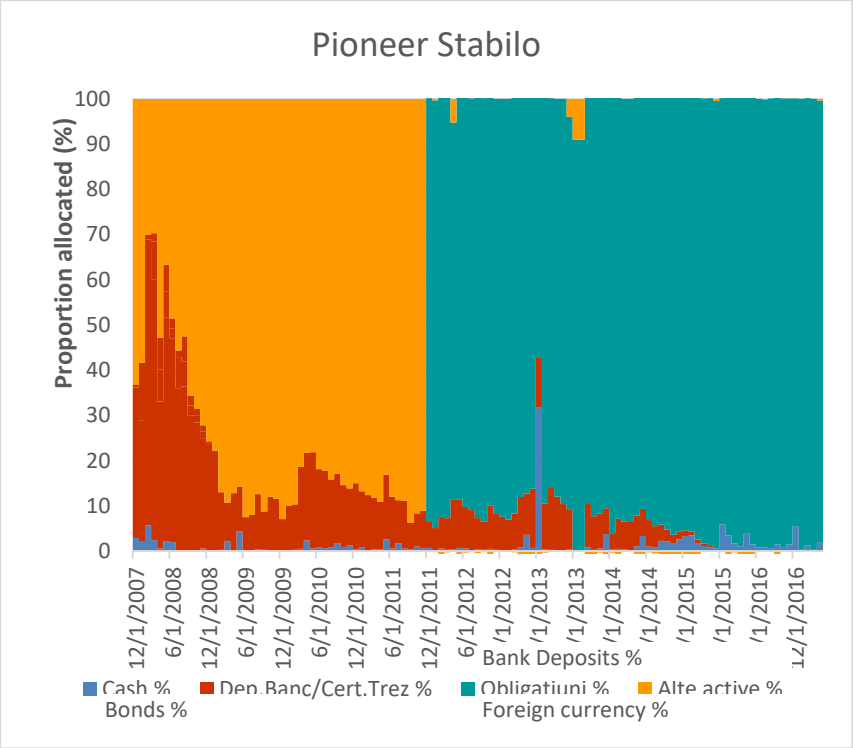

Figure no. 6: Allocation Strategy of Pioneer Stabilo
Source: Excel
data source: http://www.aaf.ro

"Pionner Stabilo" allocation strategy *(Fig.6)* consisted mainly in forex investments and bank deposits, for the period of Dec 2007 – Dec 2011. After this mentioned period, majority of investment was focused in bonds. This strategy generated an annualized returned for the period of 2007-2017 of about **+6.8%.** Due to low price volatility, this fund manages to register highest Sharpe ratio. However, due to failure to generate higher returns than the Minimum Required Return, "Pionner Stabilo" Sortino ratio is negative. This type of strategy is well suited for capital preservation strategy, but is not the best for a growth strategy.

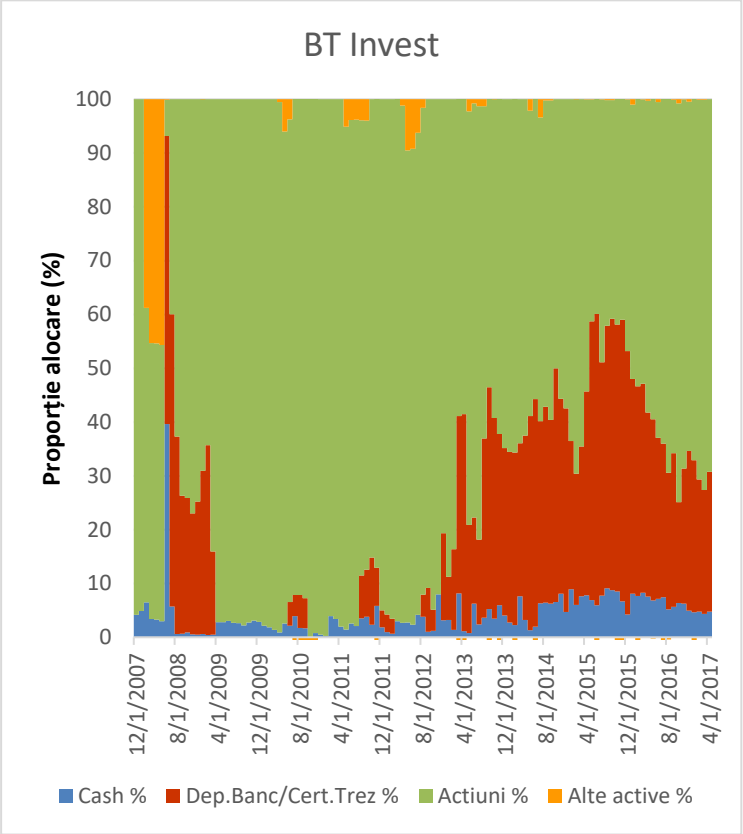

Figure no. 7: Allocation strategy of BT Invest
Source: Excel data source: *www.aaf.ro*

In major contrast, we have the investment strategy of ”BT Invest” *(Fig.7)* mutual fund. The management type of this fund was adaptive to economic cycles, but it was mainly managed as an Active fund. During the crisis period of 2007-2008, the fund opted out of stock market investments and went into Forex and Bank Deposit, in order to adjust to the security requirements of its subscribers. However, once the turning point of the crisis was fading into the past, the fund pivots back to it's original active investment style, investing heavily in stocks. The fund manages to generate higher returns than the Minimum Required Reutrn, with an annualized gain of **+14.53%,** over the whole analyzed period. As a result, we observe in *Fig.5*, that this fund generates a low Sharpe ratio, but scores the highest Sortino ratio. The Sharpe ratio is lower because the fund encountered periods of high price volatility, but managed in the end to generate returns over the expected minimum. This makes the strategy of ”BT Invest” to be appropriate for a growth investing model.

From this analysis, we also observe the importance upon the perception of risk as price volatility (Sharpe ratio), as well as the perception of risk as under-performance against a

minimum required return (Sortino ratio). The conclusions can be completely contrasting, depending of the preferred way of percieving risk. In modern and behavioral finance, the emphasis is put upon the excessive return against a Minimum Required Return, or against the overall Market Return.

3.2. Behaviorally adjusted portfolio simulation

After observing the strategy allocation of the funds and the generated returns, we propose the simulation of a behaviorally adjusted portfolio, tailored to the objectives of an investor profile.

First step consists of the definition of the scope of investment, as well as investor profile. The proposed investor profile is a person of 25 years of age, which has the goal of ensuring a stable stream of income (through annuities) after the retirement. Retirement age is 65, and the estimation is that this individual will live around 20 years in retirement, which renders an investment horizon of 40-60 years. The risk aversion of the individual is medium.

We have a young individual, with a higher than average income for the age category, which considers the necessity to ensure a steady stream of income after retirement. The salary increase growth rate was chosen to be the one estimated within the HR Barometru 2017 study (PwC Romania, 2017), inflation rate being the de BNR target rate for 2017 (BNR, 2017).

Objective	Securing income for retirement
Age	25
Retirement age	65
Years in retirement	20
Starting annual sallary (t_0)	€ 12,500
Salary Growth	4.50%
Saving rate	15%
Inflation rate	2.50%

Figure no. 8: Investor Profile Summary
Source: own estimations

In addition, we needed to estimate some Market hypothesis, namely the correlation between asset categories considered for investments. For our portfolio, we consider 3 main vehicles for investments: **stocks, bonds** and **cash**.

	Capital Market Hypothesis				
Correlation	**Stocks**	**Bonds**	**Cash**	**μ**	**σ**
Stocks	1	0.5	0	9%	15%
Bonds	0.5	1.00	0.1	5%	2%
Cash	0	0.1	1	1.15%	0
Covariance	**Stocks**	**Bonds**	**Cash**		
Stocks	0.0225	0.0015	0		
Bonds	0.0015	0.0004	0.00		
Cash	0	0	0		

Figure no. 9: Market Hypothesis summary
source: own estimations

Correlations (Fig.9) are estimated based upon the results registered by the average of 86 Romanian mutual funds, during the period of **March 2010 – March 2017**. Data source is available on Romanian Mutual Funds Managers site (http://www.aaf.ro), section "Statistics".

Based upon 10 years historical returns, the correlation between Stock Investing Funds and Bond Investing Funds has been computed. In addition, the return and standard deviation has been computed based on the historical volatility registered by those funds.

The return rate of Cash was considered to be an obtainable deposit rate for EURO, at one of the Romanian Banks, with an estimated correlation between bonds and cash of 10%.

Having the basic hypotheses in place, the estimated value of the portfolio was simulated (Tab.1), having an estimated value of **€ 865.764** at the age of 65.

Table no. 1. Future Value of simulated portfolio

Age	Annual Salary	Annual Savings	% Stocks	% Bonds	% Cash	μ	σ	Expected Value
							Sold	€1

							initial>	
25	€12,500	€1,875	95.0	2.50%	2.50%	8.70%	14.28%	€1.876
30	€15,577	€2,337	90.00%	7.50%	2.50%	8.50%	13.58%	€15.455
45	€30,146	€4,522	75.00%	22.50%	2.50%	7.90%	11.48%	€137.098
50	€37,568	€5,635	70.00%	27.50%	2.50%	7.70%	10.79%	€229.413
60	€58,342	€8,751	60.00%	37.50%	2.50%	7.30%	9.40%	€571.459
61	€60,967	€9,145	59.00%	38.50%	2.50%	7.26%	9.26%	€622.113
62	€63,711	€9,557	58.00%	39.50%	2.50%	7.22%	9.12%	€676.610
63	€66,578	€9,987	57.00%	40.50%	2.50%	7.18%	8.98%	€735.202
64	€69,574	€10,436	56.00%	41.50%	2.50%	7.14%	8.84%	€798.159
65	€72,705	€10,906	55.00%	42.50%	2.50%	7.10%	8.71%	€865.764
70	€90,603	€13,590	50.00%	47.50%	2.50%	6.90%	8.02%	€1.284.563
75	€112,908	€16,936	45.00%	52.50%	2.50%	6.70%	7.33%	€1.871.929
85	€175,343	€26,301	35.00%	62.50%	2.50%	6.30%	5.97%	€3.794.253

Source: Excel calculations

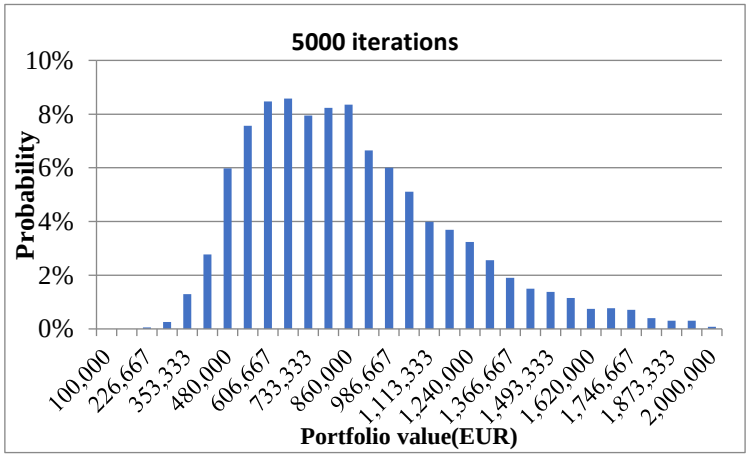

Figure no. 10: Monte Carlo Simulation
source: Excel calculations

To test the distribution of the Future Value for that period, a Monte Carlo Simulation was carried, with 5000 iterations (Fig.10). According to the simulation, the probability to obtain a Future Portfolio value higher than zero, is of **82%.** Lowest 5% probability, indicates a Future Value of around **€ 417.639**, and the biggest 5% is situated around the value of **€ 1.536.939.**

Moreover, we have estimated some relevant performance indicators for a retirement portfolio:

- Portfolio value versus last working year's salary;
- Annuities coverage versus last working year's salary

Simulation Results (t_{40}, age 65)			
	Average	5% min	5% max
Portfolio Value	€860,212	€425,854	€1,542,160
Annuity	€69,026	€34,172	€123,747
Annuity Present Value	€25,707	€12,727	€46,087
Portfolio value/ Salary(t_{40})	11.83	5.85	21.21
Salary(t_{40})	95%	47%	170%

Figure no. 11: Simulation results
source: Excel computation

According to the results (Fig.11), the average portfolio value is around **€ 860.212**. This value is 11.83 times higher than the last working year's salary at the age of 65. Under such conditions, the portfolio can pay an annuity of **€ 69.026.** This payment can cover the latest salary in proportion of **95%**. To ensure highest probability for the portfolio simulation to evolve according to the estimations, it is necessary to diversify the portfolio.

The generic allocation model considered in the simulation is the one exemplified in the Figure 12. As the individual progresses in age, the capital allocated to stocks should drop incrementally, because the objective towards the end of the portfolio horizon is to ensure safety of principal, rather than growth. Through this distribution of the capital, we apply the first level of diversification between the asset categories.

As the stocks represent the biggest proportion of invested capital, it is necessary to diversify and optimize the portfolio within the stock category of the portfolio. To achieve the optimization in relation to historical volatility risk, it is necessary to consider few stocks to be included in the portfolio. As a result of scrutiny, following stocks are taken into consideration for investment: Banca Transilvania (TLV), Transgaz (TGN), Transelectrica (TEL), Compa SA (CMP), Aerostar (ARS), Alro Slatina (ALR), Boromir (SPCU), SIF1, BRD, OMV Petrom (SNP). Based on the expected return and standard deviation (annex 1), an optimized portfolio and an efficient frontier was estimated (Fig.13)

Age	%Stocks	%Bonds	%Cash
25	95.00%	2.50%	2.50%
26	94.00%	3.50%	2.50%
27	93.00%	4.50%	2.50%
28	92.00%	5.50%	2.50%
29	91.00%	6.50%	2.50%
...	...	...	...
65	55.00%	42.50%	2.50%

Figure no. 12: Generic allocation model

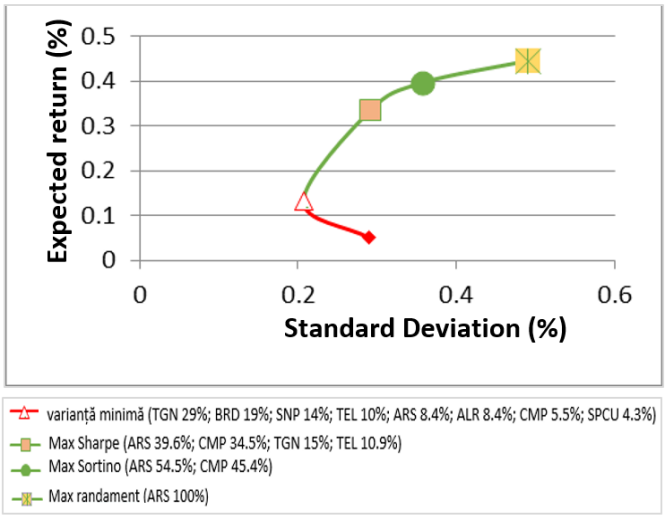

Figure no. 13. Efficient Frontier
sources: Excel computations

According to the estimated efficient frontier, the risk optimized portfolio would consist of the following stocks:

ARS 39.6%; CMP 34.5%; TGN 15%; TEL 10.9%

Besides the Markowitz optimization, the Separation Property has been applied. Taking into account that our investor has a medium risk aversion, and considering a Risk free of 2%, the *y** indicator is estimated to be 92.75% (*according to equation (2)*).

In other words, due to the risk aversion of the investor, we are advised to invest only **92.75%** of the capital dedicated to stock investments, and to invest the remaining **7.25%** into the risk-free rate asset. This allows us to diversify not only between categories of assets, but as well within the biggest category of assets, by incorporating the risk aversion behavioral aspect. As a result, we obtain an allocation strategy model *(Fig.14)*, that is tailored to the individual objectives of the individual and his behavioral profile.

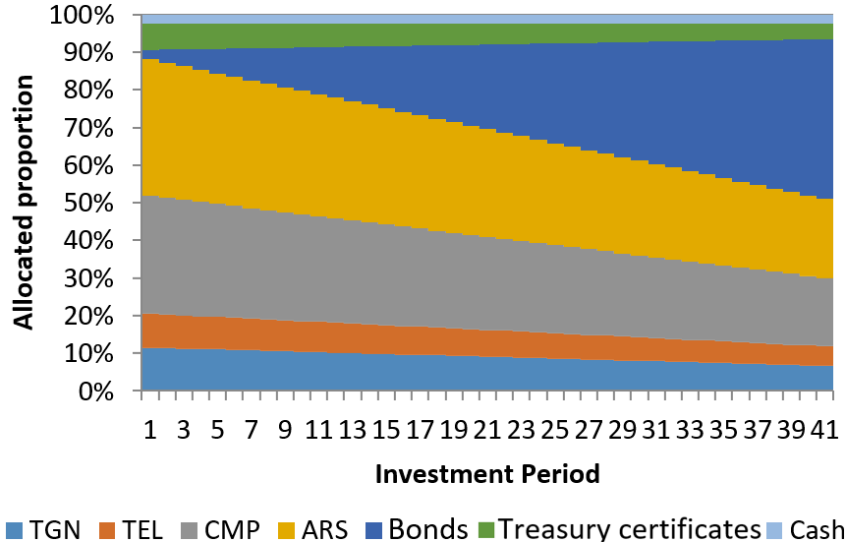

Figure no. 14: Simulated Allocation strategy model
source: Excel computations

Conclusions

More and more Behavioral Finance studies are being developed, striving to develop a definitive model that would include best practices of mitigating all behavioral errors. As such, there isn't yet a prescriptive model of Behavioral Finance, as there is the Markowitz Prescriptive Model of the Modern Portfolio Theory. The behavior of investors and crowd of investors, is highly unpredictable, this being the reason behind the difficulty of incorporating all practices under an elegant model.

Within this research we have observed indirectly the behavior of the mass of investors through the perspective of mutual funds on the Romanian market. We concluded that active management of portfolio, which is able to adapt to economic cycles, and that avoids the incurrence of consistent losses, is the one that scored highest returns on investments that were above the average market expected return. If investment on the Romanian Market is considered for growth purposes, it is better to employ an active management style.

With these observations in mind, we went ahead and simulated the steps of a portfolio creation, which incorporated behavioral aspects of a specific investor profile and also behavioral practices of portfolio creation. We have applied multiple diversification levels within this portfolio. One diversification level is achieved through the generic allocation model between different categories of assets, and a second level of diversification was applied within the biggest category of portfolio assets. The "Stocks" category was further optimized using Markowitz's Portfolio Optimization model. This optimization, in turn, was adjusted with the behavioral practice of incorporating risk aversion into the capital allocation.

As a result, we have obtained a portfolio model that corresponds to the growth objectives of the investor: in the first part of the investment horizon the focus is on growth, with increasing focus on security of capital as we move towards the end of the investment horizon. We have applied multiple and various levels of diversification and behavioral adjustments, thus building a reference model that is well developed for this particular case. The model showcases only the high-level strategy to be employed, based on current market evolution and hypotheses. Besides the model, the investor should keep in mind about all the biases that he is exposed to when making investment decisions. Here is where a financial advisor, that is schooled about the Behavioral Finance concepts, can contribute as a controller of the investment decisions that an investor is about to take. Under normal conditions, a strategy should be changed only when there is enough real evidence that the strategy isn't generating the minimum required return. As long as the strategy is aligned with the results and initial investor's objectives, the financial analyst has to be against any desire of the investor to pivot the strategy and invest according to some trend or current fashion. Such unnecessary transactions and strategy changes, come with additional brokerage fees, and can diminish investor's capacity to assume future unforeseen risks.

This research can be used as a model to the investment process and practices of the modern finance. Financial markets are continuously changing worlds, and the skill of adapting to current environment and resistance to external factors of influence can be developed only by being exposed to this real environment. Human beings are the ones that make a market exist, and the human beings are mainly driven by their fears and irrationalities. Under such conditions, this mysterious universe cannot be studied to its full extent, just through the lens of exact sciences. The fact that a study field such as Behavioral Finance emerged, demonstrates that we are social beings, and that the real behavior cannot be modeled only though equations and formulas.

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Annex 1

Table no. 1. Efficient frontier estimation

	TLV	TGN	TEL	CMP	ARS	ALR	SPCU	SIF1	BRD	SNP
Er	12.71%	14.60%	17.79%	33.64%	44.56%	-2.30%	11.22%	12.13%	0.85%	7.52%
StDev	15.00%	7.18%	10.28%	17.84%	24.08%	20.41%	43.50%	13.10%	8.78%	9.59%
Riskfree	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Sharpe	0.71	1.76	1.54	1.77	1.77	-0.21	0.21	0.77	-0.13	0.58
	TLV	**TGN**	**TEL**	**CMP**	**ARS**	**ALR**	**SPCU**	**SIF1**	**BRD**	**SNP**
Er	12.71%	14.60%	17.79%	33.64%	44.56%	-2.30%	11.22%	12.13%	0.85%	7.52%
StDev	87.24%	79.40%	71.78%	63.52%	54.14%	45.46%	34.17%	22.57%	13.94%	6.08%
RMA	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
SORTINO	0.03	0.06	0.11	0.37	0.64	-0.27	0.04	0.09	-0.66	-0.41