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Portfolio Management, Hybrid Funds, and Smart Beta Performance

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Master in Finance

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Iscte-Iul

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Department of Finance

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Writing a thesis is complex, an emotional roller coaster, that is long awaited by the time we enter in the master. It was probably one of the biggest challenges I ever taken in my life, with some setbacks along the way. However, I am not a person that gives up only because things are going bad. Life is made of challenges, and this was a quite big. Right now I am happy a can finally answer one of the most common questions people asked me "How is the thesis going?" with a positive answer.

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Abstract

This thesis explores portfolio management, focusing on hybrid funds and their potential to outperform traditional market benchmarks. Hybrid funds combine active and passive strategies to strike a risk-reward balance. Smart beta funds, a subset of passive strategies, deviate from market capitalization-weighted indices to enhance returns. The research aims to determine if hybrid funds, with active and passive components, can slightly outperform the market by incorporating smart beta strategies. It employs quantitative analysis, risk assessment, and performance evaluation. The study begins with a theoretical foundation in portfolio management, covering concepts like asset allocation, risk management, and diversification. It highlights hybrid funds' unique value proposition. The research also explores smart beta funds, emphasizing their distinct approach based on factors like low volatility, quality, value, and momentum. Using historical data and statistical methods, the study evaluates hybrid funds with smart beta components, comparing them to market benchmarks for marginally better risk-adjusted returns. The findings contribute to discussions on portfolio management, indicating the potential for hybrid funds to achieve slightly better returns, especially when smart beta strategies are applied. This research is valuable for investors, asset managers, and financial professionals, aiding in decision-making in the complex financial landscape. In conclusion, the thesis bridges traditional and modern portfolio management, shedding light on the role of hybrid funds and smart beta strategies in enhancing returns within diversified portfolios.

Keywords: Portfolio Management, Efficient Markets, Behavioral Finance, Hybrid Funds; Smart Beta Funds

JEL Classification System: G1 and G4

Resumo

A tese explora a gestão de portfolios, focando nos fundos híbridos e o potencial para superar *benchmark* de mercado. Os fundos híbridos combinam estratégias ativas e passivas para atingir um equilíbrio entre risco e recompensa. Especificando os *smart beta funds*, desviam-se dos índices pela capitalização de mercado para melhorar retornos. A pesquisa tem como objetivo determinar se os fundos híbridos, com componentes ativos e passivos, podem superar o mercado ao incorporar estratégias *smart beta*. Através da utilização de avaliação de risco e avaliação de desempenho e de testes de hipóteses. O estudo começa com uma base teórica em gestão de portfolios, abrangendo conceitos como alocação de ativos, gestão de risco e diversificação. A pesquisa também explora os *smart beta funds*, enfatizando sua abordagem distinta com base em fatores como baixa volatilidade, qualidade, valor e *momentum*. Usando dados históricos e métodos estatísticos, o estudo avalia os fundos híbridos com componentes *smart* beta, comparando-os com *benchmarks* de mercado para retornos ajustados ao risco ligeiramente melhores. As descobertas contribuem para as discussões sobre gestão de portfolios, indicando o potencial dos fundos híbridos para alcançar retornos ligeiramente superiores, especialmente quando estratégias *smart beta* são aplicadas. Esta pesquisa é valiosa para investidores, gestores de ativos e profissionais financeiros, auxiliando na tomada de decisões no complexo cenário financeiro. Em conclusão, a tese faz a ligação entre a gestão de carteiras tradicional e moderna, lançando luz sobre o papel dos fundos híbridos e das estratégias *smart beta* na melhoria dos retornos em portfólios diversificados.

Palavras-chave: Gestão de Portfolios, Mercados Eficientes, Finanças Comportamentais, Fundos Hibridos; *Smart Beta Funds*

JEL Classification System: G1 e G4

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1. Introduction

Since the beginning of human transactions the objective is to benefit from an acquisition, whether it was a property or an object, the goal was and is always the same. In the stock market this precedent continues, an investor objective is to have a positive return from acquiring any financial asset. Having positive returns is detrimental for an investor success. However, the desire to outperform and establish consistent positive returns above the market return is what distinguishes and creates a hierarchy of the investors. Separating a regular investor from a financial guru.

The previous innuendo supports the following question "Is it possible to beat the market consistently?" This sentence is one of the biggest dilemma of Portfolio Management theory. It fundamentally means, as an investor, earning a return superior to that of the market, here represented by the Standard and Poor's index, the benchmark defined. The following thesis objective is to analyze if a portfolio relying on active management and passive management can actually achieve it.

An Active management portfolio relies on a strategy that implies tracking and monitoring a portfolio and performing on a regular basis buy, sell or hold decisions. This strategy obviously implies high transactions costs and time expended analyzing and forecasting assets. Seeking higher returns to that of the market explained by the extra effort. It is a common strategy among hedge funds and portfolio management firms.

On the other hand, a Passive management portfolio relies on a completely contrasting strategy which is also known as indexing. Meaning that the portfolio of the investor is a replica of an index. In recent years the surge of Exchange traded funds allowed an easier and simpler execution of such strategy, popularizing it. This strategy accounts for little to none transaction costs as well as little effort since the entire portfolio position consists of the index movements.

In this innuendo surges a hybrid system of investing which relies on both strategies as the name states. It relies on aspects of these two theories having the cost efficiency of passive strategies and the market adaptation of active strategies. The popularity of hybrid funds is in a constant rise and this thesis purpose is to explore this effects whilst focusing on Smart Beta Funds. The benefits of these highly flexible products will be subject to the test.

The research purpose of this thesis is to establish the differences between active management and passive management. Whilst exploring the topic of hybrid funds, compiling both strategies. Beyond the main topic of research explained previously this thesis is going to

provide an extended analysis on Hybrid portfolios more specifically Dynamic Hybrid Funds. Focusing on the latter Smart Beta funds are going to be the main target of this analysis. The research will be centered across this type of portfolio ability to outperform the market. To capture the value of the research objectives it is extremely important to have the following questions as postulates to extend the parameters of such: "What is the theoretical basis behind the existence of Active Management and Passive Management?"; "What are the main critiques to both strategies?"; "How can an investor benefit from both strategies and how can they complement each other?"; "How to benefit from a dynamic portfolio with both passive and active traits?"; "What are Smart Beta Funds?"; "Can Smart Beta Funds Outperform the market?"; "What is the best strategy in bullish/bearish times?"; "Is any strategy crisis proof?"; "What can be retrieved from this analysis".

All of the questions above contemplate a certain aspect of the thesis and will be answered based on previous works and the author analysis. Throughout the analysis of books, papers and different articles adding to this also the author own analysis and results the questions will be answered in a non-biased manner, objectively supported by facts. It is also to retrieve from the questions that they will also be essential in order to define the structure and guiding the reader throughout the thesis.

This thesis follows a structured approach. It begins with an introduction, highlighting the importance of the topic. Next, we delve into the theory of portfolio management, laying the foundation for our exploration of hybrid funds. We also examine smart beta funds. In the empirical phase, we use historical data and statistical analysis to evaluate hybrid funds, comparing their performance to traditional benchmarks. The thesis concludes with practical insights for investors and asset managers, emphasizing the potential of smart beta-infused hybrid funds to improve returns and manage risk.

2. Literature Review

In this section it is provided a brief and concise review of the most recent topics at study, which concern Active and Passive Management, Smart Beta Portfolios, their strategies, and a general overview of Portfolio theory.

2.1 Portfolio Management

In order to advance further in the topic of the thesis it is important to understand firstly what is Portfolio Management. Portfolio Management came up recently and its integration in society has been growing in the past few years, it is an extremely important definition in the world of finance. Portfolio Management can be defined as "a business process by which a business unit decides on the mix of active projects, staffing and dollar budget allocated to each project currently being undertaken". Portfolio Management is responsible for developing a strategy that will allow the creation and further development of a portfolio. (Hilsted, 2012) The following thesis is structured around assumptions of Passive Management and Active Management and if it is possible to benefit from a hybrid system of management. However firstly it is important to analyze literature on Portfolio Management Strategies as a whole.

2.1.1 Portfolio Management Strategies

In Harvey and Van Hemert (2019) the authors explore the nature of hedging, starting by the usage of derivatives. Developing for Equity hedging and how it can avoid big equity corrections, despite being and expensive and difficult task to manage, put options on the S&P500 and United States Treasury Bonds. Gold is also used by some investors since it is a contractionary performer. Separating from the traditional strategies to the modern ones, the previous were clearly more traditional. However, the strategies that perform typically best are dynamic strategies which include futures time-series momentum and a mixture of investment in good quality companies and shorting bad quality companies. Despite all of this the authors conclude that both active or passive investors are susceptible to drawdowns, both specific stock or indexes can fall abruptly in one day. Suggesting as well some hedging strategies such as Passive Hedging theories: short firm-value strategies (long puts and short credit risk); Safe haven assets (long gold and long bonds); Active Hedging strategies: Times-series momentum

(using futures); Quality stocks. Harvey and Van Hemert (2019) conclude that a portfolio can be crisis proof however at a very high cost.

Lopez de Prado (2018). A paper mostly focused on the future of Portfolio Management. Furthermore, the author focus on Machine Learning, stating that Machine Learning algorithms learn patterns in a high dimensional space. These functionalities do not replace theory but are able to guide it when correctly used, they are useful tools and provide helpful insights when it comes to investing. The author explores an interesting paradigm in order to understand investors rationality, the Sysiphus Paradigm that states: investors do not follow a straight line strategy they make decisions based on information and context it is provided, a machine learning system is completely rational and searches for patterns. It also contemplates that investors do not always behave in the same ways, making the necessity for a machine learning system to be highly complex. Leading to believe that constant updates and actualizations are crucial in regards to Machine Learning. The author also infers importance into back testing and repetition of patterns which are also the basis of an ML algorithm. To conclude the author, incorporates possible solutions to this matter such as the meta-strategy paradigm and many more.

Benzoni and Goldstein (2006) explore the realms of investor life stages giving economically reasoning for young investors to take different positions than investors with more experience and more years of investing. The study suggests that young investors should substantially short positions in the stock market. Because of co-integration the young agent's human capital effectively becomes "stock-like." However, for older agents with shorter time to retirement, co-integration does not have sufficient time to act, and thus their human capital becomes more "bond-like." Together, these effects create hump-shaped life-cycle portfolio holdings, consistent with empirical observation. These results hold even when asset return predictability is accounted for.

Shiller (2003) explores the theories that effectively build up the Portfolio Management scenario. Starting off by the Efficient Market theory gained traction in the 1970s at the time it was given the rational expectation revolution on economics, in 1973 Robert Merton published " An in temporal Capital asset pricing model" which had on its foundations completely rational expectations. In 1990 the Behavioral Finance theory started to appear when too many irregularities started appearing, Campbell, Lo and Mackinlay's 1996 book The Econometrics of Financial Markets, laid the foundation for a revolution in finance.

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2.2 Efficient market hypothesis

The efficient market hypothesis states that investors are completely rational and for the sake of the argument their decisions follow this rationality. Information is accessible and available to all investors. These factors are also incorporated and reflect consequences in the functioning of the markets. In this scenario there are no arbitrage opportunities, since the price of the stock reflects every information available relevant for this matter. Meaning every share of a company is priced at its fair value, eliminating the existence of undervalued or overvalued stocks from the financial markets. In this hypothesis it is impossible to outperform the market while having the same level of risk (systematic risk). However, in contrary to what is believed it also states that for a higher risk level it is possible to outperform it.

Exploring the realms of Lo and MacKinlay (2002). Focusing on the Random walk theory which reflects that patterns from the past do not determine the future of the price, in other words future returns cannot be forecasted by previous returns. all information contained in past returns has been impounded into the current market price: therefore, nothing can be gleaned from past returns if the goal is to forecast the next price change. There is one implication in this theory that correlates an increase in volatility of returns with the returns on a one by one basis. A rejection of this theory implicates a possibility of an active trading strategy beating the market.

Some strategies used such as stock selection are not valuable anymore since their purpose is not accomplished. Stock selection and market timing fail due to a condition stated previously, every stock is priced at its fair value. In addition, market timing is also not viable anymore justified by the same reasoning as of the stock selection failure.

The price of the stock changes based on new information, this effect is not predictable and can be verified in any direction based obviously on rationality. It follows the postulate of the random walk theory, implying basically that the price of a stock is unpredictable and follows a "random" path. Their changes follow the same distributions whilst being independent of each other, statistically inducing the investors into not taking decisions based on previous price movements. This theory complements the efficient market hypothesis giving aid and supporting its functioning. Taking this into consideration the existence of predicting models that are used to track the stock price are irrational and obsolete in the long run.

2.2.1 Portfolio Management strategies derived

The main strategy derived from the efficient markets postulate is indexing, a passive management strategy that consists in, as the name indicates, replicating an index. It is a simple

strategy that mimics the performance of a chosen index by selecting the same securities in the same positions. Thus canceling the effects of security selection or trading, traditional to active management strategies.

Active funds are in all of the formats presented more cost inefficient than index funds (Appendix A). The most expensive format is the "alternatives" in both active and index funds, comprised of more exotic financial products. The least expensive in active funds is taxable bonds and the least expensive in index funds is U.S. stocks, a market highly developed and advanced compared to the rest of the industry. The reasoning behind this discrepancy is that active funds require the constant shifting of stocks or bonds leading to a higher number of transaction costs. Furthermore, active fund requisites the effort of a fund manager in order to identify market opportunities and allocate the necessary means to perform the transaction.

2.2.2 Market efficiency in today's time

Market efficiency is proposed in Abner (2016), whilst focusing on the ETFs. In this work Abner says that this financial product surged when equity block trading was beginning to show signs of decline, ETFs provide a truly hedge to their positions by trading a basket of underlying stocks. Many passive investors if not all operate in the ETF market. It highlights 5 type of liquidity providers that interact with ETFs: Broker-dealer facilitator desks; Proprietary market-making firms; Lead market makers; High frequency trading firms; Liquidity aggregators. ETFs are complex market replicators that can function with multiple variables and aggregations.

Following the ETFs line of thought surges Indexing which is a simple strategy that can be utilized via ETFs, Exchange traded funds on S&P 500 registered a return of -19.64%, in one of the worst years of the index in recent time, being followed by the other caped stock indexes. According to Morningstar (2022), in an unprecedented and unpredictable year (2022) indexing failed to outperform several other mutual funds such as large cap, defying it by a great margin. However, exchange traded fundsS&P500 registered a return of 26.89% in the last year (2021) rebounding from the return registered in 2020 of 16.26%. These returns are impressive taking into consideration the pandemic crisis disruption in the market. Only 15% to 20% of growth mutual funds effectively beat their set benchmarks. Historically this percentage is higher, in the marks of 30% which leads us to believe: Is the market becoming harder to beat? Or the investors less capable of beating it?

The best performer of the mutual funds was U.S. Large-Cap Stock with a return of 26.07% in 2021. However, it is still below the value registered by the index S&P 500, 26.89%. It is plausible to state that the average mutual fund underperforms the market, here represented by

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the index. The difference is staggering and when it comes to the financial markets small discrepancies are valuable. It is important to notice that in recent years the average return has increased, the 15-year average is way below the 3 or 5-year. In almost all of the formats this factor happens the influence of the crisis of 2007 is still perceptible in latter averages, in addition the Covid-19 pandemic affected forcefully the averages. Moreover, smaller averages such as the 3 and 5-year were more drastically impacted by the pandemic.

2.2.3 Exchange Traded Funds

Exchange traded funds are a financial instrument utilized typically in passive management despite also being utilized in active strategies. This financial product originated in the 1990's when investment banks realized that these could be helpful tools for investors, which ultimately led to ETFs gaining traction in the early 2000's. It urged in the so called "upstairs market" in the block, electronic liquidity and stock loan portfolios (Abner, David J.; 2016).

The most common ETFs consist of index replicas, having the same positions and the same asset allocation as indexes being the most common the S&P 500. Furthermore, ETFs can also have multiple formats in distinct categories, below there is a table with the various types of Exchange Traded Funds.

Exchange traded funds despite their multiple formats all function similarly (Appendix B), despite their portfolio block structure they can also be traded just like stocks. Through a brokerage firm the process is similar and technology has come in handy to help develop the industry. "ETFs are transforming the investment landscape and ultimately advancing investor interests. Just as we expect our car and phone technology to evolve, we should want and expect the same from our investments." by Nate Geraci (2019).

This industry is in continuous development and all investors are benefiting. In addition, the creation of up to date financial tools with even more efficiency whether it is at a cost or tax level is crucial. ETFs have the ability to simplify an increasingly complex market with streams of everlasting information. However, the word simplifying does not mean that these financial instruments are risk free or that they cannot lead to losses. ETFs are financial instruments and as such they need to be used with prudence and information (Market participants and their trading strategies, 2010).

The industry of the ETFs is in constant innovation and the yearly change can be seen in the graph above. The number of Exchange traded funds opened increased throughout the years despite slight fluctuations. In 2011 the number of ETFs opened were 231 while in 2020 there were opened 82 more, registering a total of 313 (Appendix C). The number of liquidated or

merged ETFs also grew over the years despite slight fluctuations, following a similar pattern to the opened ones. In 2011 the number of merged ETFs was 15 and it ended the year 2020 with 182, registering an exponential increase throughout the period in analysis.

This evolution can be easily observed, the number of Exchanged Traded Funds in the United States sky rocketed. In 2003 the number of ETFs present in the American market was a shadow of what it is currently, having 123 of these type of funds in that year (Appendix D). This number increased tremendously throughout the period in analysis having surpassed its original value by ten times in only 10 years, meaning that in 2013 the number of ETFs surpassed 1230. Furthermore, by 2021 this number doubled its sized reaching a whopping 2632, the highest value it has ever reached. The growth of the number of ETFs was astoundingly consistent and did not sustain any particular "damage" related to crisis or the overall state of the economy. The growth rate was consisted, averaging over the 18 years in analysis, a value around 19%. This shows exactly the gaining in popularity exchange traded funds have had. In times where the demand was low the offer of this type of funds was also low. Investors in the early 2000's were not seeking exchange traded funds, preferring to invest in more traditional products and options. However, with the increment in its popularity ETFs are now having possibly the highest demand recorded. Considering that ETFs have never amounted to such high value invested than currently. Following this path, the number of ETFs has also sky rocketed in an attempt to satisfy the investors demand for this type of security.

2.2.4 Evolution of asset class

The return of financial assets, divided by category, between 1985 and 2020 gives us a great perspective (Appendix E). It is notable that emerging stocks have been the best overall performer while having the most volatility of all of the categories. It reached its peak in the early 2000's before the financial crisis of 2007 which registered a huge setback in its return. The second best category in terms of return in this period of time was U.S. (Ross & Rida Khan, 2020) Large Cap Stocks which had very similar values to those of emerging stocks in 2020. In addition, this category registered a higher stability and less volatility in its values, reaching its peak in 2020 whilst on a steady upwards trend. U.S. small cap stocks and REITs had an almost identical behavior and registered very identical changes. The other asset categories all had lower returns justified by its nature of fixed income, less volatility tends to be rewarded with less market returns. (BobPisani, 2020)

2.2.5 Critiques to Exchange Traded Funds

ETFs are not magical instruments that grant always return, they have also their flaws. In today's financial market it is not possible to be perfect neither it will ever be. These type of instruments have also to deal with management fees, they are not free to operate with as sometimes it is believed. This management fees despite accounting for a small perceptual cost to some investors, might damage the return or profit of many others. (Fidelity, 2022)

To operate with ETFs it is necessary to open an account in a brokerage firm. However, an investor which underlies its assets in a no-load firm can also reach this financial instrument. Using its firm as an intermediary it can contact with a brokerage firm responsible for ETF operations. This operation obviously leads to an extreme increase in its costs, paying commissions to buy shares, being this the only possible manner to purchase ETFs. The previous commissions sometimes have fix monetary values, meaning that smaller accounts are more vulnerable and accounts with higher sums can sustain these expenses with ease. This format of commissions damages the flexibility of the ETFs giving an unfair disadvantage to smaller investors to reach this market. In addition, this is a current practice in the industry and it is very similarly done with many more financial products.

ETFs were constructed to be tools that tracked index funds, however sometimes there is a tracking error and the ETFs strays away from its origin. This difficulty in tracking with a 100% accuracy exists since indexes do not hold cash in its assets. On the other hand, an ETF needs to hold cash, it cannot operate without it. It is a fundamental asset since the fund needs to mimic the index positions whilst accounting for management and purchase fees. Dividends are another source of tracking error, the timing of dividends includes an ex-dividend date and the reinvestment of the dividend, an assumption made by the index fund. ETFs funds are not able to reinvest their dividend no sooner than the dividend is actually delivered leading to marginal errors.

ETFs mechanics are very characteristic, their complexity is beyond the normal stock transaction. This is obviously a barrier when it comes to asset liquidity and trades between assets represented by ETFs and common stock.

2.3 Behavioral Finance

According to the efficient market theory, investor's rational attitude is assumed in all investing actions. It affects a wide range of tasks and decisions and should be taken in consideration.

However, investors shall not be perceived merely as cold calculators or machines. The market is not perfect and its complexity is hard to be standardized in a "block of positions". They have greed, frustration and anger. By the start of the 21st century, the prevalence of this theory had progressively become less universal and behavioral finance has started to gain force in the study field of investment decisions.

According to Bachmann. and Hens (2018) Behavioral finance: combines psychology with finance to better understand investors rational. Investors have limitations to rationality, contrasting with efficient markets premises. Neuro finance, how the brain coupes with risk, gain, loss. It is also important to consider the cultural impact on neurological receptions on loss aversion. There are different perspectives on loss aversion changing from culture to culture. Strategic asset allocation is defined by investment psychology and is responsible for 90% of the performance of the investment. On some notes it is clear the importance of the growth of the decision theory: Starting as soon as in Pascal (Expected Value, 1657); Bernoulli (Utility function 1738) and more recently explored in Markowitz (mean variance model 1952); Kahneman and Tversky (Portfolio Theory 1992)

In Kahneman, (2003) the exploration of the limits to rationality is yet again proven. This author starts by explaining that there are only two systems to reach a decision intuition and reasoning. The effect of context and accessibility determines our decisions tremendously, given different contexts decisions can be completely different. The author also approaches a different topic while examining that the Schematic value function changes, being concave in the domain of gains, favoring risk aversion and convex in the domain of losses favoring risk seeking. The function is sharply kinked at the reference point, meaning that, loss averse is steeper for losses than for gains by a factor of 2-2.5. Finalizing by identifying that there are multiple factors that affect human rationality, it has its limitations and thus does not function as a perfect system. Making it clear that humans are not always rational and are susceptible to external influence.

Statman, (2018) also explores the behavioral effects of investing. Stating that it is of most importance to identify the investor needs and wants in order to maximize its utility. The usage of cognitive and emotional shortcuts is implicit and there is a need to be aware also of cognitive and emotional errors. Interpelling that it may affect investors rationality and their decision making ability. The author identifies the existence of behavioral finance and its generational stages as well. Starting off by the Standard Finance (first generation of behavioral finance): investors are rational they only want the highest return; these investors typically choose mutual funds. Second generation of behavioral finance are correlated with coping with their errors and avoiding to repeat them in order to reach their wants and needs. Analyzing also the todays

investor and what they look for, they typically seek 3 benefits: utilitarian, emotional and expressive, not only returns. Statman also identifies limits to investors rationality, explaining as cognitive errors and shortcuts: Framing, hindsight shortcuts (repeating actions who brought us good outcomes and confirmation errors (assigning little importance to disconfirming opinions).

The human mind is in fact liable to biological and physiological limits. In accord with (Sewell, 2005) "Behavioral finance is the study of the influence of psychology on the behavior of financial practitioners and the subsequent effect on markets". Behavioral Finance studies show investors are acting based on emotional and instinctive components. Additionally, in a research performed in recent years 80% of individual investors and 30% of institutional investors appear to be more inertial than rational.

Moreover, the influence of emotions may be responsible for errors in evaluation, which can result in irrational missing optimal choices. Hence, the resulting inefficiencies in the capital markets can create opportunities for the investment. In this investment process, investors typically face a roller coaster of emotions (Appendix F)

Irrationality is induced by psychological forces (affective biases and cognitive heuristics) and biological forces. Usually, the most common cognitive heuristics or rationales presented by psychologists which affects the decision of investors in the stock market and explain why Behavioral Finance leads to irrational behavior are:

The concept of overconfidence is one of the most studied phenomena by Behavioral Finance. Being one of the most commonly felt in the investment world. This term is seen as an overestimation of investors own abilities and knowledge to identify successful investments. Which ultimately can lead to biased investing decisions or unprofitable trading. Therefore, they over-evaluate the probability of success and accuracy of information. On average, the confidence level is inversely correlated with some experience factors such as the amount of time experienced in the market. More experience can lead to more overconfidence.

This phenomenon is characterized by the tendency to hold onto a belief and hardly adjust their initial ideas to new information. Tversky and Kahneman (1974) found that people tend to be constrained by meaningless "initial anchor". Investors base their decisions on the first source of information to which they are exposed, such as a stock price at a given time or market index levels, without considering their history and the variability of its price in the past.

Herd behavior illustrates the fact that investors feel the need to join in groups and, consequently, imitate others' behavior especially in decision-making situations of uncertainty. Under these circumstances, they over-rely on public opinion without considering their own

personal assessment. (Lakonishok, Shleifer and Vishny, 1992) stated that herd effect happens for instance when investors buy or sell stocks at the same time with other investors or when they gather in investment clubs to plan together the best lines of investment under the terms of risk-performance. This behavior can stimulate active investment strategies based on momentum and lead to speculative bubbles and sudden price falls. In the event of a negative performance, the sense of regret of the individual for the wrong choices is reduced due to a joint responsibility of the group.

Efficient market theory states that the higher the risk associated with an investment, the greater the return. Contrary to what is argued in Behavioral Finance, this theory assumes that investors seek the highest return according to the level of risk they are willing to take on. The loss aversion has been analyzed for the first time by the pioneers of Behavioral Finance (Kahneman and Tversky, 1979), where they found out that investors are more sensitive and risk-averse to losses than to risk and possible return. Complementarily, some estimates suggest that investor weights losses twice as heavily than wins. For instance, under uncertain conditions, the fear and panic of losing 1€ is higher than the event of gain one.

2.3.1 Behavioral finance in practical terms

Behavioral finance contrasts with the efficient markets theory, it states that investors are not rational thus the market is not perfect. There are limits to investors rationality, influencing investors and their decision making process. An investment process is comparable to a roller coaster with multiple stages where in some cases emotions get the best of the investor. Leading to imperfections: decisions which do not maximize return and minimize risk.

With this being said, in theory, behavioral finance leads to believe that there are opportunities that can outperform the general market, which allow for higher returns with less or similar risk. The market does not function perfectly or without committing any mistakes. The market has its flaws and investors can take advantage of them. For example, this theory states that pricing errors can exist and can also be exploited, to an investor own advantage. The previous was impossible in the efficient markets theory, there were no flaws and everything was priced correctly.

Financial market errors can lead to amazing opportunities, it is necessary to be able to identify and take advantage. Each theory identifies more with certain type of financial instruments. ETFs are not as consistent with this theory as they were with efficient markets, solely by their unit and "block" characteristics, making it difficult to take advantage of specific opportunities, when an exchange traded funds operates in a group of assets. On the other hand,

stocks seem to be the correct financial instrument to deal with specific market opportunities. It is easier for one stock to be mispriced than an entirety of stocks comprised into the ETF. Behavioral Finance suggests that it is possible to identify errors in stock pricing thus creating an opportunity. While having the necessity to introduce a strategy or certain operations that are profitable in respect to what was previously analyzed.

2.3.2 Stock Trading

Stock investing is one of the eldest fashioned trading strategy, since it's one of the first financial instruments to ever be created. The first stock originated in 1611 when the Dutch East India Company went public originating a landmark on the financial world, a start to one of the most used financial asset. In later years the Philadelphia Stock Exchange was formed and its success expanded to the creation of stock exchanges all around the world. This is the beginning of the financial market as we know it today, stocks are one of its founding pillars. They are simple instruments used by the generality of investors, it is impossible to operate in the market without knowing what is a stock (Hwang, 2023). Investing in a stock is considered a high risk, since depositing the entirety of your portfolio in one asset category can lead to high losses. However, with high risks also comes also the possibility of high returns. For example, investing in a specific growth stock may lead to an astronomical return, but it is of extreme difficulty selecting a stock that carries these traits. However, stock investing is not to be looked upon as something easy, it requires knowledge and expertise. The stock market is in constant evolution and since 1611 that it is always in reconstruction gaining and loosing companies that operate in the vast realm of human endeavor that is the global economy. From the beginning of its genesis with only one company to millions of companies traded publicly on a global scale in an interconnected sphere. Stocks or equities in general shall not be looked upon as something static however there are multiple categories that stocks can fall into. In these thesis the followings will be explored and further analyzed.

All of these types of stocks (Appendix G) are crucial in market operations. There are many more type of stocks however the ones explained were the most common known. Stocks have their own advantages and disadvantages; the following part will analyze one of the most popular financial asset.

The main advantage of stock trading is obviously the expectancy and possibility of high returns, this being with an individual stock acquisition or through a collective of stocks, portfolio. Another advantage of owning stocks is the dividend payout, this might come in the form of cash or stock and is attributed to owners of shares of the respective company issuing.

Dividends are an interesting feature since their value might increase throughout the years however not every company or firm pays dividends to their shareholders.

In order to operate in the stock market, it is necessary to pay some commissions whilst performing trades. These commissions have been decreasing in the last decade, with the creation of online brokers the cost of buying or selling has been almost reduced to nothing. In conclusion stocks are of easy accessibility, everyone can invest through buying or selling operations. Furthermore, they are one of the most liquid assets in the market, they are flexible and easy to operate with, the bureaucracy has decreased in recent times providing even more advantages. Stocks are great tools to achieve financial outcome.

Stocks may have an above average return however this return needs to be tax deducted, capital gains are taxable, but only when the asset is sold. This is not only a disadvantage of stocks but also of all of the financial instruments.

An above average return also means higher risk thus a higher volatility, stock prices can fluctuate in great proportions in a matter of days or even hours. It is a risky investment that does not promise a full recovery of the initial value. It can generate tremendous losses and damage the wealth of investors in a serious manner, during periods of crisis it is normal to account for a 20% reduction, for example.

Stock trading is considered accessible worldwide however in order to get positive returns it is required great stock picking skills. Not easily accessible for everyone, despite being an accessible market it does not mean that it has a low complexity level and that every investor can make capital gains. These skills can be acquired through an extensive effort to analyze the individual price of a stock: utilizing models, ratios or any type of information relevant to the stock price. It requires time not every investor has, thus resorting to investment firms and portfolio managers leading to the payment of fees or other commissions that damage the investor return.

Stock trading is not for everyone and requires knowledge and skill when operating with such a complex market. It requires certain characteristics that are crucial to an investor success.

2.4 Characteristics of a successful stock trader

A successful stock trader despite having limits to its rationality, as explained previously, is able to make logical decisions in the majority of situations. There are some characteristics that define an investor like this, being the following not only displayed on the personal sphere on the investor. The characteristics are:

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- *Market timing*: the ability of buying or selling a stock at its most prolific time, when the return is maximized and cost is minimized. It is of extreme importance in order to enhance the return an avoid further losses.

- *Stock selection*: the ability of selecting the right stocks and allocating the investment to the sectors or companies that are top performers. This companies can outperform the market and are responsible for high returns. Being able to pick a company that is able to grow exponentially is a valuable skill to an investor.

- *Information analysis*: The most important and valuable asset when dealing with the financial markets is information. However, all of the information becomes useless if it is not correctly analyzed or if it is badly interpreted. Being able to analyze data and interpret specific values of ratios, metrics or even financial statements is fundamental to be a profitable investor. It is a characteristic that is also required for many other. It is not possible to be great at timing the market and getting a grasp of what opportunities there are available without information. Information is the key to success and knowing how to interpret it is the map to finding it.

- *Discipline and Emotional Control*: Knowing which operations are the most prolific is extremely important. However, having the capacity to put them in practice is even more, investors are not always rational when making their decisions. Being able to control their emotions and avoiding making irrational mistakes is one of the most important characteristics a successful investor needs to have.

2.5 Active Management and Passive Management

Now we reach the two most dichotomic strategies of Portfolio Management theory. The first one being Passive Management, correlated with the efficient markets perspective, and Active Management correlated with behavioral finance perspective.

Passive management has on its sphere of influence Indexing for example whilst having multiple other strategies that serve the same methodology. It is focused on believing in the market evolution as the most trusted investment, with minimal risk and maximum return. Since it operates perfectly there is no reason not to invest in it.

On the other hand, Active Management believes it is possible to outperform the market. Utilizing an extensive array of methodologies, it is possible to create a strategy through hold and sell operations that can generate a higher return to that of the market with similar or less

risk. These methodologies include algorithms, forecasts, company analysis and own experience. All of them having the same purpose beating the benchmark.

An advanced level of active management goes beyond beating a certain benchmark. It has secondary objectives that can range from having the least taxable value in the end of the year possible, limiting the amount of risk exposure or even taking into consideration environmental and social responsibility. Overall active management requires as the name suggests an active approach, it requires time and knowledge, it is more intrinsically demanding. Passive management as the name suggests belongs to a more static approach relying on trusting in the market return as the highest risk adjusted return.

2.5.1 How to benefit from both passive management and active management

Investing is not a static procedure or simple process, it involves a wide range of tools and knowledge. Investors utilize strategies I order to get ahead, in order to fulfil their return objectives, in the majority of cases utilizing not one and only one strategy but a mixture of various. It is clear that active and passive management are unique and distinct from one another however and despite their disparities both can be combined in a hybrid management strategy.

A hybrid strategy gathers the best of both worlds, the tax and cost efficiency of passive management and the return opportunities of actively managed funds. It finds an intermediate point between such distant realities and provides new portfolio management strategies that are becoming more and more popular. These portfolios are typically associated with a low tracking error and a low to intermediate share activity. These strategies are more appealing in the eye of the modern investor and their gain in popularity has become apparent. Ideologically closed investors find trouble in today's market. The modern investor follows a more dynamic approach and its characteristics are a mirror of it.

- *Education*: Is the most educated investor in history and operates with greater awareness and effectiveness than in the past. Followed upon the gain and massification of financial literature and availability
- *Technology*: The investors tend to study and analyze before making decisions and are curious for technological tools and new products that may derive from them. Willing to jump on new trends and follow online communities with trading and investment support
- *Financial Product Diversity*: The assets they trade the most are ETFs and cryptocurrencies, the modern investor is not as risk averse in some aspects as the traditional investor. Willingly diversifying in highly volatile products

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2.6 Hybrid Management

Having explained the characteristics of the modern investor it is clear that they would not stick with a rigid system of investing. Modern investors prefer flexibility and do not rely only on the classical and traditional ways of investing. With the recent technological development that ultimately led to the establishment of different and more up to date strategies of investment, the traditional strategies gained some competition. The strategies that are most popular with the modern investor are technologically advanced, these strategies require the usage of more detailed information than ever before in pair with its research and analysis. The needs of the modern investor match in a nigh on perfect correspondence with hybrid strategies, and this thesis will further explore a few of the existing ones.

In Dolvin and Kirby (2011) Momentum trading is based on identifying industries or stocks who are winners and avoiding those who are losers, introduction to the "There is always a bull market somewhere", calendar approach to investing is a crucial part of momentum trading. January barometer predictability of the market for the remainder of the year (90% accuracy) following momentum trading strategy. There has been a strengthening of the abnormal returns and volume in the most recent period leading active traders more susceptible to beat the market.

Starting by low volatility assets, Hsu and Li (2013) studied the "low volatility anomaly" that suggests that stocks or equities that register this factor, low volatility, have a higher return than those which registered a high volatility value. Meaning that on a general basis stocks with low volatility outperform high volatility ones. Hsu and Li offered an explanation to this event, the methodology of their study implied the analysis of the excess returns, through making the decomposition of them. The excess returns were decomposed into established and known sources of stock factor premiums, giving that the standard log only low volatility strategies were able to reach not just low volatility premium but also were able to capture other premiums. This ultimately led the authors to finding that the incorporation of low volatility strategies was able to not only reduce the risk but also increased the overall return of the portfolio.

Following the path of low volatility strategies, it is important to analyze Kuo and Li (2013) which were able to accentuate the search for low volatility strategies, the methodology for this study was based on the empirical evidence of the capabilities of outperformance annexed to these strategies. Furthermore, and following the logical path of the authors it was also discovered that low volatility strategies are optimized amidst the utilization of small cap stocks and those who are responsible for concentration of market sectors and countries. The authors also studied the inference of small betas equities in the portfolio and combined it with the

previous low volatility equities. The result suggested a higher Sharpe ratio with a smaller turnover rate, which are all positive factors in regards to this portfolio creation. The portfolio was also able to register an improvement on its investment capacity.

Hybrid funds started gaining tractions after the 2007 sub-prime crisis, their insurgence came from a market need to break into the growing investors base offering more flexibility and diversity than hedge funds or private equity offerings. Hybrid funds provide multiple advantages of multiple asset categories under a single umbrella. Its allows for greater customization and an overall better alignment with the investor needs and preferences. More specifically in terms of its yield, efficiency and holding periods. They present appealing characteristics for the modern investor, the following are:

- *Advantages*
  - *Flexibility*: This type of fund is designed in order to satisfy a certain investment goals and time horizons not being held captive by rigid structuring rules.
  - *Yield*: Hybrid funds offer high yield of its alternative investment strategies and also provide some cash flow stability and liquidity based on more traditional investment approaches.
  - *Flexible Holding Periods*: There is no pressure to hold assets and those can be sold when the investor is looking for liquidity.
- *Disadvantages*
  - *Complexity*: Hybrid strategies require more knowledgeable managers and expertise in multiple areas of investment. Starting by the selection and asset composition a hybrid fund requires research and analysis and furthering this work to its maintenance. Asset allocation changes must be thought through and in pair the economy. The flexibility of hybrid funds can be seen as an opportunity however such trait can also bring its own disadvantages.
  - *Regulation*: Regulatory and compliance struggles are a reality in the world of investing, this also extends to Hybrid Funds. Where the funds complexity only dampens the problem.

Furthermore, it is important to analyze the different types of Hybrid funds. There is a vast number of them however this thesis will in focus on the most well-known.

Table 1 - Types of Hybrid Funds

Types of Hybrid Funds	
Aggressive Hybrid Fund	Having an aggressive strategy corresponds to a heavy asset allocation on one financial product, having small encouragement to diversify the portfolio and relying its core portfolio genesis on one asset. Aggressive Hybrid funds rely heavily on equities; their portfolio composition invests 60% to 80% on this asset alone. The rest of the portfolio composition is allocated in obligations, treasury or private and the rest is allocated in the foreign exchange market, a highly liquid market that provides support to money operations. Having in mind the portfolio asset allocation it is clear that the portfolios is not diversified. Thus implying a higher risk to the investor, than other possible more conservative options. However, this downside is seen as an opportunity by indulging in greater risk the portfolio is able to capture a higher return, relying heavily on stocks and their performance.
Conservative Hybrid Funds	Having a conservative approach means that the asset allocation of the portfolio relies heavily on low volatility products or to an extended degree fixed income ones. With this being said Conservative Hybrid Funds rely heavily on debt products, their portfolio composition is centered around fixed income products, such as: Commercial Papers, Certificates of Deposit, Treasury bills and Corporate Bonds. In addition to this, Conservative hybrid funds also operate with money market assets. The rest of the portfolio composition is allocated to equities. Having in mind the portfolio asset allocation it is clear that this strategy is suited for risk averse investors presenting low volatility and high stability of return flows.
Multi Asset Allocation Fund	Similarly, to the Dynamic Hybrid Fund, this type of fund performs also operations in order to adapt its asset allocation to market characteristics, however not in a such active style as the latter. As the name leads us to believe, this fund main goal is pointed towards diversification and scattering its asset allocation throughout multiple securities and financial products. The range of this securities is extremely broad and can vary from equities, other exchange traded funds, assets in the foreign exchange market and also commodities (being the most used amongst this funds gold).
Arbitrage Fund	This type of fund is considerably different from the previous exposed. An arbitrage fund main objective is to take advantage of market opportunities related to the difference between the price of an asset in two different markets. These markets tend to be the futures market and the cash market, buying the security in one and selling it on the other. With this being said the portfolio composition relies heavily on equities and futures.
Equity Savings Fund	As the name suggests an Equity Savings Fund operates mainly with equities and inside this market. In addition, it is also operating with fixed incomes assets, arbitrage opportunities and derivatives. The main difference between an equity savings fund and the others is the fact that the first operates besides equities with derivatives on a daily basis. These funds tend to be suited for long term returns and wealth creation, meaning investors with a larger horizon of investment.
Dynamic Hybrid Funds	This type of fund is not static, it is as the name suggests constantly changing and adapting. It is capable of performing changes to its portfolio composition, often, in order to take advantage of market opportunities and market conditions. Typically, Dynamic Hybrid funds switch their portfolio composition between fixed income securities and equities. Intending to find a balance between both that matches the current market conditions. This type of fund is suited for an investor that searches for market correlation, it does not entirely belong to the sphere of risk aversion however the fund offers a better risk adjusted return than the previous options.

2.7 Smart Beta Funds

Smart Beta (SB) funds or as they can also be called Smart Beta ETFS, track indices that consider no capitalization and in contrast pay close attention to other factors, as the ones here mentioned: book value, dividends, dividend growth, expected growth, volatility and momentum to weight securities in their portfolio. By applying such rules-based strategies or, as alternatively called, factor investing, SB ETFs combine attributes of both passive and active management. Tracking an index and also trying to keep expenses low, whilst at the same time, trying to beat the market and deliver enhanced risk-adjusted performance relative to traditional ETFs investing in market-cap-weighted indices.

The interesting characteristics of Smart Beta funds is their capacity to fit multiple risk profiles and generate great returns. Here explore in the study of Malkiel (2014) when analyzing the Smart Beta Funds, reported that some of the portfolios were able to outperform the market in the entirety of their lifespan. However, they were not able to do so without indulging in a higher risk and assuming more volatility. Meaning that these strategies were incapable of outperforming the market with the same level of risk, meaning that it failed the safety test. The author infers to Smart Beta strategies as not the best option, comparing it to the in his opinion most favorable option the single beta index funds, a more traditional strategy that indulges in the same outperforming of the market returns.

In the report of Meziani (2014) it is discussed the popularity of the Smart Beta portfolios, their popularity sky rocketed in the ETF expansion era. Smart Beta ETFs gained popularity in pair with low volatility ETFs, one of the most dominant duo on today's market. Despite this popularity gain the author finds the same as Malkiel (2014) stating that the compensation of smart beta investors is not high enough for the level of risk. Agreeing in an opinion that is also favorable of more traditional strategies such as cap weighted ETFs, meaning that, the risk adjusted performances of Smart Beta Portfolios is inferior.

On a study that explores strategic beta allocations and smart beta portfolios, Hsu (2014), states to differ from the previous two authors. Hsu realizes that traditional approaches of value and growth indexes have some difficulties in exploiting the value premium in multiple industries and stocks at the same time, considering a problem of the "blocking" strategy that these portfolios have. Furthermore, the author states that smart beta strategies and its approach in general is able to capitalize on the previous, being able to follow the value investor saying "buy high sell low". The author gives credit to their mechanism that is able to more easily profit form mean reversions in the price of the equities. To avoid the glorification of this strategy the

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author encounters limitations in the wide variety of portfolios using this mechanism. Justifying the previous with the multitude of approaches on their construction and also the work to maintain the fund functioning.

Also on the topic of Smart Beta strategies popularity it is important to consider Denoiseux (2014). Which explores the insurgence of these type of portfolios before the 2008 financial crisis. This happened has a result of the search for low risk exposure, in addition as this type of fund also has a low volatility associated, it enters into the low volatility anomaly. Given the fact that low volatility stocks tend to outperform their antagonists.

In Glushkov (2015) the author develops a study in order to provide evidence on Smart Beta portfolios performance. Several factors were analyzed such as size, value, momentum, quality, beta and volatility. Retrieved from the study was found no conclusive empirical evidence regarding the generation of factor premiums efficiently, despite this, the risk adjusted performance of the funds was positive. The decomposition of the of the allocation of the Smart Beta funds led also to believe that the benefit of the dynamic asset allocation was irrelevant

In the midst of Dynamic Hybrid funds and focusing on the main objective of this project, it is crucial to analyze the Smart Beta funds more extensively. The Smart Beta Funds are part of the hybrid funds sphere. Their portfolio composition adapts to market conditions and enables its capacity to take advantage of the market opportunities. These type of funds are moved per different factors in opposition to other funds, the following factors explain in more detail the goal of Smart Beta Funds.

In the Value Factor Smart Beta funds (Appendix H) will look in the same perspective as value investors would. With this being said the stock characteristics that are sought on mostly rely on low stock price relative to its fundamental value. The investor is basically searching for underpriced stocks by investing on stock with low Price ratios and high or growing dividend yields. Typically, these type of companies are called "blue chips", well established enterprises that provide a steady flow of income and normally establish high dividend policies.

In regards to the size factor (Appendix I), smart beta funds will search for a well-established company with a sizeable operation and a good historic. With this being said it is expected to be found High Market Cap companies with great balance sheet ratios (solvency, profitability and liquidity). It is also expected for companies to have a long background history with many previous years of operation to better access its viability in the portfolio.

One of the most complex factors accessed by Smart Beta funds is momentum (Appendix J). Momentum is basically the velocity in which a stock follows a trend movement, the objective in momentum trading is to buy uptrend stocks and selling downtrend stocks. Having this in

consideration funds will sought after companies that had a strong past performance over the proceeding 3 to 6 months. Momentum traders are typically aided by metrics such as the Moving average convergence divergence (MACD), historical alpha and point to point past returns. These will also correspond to the metrics used by SB ETFs in order to analyze stock's momentum.

Low volatility (Appendix K) needs to be present in every portfolio of a Smart Beta fund, since its strategy does not rely on extremely aggressive positions. With this being said the stocks sought after will have a below average volatility. To find these the metrics to use are obviously the standard deviation or the downside standard deviation and the Beta of the company.

To access the quality of the stocks there are some key characteristics to watch out for. Smart Beta funds (Appendix L) are interested in strong profitability possibilities and stability of cash flows. Having this in mind the metrics to be used are high performance of earnings and returns ratio, in pair with also their historical stability throughout the years. It is also sought on these type of funds dividend growth, balance sheet strength and low leverage as it was previously approached.

2.7.1 The usage of Smart Beta products

SB funds have been gaining traction and investors trust in the last years. It was common for normal ETFs to adapt to this new market need and transform into Smart Beta funds. As reported by Glushkov (2016), the SB sector attracts more net cash flows than the rest of the ETF market with about a quarter of asset managers in North America having adopted these strategies in their portfolios. In Europe, more than 40% of the asset managers rely on factor investing strategies in searching of above market returns.

It is observable that ETFs have become popular assets however it is yet to be proven the popularity of Smart Beta Funds. This question can be precisely answered (Appendix M), it amounts to the percentage of smart beta products in the totality of assets under management. Meaning, the higher the percentage the better the perception of Smart Beta funds is. Having a great percentage of the same product in an investor portfolio means that it is a reliable and a trustworthy product that is able to bring profit and benefits, taking in account the investor's desires.

Analyzing the graph, it is clear to see that throughout the years 2020 and 2022 the percentage of investor that did not used smart beta products decreased tremendously. In 2020 that percentage corresponded to 6% and in 2022 this value reached only 1%, meaning a great advance for the insurgence of this type of products. Furthermore, the number of funds that

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utilized 11 to 20% of smart beta products increased suddenly in 2022 reaching 47% a value much higher than the previously registered in the past year of 41%. In addition to this trend the percentage of funds that utilized more than 20% of smart beta products also increased exponentially in 2022. In 2022 the percentage of portfolios that utilized more than 20% of this type of products was 17%, a value much higher than the one registered in the previous year of 10%. To conclude the percentage of utilization of smart beta products increased by a large margin in the generality of portfolios. It is unavoidable to come across the benefits of this type of products especially in more recent times when it is gaining more and more popularity. The challenge of utilizing more of this product is valid for future years and rest in the capacity to innovate and find cost efficient options that allow the maximization of returns.

That smart beta products are popular is already taken as a fact however the reasons behind it vary exceedingly. Despite changing depending on the region the study is held smart beta funds are utilized almost equally given the following four reasons. Investors that are predisposed to invest in this market do it so in order to (Appendix N):

- *Seek returns above benchamrk*: This information is accurate for some Smart Beta funds, however not all of them can outperform their benchamrk, or have diffculties doing so. Furthermore it is extremely important to notice that the perception of investors in regards to these funds is quite positive. Acknowledging that there is a large portion of smart beta funds that in fact are able to register high returns and beat the market. Finding these funds as a reliable source of income

- *Mitigate risk:* Smart Beta funds are inserted into the category of hybrid funds, belonging to a mixture of both active and passive strategies. Their not made to fit an extremely aggressive investor, the portfolio does not indulge in unecessary risk, balancing its risk adjusted return in harmony with the investor profile.

- *Generate income*: As an option to remunerate investors SB portfolios are considerably interesting since they are historically able to generate a positive return.

- *Reduce volatility*: Smart Beta funds present a low volatility in order to take advantage of the "low volatility anomaly". That states that lower volatility options tend to outperform higher volatility ones.

SB funds are extremely flexible and not only they offer low tracking errors with little costs associated with market activity. But can also benefit investors by applying low-volatility strategies. These strategies are used in order to establish a protection against highly volatile and turbulent stock markets, or they can also be used to help investors derive average market returns

with considerably less risk. Income goals of investors can also be served by SB ETFs. Such targets are met via the implementation of dividend-paying strategies, which invest in stocks with sustainable long-term dividend growth, one of the factors that is considered in smart beta funds.

On the other hand, SB funds have also their disadvantages, there are certain risk factors that investors should bear in mind when considering strategic beta strategies with ETFs. One type of risk relates to the factors selected to implement factor investing. Since the process of structuring is different from regular ETFs and as noticed by Blitz (2016), smart beta strategies may provide an amount of factor exposure that is superior to that of the investors preference, leading sometimes to exposure to factors whom are not intended to exist in the portfolio. In addition, it is exactly this factor exposure that down the line may contribute to the outperformance over a traditional index. Happening over bull markets typically, however there is a risk associated which may result in significant underperformance over bear markets.

There are other disadvantages of this type of strategies and one of them is in regards to the so-called 'crowding effect', which occurs when too much money chases a strategy. Crowding can result in a SB ETF underperforming the market. A last significant risk element concerns tracking error, which, in the case of SB ETFs, may be much higher when compared to the normal ETF. And also higher than their expense ratio due to frequent portfolio rebalancing whereas in the case of normal ETFs the tracking error is usually commensurate to their expense ratios (Chen & Chi, 2018).

3. Methodology of the study

The main goal of this thesis is to prove the positive performance and ability to beat the market of smart beta funds. In order to study this postulate, it is of extreme importance to analyze and compare SB funds to the market represented by the Standard & Poor's Index. This index was selected since it is one of the most established index funds in the world, a reference worldwide in benchmarking and it is representative of the overall state of the economy. This index is especially indicative of the wealth of the United States of America, being its composition the reason behind it. The weights of each stock and its variations throughout economic changes allows it to resemble the functioning of one of the world's most dominant financial country. Having selected this index as the study benchmark and following through with the analysis, the following steps were taken in consideration.

The first step was to establish the temporal interval of data collected. The time period to be studied corresponds to 10 years between January 2013 and January 2023. A 10-year period allows a broader sample of events and circumstances to be studied in opposition to a small period of time study. This allows a more precise result to be reached and an answer to the topic of this thesis. Patterns of return will be analyzed as well as a handful of factors that will help determine the success of Smart Beta Portfolios.

Having defined the time period, it is of extreme importance to establish what sort of data will be used. This thesis will dive in Smart Beta funds so there were selected 10 SB portfolios, all of them present in the North American Market through Vanguard. The funds selected were VBR (Vanguard Small Cap ETF), VYM (Vanguard High Dividend Yield Index), VUG (Vanguard Growth ETF) and VTV (Vanguard Value ETF) VOOV (S&P 500 Index fund), VUG (Vanguard Growth Index Fund), VOT (Vanguard Mid-Cap Growth), VONV (Vanguard Russel 1000 fund) and VBK (Vanguard Small Cap Gowth) and VOE (Vanguard Mid-Cap Value Index Fund). The portfolios are relatively different among themselves and represent the overall portfolios present in the Smart Beta market. These were also the most popular traded SB funds in the market at the time of the research. The objective of this study is focused on the performance of this type of funds, so it is necessary to extract the daily returns of all 10 Portfolios.

In order to perform that it was used the following formula:

$$Daily\ Return: \frac{Daily\ Close\ Value}{Daily\ Open\ Value} - 1$$
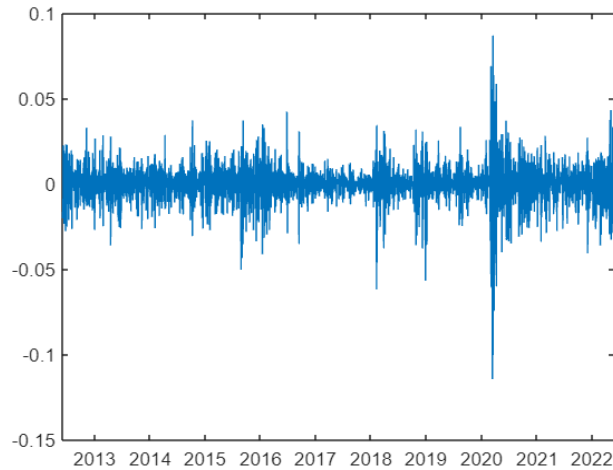
Graph 1 - The daily return evolution 2013-2023

Source: Own elaboration, data from Yahoo Finance.

This graph represents the scattering of the returns registered throughout the full period. The display shows great variance in returns, the years with the most fluctuations are easily perceptible. These years are 2016, 2018 and the most obvious of the three 2020.

The 2016 volatility in returns and consequently overall losses in investor's portfolio were generated by multiple factors. The so called 2015-2016 market selloff was a consequence of the slowing Chinese economy and GDP, which saw past growths not being matched and a decrease in China's overall economic and financial performance. The previous lead to turbulence in the Chinese stock market and the further decline of the SSE Composite Index in a staggering 40%. Ultimately devaluing the yuan, affecting multiple markets, it is secure to say that the Chinese crisis echoed throughout the global scene.

However, China was not the only involved in this 2015-2016 market selloff. This year was also receptacle of an energetic crisis with the plumbing of oil prices, established by the slowing down of the economy in general. Other important factors consist of the increase in bond yields in the US consequence of a whiplash of the end of quantitative easing in the year prior. Lastly the Greek debt crisis drove the market even worse.

The 2018 volatility in returns can also be explained by multiple factors, however the most prominent one corresponds to the slowing down of the economy growth. The global economy registered a slowdown and could not keep up with past levels. This state was a consequence of the unexpected and rapid increase in interest rates performed by the Federal Reserve, that led to an economic cool down and a pessimistic lookout for investors that rippled in the stock

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market returns. Adding to this in 2018 the United States of America and China where in the midst of a trade war which ultimately encouraged the financial market recession.

The year 2020 was tarnished by the Covid-19 Pandemic, leading to the shutting down of the economy fed by the fear of world spread disease. The virus was extremely harmful to the economic viability of businesses endangering them or even closing. This had tremendous consequences in the life of families and in a snowball effect the consumption also decreased. Despite efforts in fighting the virus and economy recovery stimulus, 2020 ended up being a strongly volatile year with negative returns for the stock market. The consequences of the Covid-19 Pandemic are still being felt and were amongst many reasons the cause for the inflation levels registered in the years after. It is also observable in the graphic after 2020 the volatility registers unprecedented values.

4. Discussion

4.1 Comparison of Returns

In order to compare results against the market, it is important to collect data of the market itself, represented by the Standard and Poor's Index since it will be utilized as a benchmark; in other words, the Smart Beta funds will be compared to the index to assess their performance. To establish this comparison, the returns of the index will also be calculated, using the previous formula.
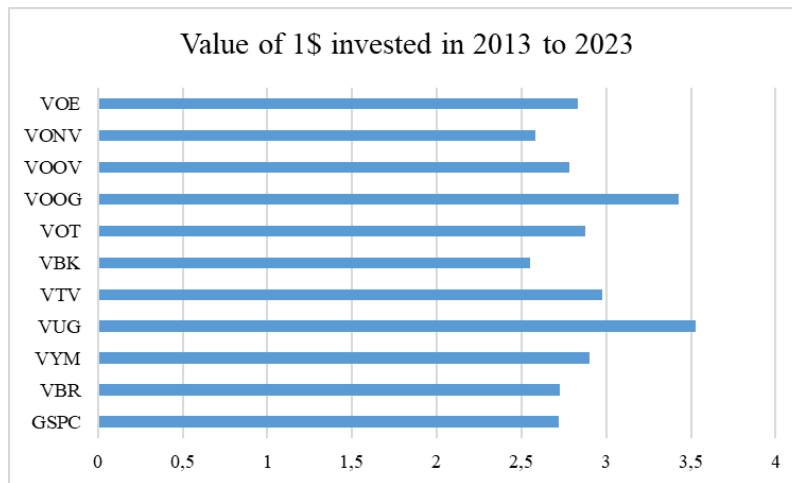
Graph 2 - Value of 1$ invested in 2013 to 2023 in the Standard and Poor's and Smart Beta Funds

Source: Own elaboration, data from Yahoo Finance.

The graph presented previously represents the today's value of 1$ invested in the beginning of the period in analysis, January 2013. All of the portfolios in analysis are displayed as well as the Standard and Poor's 500 index (GSPC), that, as stated previously represents the overall market and the funds' benchmark. In order to surpass the benchmark, the portfolios need to register a final value higher than 2.72. Since this was the final value in 2023 of 1$ invested in 2013. It is perceptible by observing the values displayed that the majority of portfolios actually were able to surpass and register a higher return than the benchmark. It is notable that both the Vanguard Growth Index Fund (VUG) and Vanguard Value Index Fund (VTV) were the best performers. Registering a final value of 3.5$ and 3$ respectively. The reasoning behind Vanguard Growth Index Fund (VUG) phenomenal performance is due to its portfolio composition in 2017 that translated into the best year of the portfolios in the period in analysis. The same can be applied to Vanguard Value Index Fund (VTV) however this portfolio

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registered a tremendous performance in the previous year 2021. The rest of the portfolios that were able to outperform the benchmark: Vanguard Mid-Cap Growth Index Fund (VOT) and Vanguard Value Index Fund (VTV) registered slightly better performances despite being similar to their respective benchmark Vanguard Small Cap ETF (VBR), VYM Vanguard High Dividend Yield Index (VYM), Vanguard Mid-Cap Value Index Fund (VOE).

On the other hand, and contrasting with the extremely positive performance of some Smart Beta funds there were portfolios that registered a return, despite being positive, worse than the benchmark. Two of these portfolios VBK (Vanguard Small Cap Gowth) and Vanguard Russell 1000 Value Index Fund (VONV) which were not that distant to the final value of 2.72$ registering 2.55$ and 2.58$ respectively. The VONV portfolio registered one of the lowest performances mainly due to negative returns during 2018 and its conservative approach considering it has a Value investing approach. The VBK portfolio indulged on a similar result but with a completely different path, it suffered the consequence of the small cap restriction imposed on the fund, mainly in the covid period.

Recurring only to this graphic the majority of the funds in analysis in fact were able to establish returns higher than their benchmark. On average, if 1$ was invested in 2012 in the Smart Beta Funds the final value of this operation would lead to 2.92$. Registering a profit of 1.92$ meaning that the value invested was tripled during the 10-year period of analysis. Remembering that the benchmark reached a final value of 2.72$ it can be said that, given the selection and timeline, the majority of Smart Beta funds were able to register a performance better than their respective benchmark. Leading to believe that this funds are capable and suitable for investors that require a similar to market level volatility and above market level returns.

Having calculated the results, it is crucial to compare them with those of the SB funds utilizing the following formula:

$$Return\ Difference = S\&P\ Returns - SB\ Fund\ Returns$$

Being this the first hypothesis put to test, a simple return comparison that allows to understand whether the results of the Smart Beta products are higher than the Standard and Poor's. These operations will be performed using the operating system Matlab and its features. The hypothesis studied will be further displayed requiring simple features of the program such as equations and more advanced features such as regressions.

The first part of the study indulges in the hypothesis of the Smart Beta Funds beating the S&P 500. Being this, one of the ways, to assess their performance by comparing the returns of

this funds to their benchmark. Having extracted the daily data of both constituints of the equation the return difference obtain and the comparison to be sought after, corresponds also to the daily returns. To further explore this analysis it will be necessary to utilize the following formulas, in order to study the entirety of the period in analysis.

$$Sum\ of\ S\&P\ 500\ Returns = \sum Returns\ of\ the\ S\&P\ 500$$

$$Sum\ of\ Return\ Differences = Sum\ of\ S\&P\ 500\ Returns - Sum\ of\ SB\ Fund\ Return$$

In addition to analyze the daily returns and to broaden the study to the entirety of the 10 year period in analysis it is crucial to add the returns it is possible to further develop the study into the entirety of the period in analysis. Having in consideration the previous formula that equals the Sum of Return differences the result of this is exposed below in the histogram. Furthermore a positive value here presented means that the benchmark was not beaten by the portfolio, in opposition a negative value means that the market was actually beaten. Having the portfolio registered a return superior to that of the market it is plausible to say that the portfolio was successful.
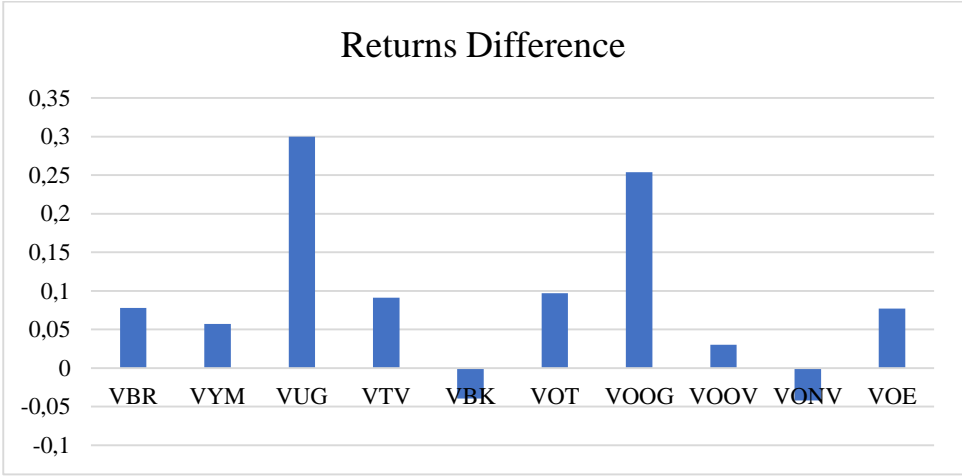
Graph 3 - Return difference between Standard and Poor's and Smart Beta funds

Source: Own elaboration, data from Yahoo Finance.

In this graph it is observable that 8 of the Smart Beta portfolios were able to register a return superior to that of the Standard and Poor's. In contrast with VBK (Vanguard Small Cap Growth) and VONV (Vanguard Russell 1000 Value Index Fund). Both VBK and VONV were not able to register returns superior to those of the market, making their performance, despite being positive, below their respective benchmark.

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From the 8 portfolios that registered returns higher than the market, we are able to highlight Vanguard Growth ETF fund was the one that displayed a higher difference to its benchmark. Surpassing it by a margin of 0.3 and Vanguard S&P 500 Growth Index Fund (VOOG) which was able to do the same by 0.20. This result may not seem a lot however, being able to surpass the returns of the market for a consistent 10 year period is really hard to find. Thus, the exceptionality and bright future for this category of portfolios, this is for sure one condition for success.

4.2 Risk Adjusted Ratios Analysis

In today's time active fund managers are obliged to outperform target passive investment portfolios, whilst being able to maintain an acceptable level of risk. This procedure serves as a quality control and risk management in order to protect the funds managed actively. It is also relevant to understand the other motivations that include sudden portfolio changes and diversification requirements. Typically, the manager's remuneration is linked towards its funds' performance and risk relative to the benchmark established. The use of the Capital Asset Pricing Model or other multi-factor regression models may be outdated since these models do not account for the fund performance relative to its benchmark. As this limitation is imposed on managers it is crucial to find a viable option. (Bawa & Lindenberg, 1977).

In this chapter surge multiple ratios, such as: Treynor, Sharpe, Jensen's Alpha and Sortino. These are able to establish a connection between the return and risk, making a risk adjusted performance analysis. Whilst being comparable with their benchmark.

The following part of the dissertation is focused on the risk adjusted performance of the Smart Beta Funds. It expands on the main question of this thesis and follows the simple return comparisons exploited in the previous topic.

4.3 Treynor Index

The Treynor Index is used to calculate and measure risk adjusted performances of a portfolio. The Treynor index analyzes a portfolio's excess return (the difference between the return of the portfolio and the return of a security with zero risk) per unit of market risk (represented by the beta of the portfolio, that gives us how a portfolio returns changes in response to the market return changes).

The Treynor Index is given by the following formula:

$$Treynor\ Index = \frac{Rp - rf}{\beta}$$
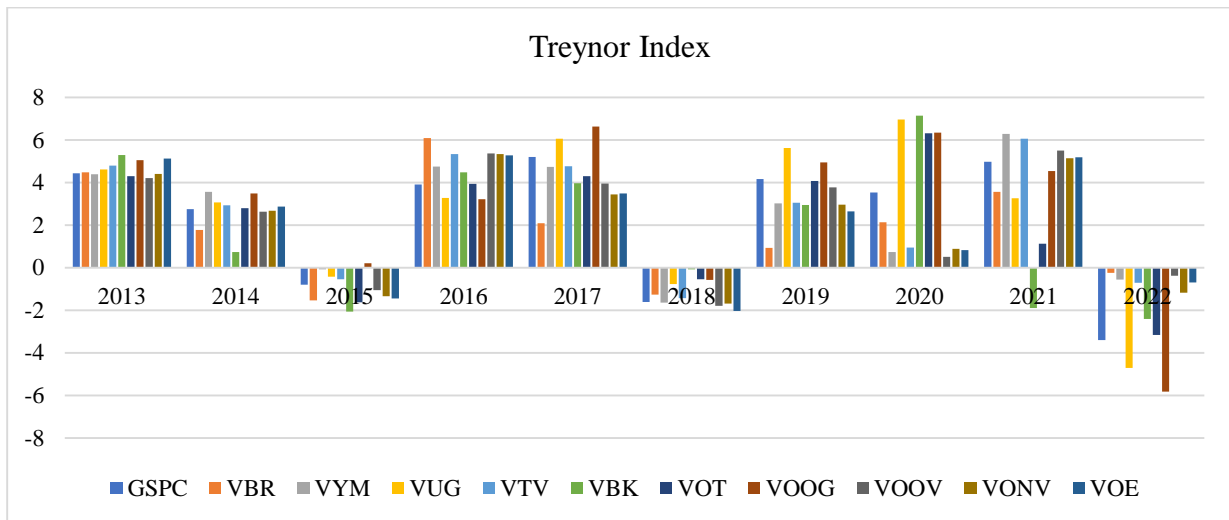
Graph 4 - Treynor Index Evolution of Standard and Poor's and Smart Beta funds

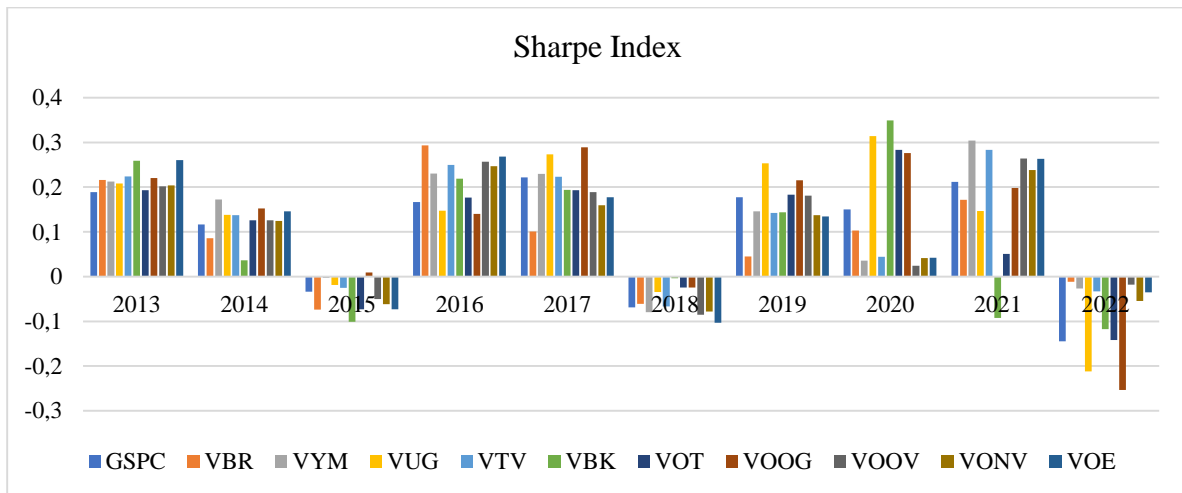**Source:** Own elaboration, data from Yahoo Finance.

It is important to analyze the risk adjusted performance of the portfolios in the following graphic it is presented its evolution throughout the period in analysis. A beta of 1 indicates that the portfolio's returns vary around the portfolio's mean to the same magnitude and in the same direction as the benchmark returns vary around the benchmark mean; it does not mean that the portfolio will have the same returns as the benchmark.

Smart Beta funds do not deviate immensely from the exposure to the systematic risk, they presented similar volatilities to those presented in the overall market and corresponding benchmark. The Treynor Index reflects that, throughout the period in analysis the risk adjusted performance from the portfolios is similar in many instances to that of the market. Overall, the portfolios followed the market trends of the market and sustained positive values during economic growth and negative values during regression periods. Whilst some portfolios were not able to register a risk adjusted performance as good as the market, 6 of the ten were able to surpass the market value, in this the risk adjusted measure. Previously by only analyzing the returns 8 out of the 10 portfolios surpassed the market. Meaning that despite registering in the majority of the cases higher returns than those of the market Smart Beta funds do it so obviously by indulging in more volatility. The risk adjusted analysis is crucial to effectively understand the real performance (Hübner, 2005). In order to further analyze the condition of the risk adjusted returns it is necessary to calculate the Sharp Index.

4.4 Sharpe Index

The Sharpe Index, is an indicator that gives us the risk adjusted performance of a portfolio, this ratio recurs to the return difference between the portfolio and a risk free asset and analyzes it in the light of the portfolio standard deviation obtained through its volatility.

$$Sharpe\ Index = \frac{Rp - rf}{\sigma p}$$

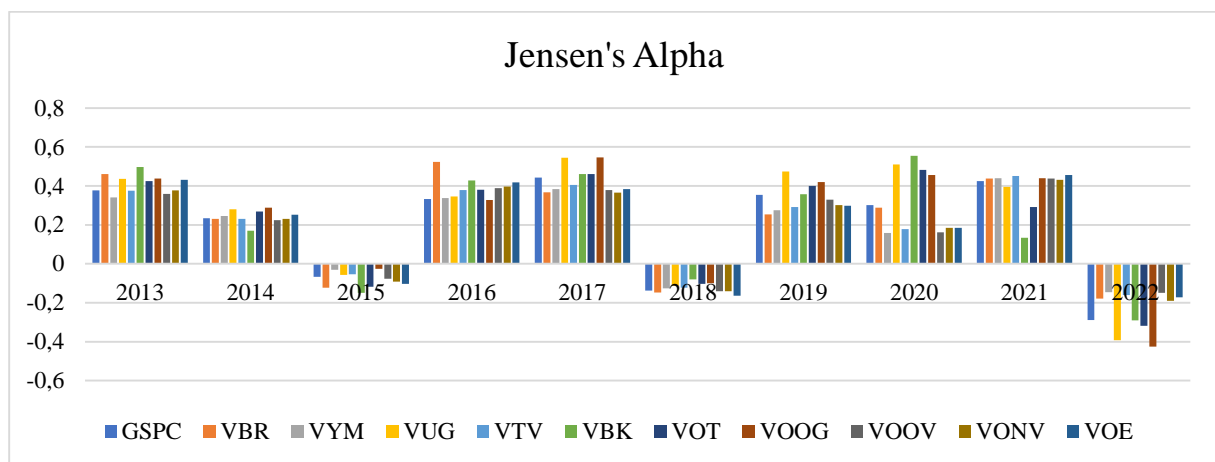**Graph 5 -** Sharpe Index Evolution of Standard and Poor's and Smart Beta funds

Source: Own elaboration, data from Yahoo Finance.

The Sharpe Index similarly to the Treynor Index registered similar values between the Smart Beta portfolios and the market, their respective benchmark. The variations were also similar to those represented in the Treynor Index, since they are both risks adjusted performance testers. The Sharpe Index of the Portfolios registered in the majority of the years a higher volatility than the benchmark. Meaning that the Smart Beta Portfolios were more likely to perform higher fluctuations of values than the overall market, when the values are positive, they tend to be higher than the market however when they are negative they are lower than the market. The range of values displayed is more concentrated in the market's performance and is more disperse between the remaining portfolios. By analyzing the Sharpe Index, it is clear that only 4 of the portfolios selected were able to outperform the market confirming the theory that Smart Beta portfolios indulge in more risk to find better results. Furthermore, in some cases this balance is found providing a risk adjusted performance better than that of the market (Lo, 2002).

4.5 Jensen's Alpha

The Jensen's Alpha is a risk adjusted performance measure, it calculates the difference between the portfolio's return and the average return of the portfolio in accordance with the Capital Asset Pricing Model. The latter is calculated in order to provide the return of the market portfolio with the same level of risk as of the portfolio in comparison. It is calculated through the portfolio's beta that establishes the correlation to the portfolio's risk (Bunnenberg et al., 2018).

$$Jensen's\ Alpha = Portfolio\ Return - Risk\ Free\ Return + Portfolio's\ Beta$$
$$* (Market\ Return - Risk\ Free\ Return))$$

Graph 6 - Jensen's Alpha Evolution of Standard and Poor's and Smart Beta funds

Source: Own elaboration, data from Yahoo Finance.

According to the Jensen's Alpha it is perceivable that in this indicator the market has a lower volatility in terms of results than the smart beta funds. Its value is more concentrated towards 0.4, in contrast smart beta funds are more dispersed and perceive a bigger likelihood of registering values above and below the market.

It is extremely important to highlight that some of the portfolios that previously registered values on risk adjusted indicators lower than the market such as VBR, VOT, VBK registered a different pattern. Displaying opposing values and being able to outperform the markets value, while also displaying a wide range of values whether negative or positive throughout the period in analysis.

There are a couple of smart beta funds that register a better Jensen's Alpha when compared to the market. Six of the ten portfolios were able to do so for this measure.

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Smart beta funds are again and also in this indicator registering values above the market. It can be perceived that in terms of risk adjusted measurements these types of funds perform positively.
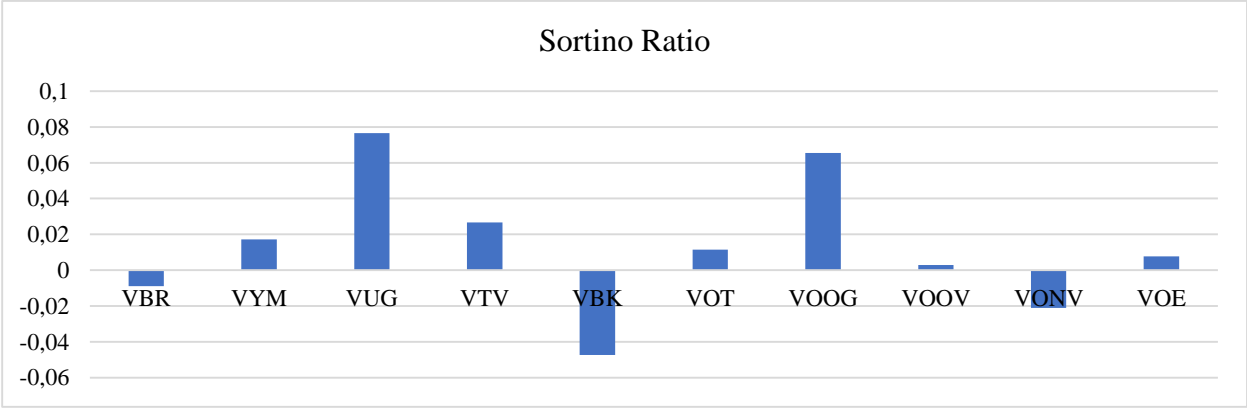
4.6 Sortino Ratio

The Sortino ratio is a risk adjusted measure, which is considered a more refined version of the Sharpe ratio. It was introduced firstly by Frank Sortino & Price and its formula is given by:

$$Sortino\ Ratio = \frac{Rp - Rf}{\partial d}$$

This ratio despite being similar to the Sharpe ratio registers a main difference lying on its divisor. Whilst the Sharpe ratio only makes use of the standard deviation this ratio uses the standard deviation of negative asset return. Meaning that the Sortino Ratio calculates the downside deviation in order to grasp a better perception of the returns that fall short of the risk-free return. Providing also a better understanding of the possible losses than simply the standard deviation. The formula to calculate the downside deviation is as follows (Sortino et al., 2010):

$$Downside\ Deviation = \frac{\sqrt{\sum_{i=1}^{n}(MIN(R_i - MAR, 0))}}{N}$$

Graph 7 – Sortino Ratio Evolution Smart Beta funds

Source: Own elaboration, data from Yahoo Finance.

The Sortino ratio in the generality of cases registered its best years in 2013 and 2020. Overall, the funds behave in accordance with the market, they established similar movements, however the number of portfolios that outperform it on a yearly basis is very reduced. However, there is one exception that is the portfolio VBK, which registers different movements from the

rest as perceived previously in the other ratios as well. Throughout this period, it is possible to see that in some years funds register a negative Sortino ratio which indicates that the investment's return was not sufficient to compensate for the downside risk or volatility it experienced. In other words, the investment's downside risk was greater than its return. This suggests that the investment underperformed or failed to meet expectations in terms of managing risk and generating returns relative to its downside volatility. As it is easily perceived investors generally prefer a positive Sortino ratio as it indicates that the investment has produced returns that are higher than the downside risk it carries. A higher positive Sortino ratio implies a better risk-adjusted performance, indicating that the investment has been more effective in managing downside volatility and generating returns. It is a positive sign that in this period the funds register in almost every year a positive value.

4.7 Risk Adjusted Ratios Analysis Overview

Overall, the Smart Beta Funds performed great during the period between 2012-2022. The return was clearly positive proving that this type of fund was a good option when it comes to investing. However, the main question of this thesis still lies, can the smart beta funds outperform their benchmark.

Table 2 – Risk adjusted indicators Smart Beta funds

	Sharpe Index	Treynor Index	Jensen's Alpha	Sortino Ratio
GSPC	0.098624928	2.319242901	0.197249855	-
VBR	0.086891941	1.804535877	0.21148923	-0.008957133
VYM	0.122158892	2.526802056	0.187666246	0.017207765
VUG	0.121554036	2.700598011	0.24219686	0.076540514
VTV	0.117964504	2.523951297	0.197096383	0.026590207
VBK	0.088598357	1.816368685	0.207817846	-0.047298036
VOT	0.096625127	2.154999385	0.216727561	0.011487276
VOOG	0.122147544	2.808328852	0.236226544	0.065517013
VOOV	0.108877452	2.277606961	0.190902189	0.002914792
VONV	0.095721887	2.071396117	0.186572942	-0.021150396
VOE	0.107977163	0.107977163	0.198338007	0.007745509

Out of the 8 portfolios selected 6 of them registered an average above the market average in regard to the Sharp Index. Meaning that the return adjusted to the fund's volatility was greater in the portfolios: VYM, VUG; VTV, VOOG, VOOV and VOE than in the S&P 500 index. Overall, over the period of 10 years these portfolios were able to register consistent returns in order to outperform it.

Of these six portfolios, 4 Portfolios were able to register a higher average than the market in the Treynor Index. It is a great indicator for the smart beta funds which again are consistent during this period in outperforming the market in a risk adjusted metric. The same can be retrieved for the Jensen's Alpha which indicates the same followed above.

In all of the three parameters at least 4 portfolios were able to outperform the market consistently over the period of 10 years represented I the study. However, in the Sortino Ratio the performances of the portfolios were not outstanding, perceiving that the reality may not seem as bright as postulated in previous indicators, however the evaluation still remains positive. Representing a great sign for the performance and results presented by this type of funds. It can be said that in some cases and throughout the period in analysis the Smart Beta Funds were able to register a lower volatility when compared to the overall market with higher returns.

4.7.1 Limitations to the use of risk adjusted return measures

Despite the positive evaluation of some of the Smart Beta Funds this analysis is clearly limited in regard to the risk adjusted returns ratio utilized and their limitations. These ratios have a limited scope; they focus solely on the risk-adjusted performance of an investment. Not considering other important factors, such as liquidity, investment costs, management fees, or the overall suitability of the investment for an individual's financial goals and risk tolerance (Chaudhry & Johnson, 2008).

The Sharpe Index assumes that the returns are normally distributed however in real life cases it is extremely rare to find this. Most financial returns are or skewed or present a high kurtosis, which is a slight impediment to the veracity of results. The Sharpe ratio also presents limitations due to its backwards looking nature. It tries to explain future returns by stating that they will act accordingly and similarly with the past. In addition, the Sharpe Index is extremely volatility focused and it can be biased towards the volatility direction, meaning, rampant positive returns are penalized in this indicator (Mistry & Shah, 2013).

Jensen's Alpha has also some common limitations with the previous ratio, such as, its backwards looking nature and volatility bias. The Jensen's Alpha utilizes the CAPM, despite being an extremely reliable tool it has its downsides attached to the nature of the model. Its main limitation concerns the fact that the CAPM is a single factor model that only covers the market risk. The Jensen's Alpha is also limited by its omission of the unsystematic risk, since it only covers systematic risk explained by its usage of the CAPM.

Treynor Index also presents similar limitations to the indexes above such as the backwards looking nature and volatility bias. However, its main limitation is in regard to the betas and the selection of appropriate benchmarks in their measurement.

The Sortino Ratio like any financial metric, has certain limitations that should be considered when using it to assess investment performance. One of the key limitations of the Sortino ratio in addition to the previous one is its focus on downside risk. The Sortino ratio primarily measures downside risk by considering only the volatility of returns below a specific target or threshold. It does not capture the full picture of overall risk or volatility of an investment. It may overlook the potential for upside volatility or gains, which could impact the evaluation of an investment's risk-adjusted performance.

4.8 Hypothesis testing

Having considered the limitations of the risk adjusted performance indicators, it was considered relevant to analyze on a statistical level the significance of these differences amongst returns. In order to establish the relation between the portfolios' returns and the market return we recur to hypothesis testing.

Hypothesis testing is a fundamental concept in statistics and research methodology which allows us to make informed decisions based on data analysis. Significance testing, in more detail, null hypothesis–based significance testing, is arguably one of the most common ways in which scientific inferences are made. This procedure will be applied in this thesis to further strengthen the analysis, as well as being one of its main catalysts for drawing conclusions. Hypothesis testing follows a procedure which is supported by the following steps: formulating a hypothesis, collecting and analyzing data, and drawing conclusions about a population based on a sample from that population.

In the field of scientific research, a hypothesis is a proposed explanation for a phenomenon or a relationship between variables. Usually, this hypothesis is divided into two parts: the null hypothesis (H0), which represents no significant effect or relationship, and the alternative hypothesis (H1), which indicates a significant effect or relationship. This thesis will focus on the relation between the portfolios identified as smart beta funds and the S&P 500. More specifically, their results throughout a specified time period will be tested. (Deriso et al., 2007)

Hypothesis testing involves collecting data and using statistical methods to determine the probability that the observed results would occur if the null hypothesis were true. If the probability is sufficiently low (usually below a specified significance level, here regarded as

95%), we reject the null hypothesis in favor of the alternative hypothesis. The data collected is inferred as the previously displayed into this work, being a 10-year period return calculation on Smart Beta funds and S&P 500.

Previously we have analyzed smart beta funds on the light of multiple performance and risk adjusted ratios and metrics however with hypothesis testing we will try to further analyze the question at hands regarding these funds and the hypothesis that they may consistently achieve equal or higher returns compared to the broader market. Being for this sake clearly and crucial to apply rigorous statistical analysis to validate or refute this hypothesis. Stating as the null hypothesis (H0), in this context, that smart beta portfolios will register equal or lower results than the market. Evidently having as, the alternative hypothesis (H1), the smart beta funds will register higher results than the market.

$$H_0: Smart\ beta\ returns =< S\&P\ 500\ returns$$

$$H_a: Smart\ beta\ returns > S\&P\ 500\ returns$$

To test this null hypothesis and matching it to the extensive data collection and analysis of both smart beta portfolio returns and the market indices statistical tests will be performed. Such as the t-test, on two samples assuming unequal variances (Limentani et al., 2005). Which can be employed to determine whether any observed differences in returns are statistically significant. In order to do so the following steps were considered:

In hypothesis testing, rejecting the null hypothesis (H0) is based on the statistical significance of the observed results, typically indicated by the alpha level and the p-value.

Alpha (α) Level: The alpha level, often denoted as α, is the predetermined level of significance that represents the maximum probability of committing a Type I error (false positive). Typically, alpha is set to be 5%, indicating that there's a 5% chance of incorrectly rejecting the null hypothesis when it is actually true (Lakens et al., 2018).

P-Value: The p-value is the probability of obtaining results as extreme as, or more extreme than, the observed results when the null hypothesis is true. Meaning, a small p-value indicates stronger evidence against the null hypothesis. If the p-value is less than or equal to α, it is considered statistically significant.

In hypothesis testing in order to achieve rejection or acceptance of the null hypothesis we have to consider the results of these values, as explained per below (Cressie & Whitford, 1986):

Table 3 - p-value and alpha scenarios, own elaboration.

If p-value ≤ α:	If p-value > α:
If the p-value is less than or equal to the chosen alpha level (p ≤ α), it signifies that the observed results are unlikely to have occurred by chance if the null hypothesis were true. Therefore, we reject the null hypothesis in favor of the alternative hypothesis (H1 or Ha).	If the p-value is greater than the chosen alpha level (p > α), it indicates that the observed results could plausibly occur by chance even if the null hypothesis were true. In this case, we fail to reject the null hypothesis, meaning we do not have sufficient evidence to support the alternative hypothesis.

In summary, the alpha level provides a threshold for determining significance, and the p-value is a measure of how likely the observed results are assuming the null hypothesis is true. If the p-value is smaller than or equal to the alpha level, we reject the null hypothesis and accept the alternative hypothesis (Hsu & Lachenbruch, 2014).

Should the analysis reveal that smart beta portfolios consistently underperform or achieve results on par with the market, it would lend weight to the null hypothesis. On the other hand, if the results indicate consistent outperformance of smart beta portfolios, it would lead to the rejection of the null hypothesis, supporting the notion that these portfolios can indeed yield superior returns.

4.8.1 T Tests

Table 4 - VBR compared to S&P 500

t-Test: Two-Sample Assuming Unequal Variances

|	VBR	GSPC
Mean	0.009937	0.009287
Variance	0.003039	0.001824
Observations	120	120
Hypothesized Mean Difference	0	
df	224	
t Stat	0.102114	
P(T<=t) one-tail	0.459379	
t Critical one-tail	1.651685	
P(T<=t) two-tail	0.918757	
t Critical two-tail	1.970611	

P-Value=0.4635

test t=0.0919
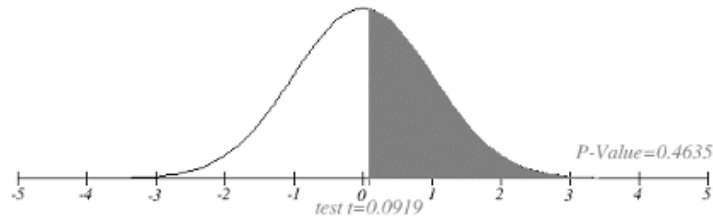
Graph 8 – T-test; **Source:** Own elaboration.

Despite observing slightly higher returns in smart beta portfolios compared to the broader market, the statistical analysis and hypothesis testing do not warrant the rejection of the null hypothesis (H0). Since its p-value is higher than alpha, as apparent also in the above graph. The null hypothesis suggests that smart beta portfolios will, on average, yield returns equal to or lower than those of the market.

Table 5 - VYM compared to S&P 500

t-Test: Two-Sample Assuming Unequal Variances

	VYM	GSPC
Mean	0.009761	0.00928
Variance	0.001703	0.00182
Observations	120	12
Hypothesized Mean Difference	0	
df	238	
t Stat	0.08748	
P(T<=t) one-tail	0.465182	
t Critical one-tail	1.651281	
P(T<=t) two-tail	0.930364	
t Critical two-tail	1.969982	

P-Value=0.4652

test t=0.08748
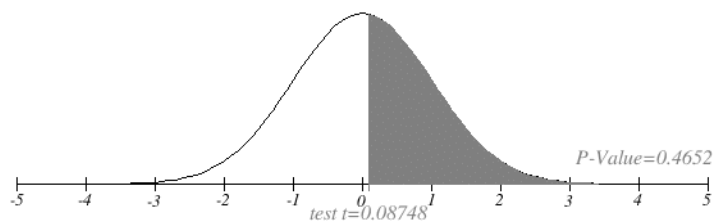
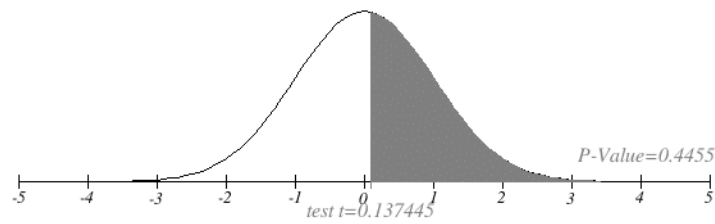**Graph 9 –** T-test; **Source:** Own elaboration.

Despite observing slightly higher returns in smart beta portfolios compared to the broader market, the statistical analysis and hypothesis testing do not warrant the rejection of the null hypothesis (H0). The null hypothesis suggests that smart beta portfolios will, on average, yield returns equal to or lower than those of the market.

Table 6 - VUG compared to S&P 500

t-Test: Two-Sample Assuming Unequal Variances

	VUG	GSPC
Mean	0.011785	0.009287
Variance	0.002472	0.001824
Observations	120	120
Hypothesized Mean Difference	0	
df	233	
t Stat	0.417588	
P(T<=t) one-tail	0.338317	
t Critical one-tail	1.65142	
P(T<=t) two-tail	0.676633	
t Critical two-tail	1.970198	

P-Value=0.3385

test t=0.41758
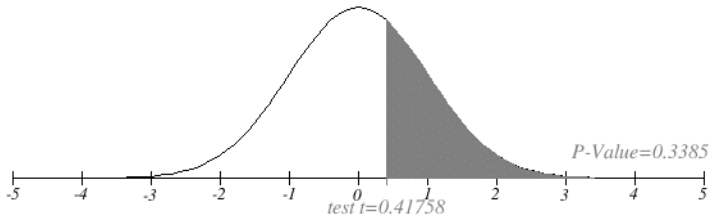
Graph 10 – T-test; **Source:** Own elaboration.

Despite observing slightly higher returns in smart beta portfolios compared to the broader market, the statistical analysis and hypothesis testing do not warrant the rejection of the null hypothesis (H0). The null hypothesis suggests that smart beta portfolios will, on average, yield returns equal to or lower than those of the market. The VUG portfolio despite being the portfolio with the best performance, it does not have a return average high enough to be considered statistically significant.

Table 7 – VTV compared to S&P 500

t-Test: Two-Sample Assuming Unequal Variances

	VTV	GSPC
Mean	0.010045	0.009287
Variance	0.001824	0.001824
Observations	120	120
Hypothesized Mean Difference	0	
df	238	
t Stat	0.137445	
P(T<=t) one-tail	0.445398	
t Critical one-tail	1.651281	
P(T<=t) two-tail	0.890795	
t Critical two-tail	1.969982	

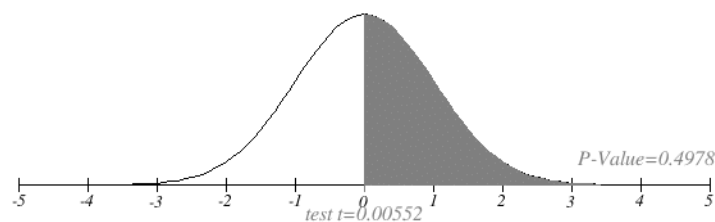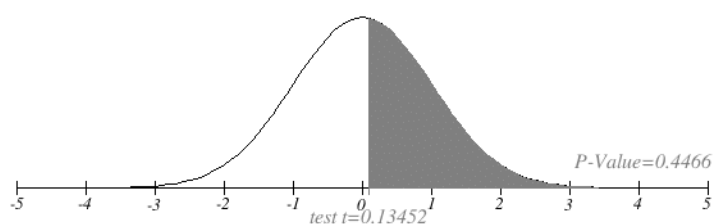*P-Value=0.4455*

test t=0.137445

Graph 11 – T-test; Source: Own elaboration.

Despite observing slightly higher returns in smart beta portfolios compared to the broader market, the statistical analysis and hypothesis testing do not warrant the rejection of the null hypothesis (H0). The null hypothesis suggests that smart beta portfolios will, on average, yield returns equal to or lower than those of the market.

Table 8 - VBK compared to S&P 500

t-Test: Two-Sample Assuming Unequal Variances

	VBK	GSPC
Mean	0.009322	0.009287
Variance	0.002956	0.001824
Observations	120	120
Hypothesized Mean Difference	0	
df	225	
t Stat	0.005523	
P(T<=t) one-tail	0.497799	
t Critical one-tail	1.651654	
P(T<=t) two-tail	0.995598	
t Critical two-tail	1.970563	

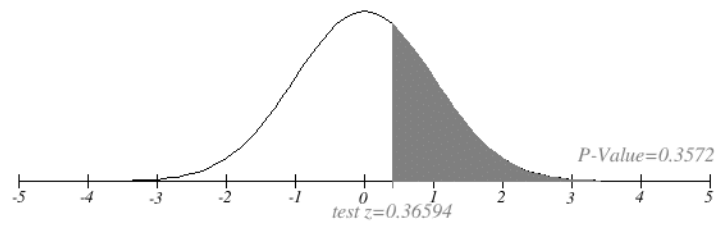*P-Value=0.4978*

test t=0.00552

Graph 12 – T-test; Source: Own elaboration.

Despite observing slightly higher returns in smart beta portfolios compared to the broader market, the statistical analysis and hypothesis testing do not warrant the rejection of the null hypothesis (H0). The null hypothesis suggests that smart beta portfolios will, on average, yield returns equal to or lower than those of the market.

Table 9 – VOT compared to S&P 500

t-Test: Two-Sample Assuming Unequal Variances

|	VOT	GSPC
Mean	0.010094	0.009287
Variance	0.002498	0.001824
Observations	120	120
Hypothesized Mean Difference	0	
Df	232	
t Stat	0.13452	
P(T<=t) one-tail	0.446554	
t Critical one-tail	1.651448	
P(T<=t) two-tail	0.893108	
t Critical two-tail	1.970242	

Graph 13 – T-test; **Source:** Own elaboration.

Despite observing slightly higher returns in smart beta portfolios compared to the broader market, the statistical analysis and hypothesis testing do not warrant the rejection of the null hypothesis (H0). The null hypothesis suggests that smart beta portfolios will, on average, yield returns equal to or lower than those of the market.

Table 10 – VOOG compared to S&P 500

t-Test: Two-Sample Assuming Unequal Variances

|	VOOG	GSPC
Mean	0.011402	0.009287
Variance	0.002184	0.001824
Observations	120	120
Hypothesized Mean Difference	0	
df	236	
t Stat	0.365941	
P(T<=t) one-tail	0.357368	
t Critical one-tail	1.651336	
P(T<=t) two-tail	0.714737	
t Critical two-tail	1.970067	

P-Value=0.3572

test z=0.36594

Graph 14 – T-test; Source: Own elaboration.

Despite observing slightly higher returns in smart beta portfolios compared to the broader market, the statistical analysis and hypothesis testing do not warrant the rejection of the null hypothesis (H0). The null hypothesis suggests that smart beta portfolios will, on average, yield returns equal to or lower than those of the market.

Table 11 – VOOV compared to S&P 500

t-Test: Two-Sample Assuming Unequal Variances

|	VOOV	GSPC
Mean	0.009538	0.009287
Variance	0.00195	0.001824
Observations	120	120
Hypothesized Mean Difference	0	
df	238	
t Stat	0.044742	
P(T<=t) one-tail	0.482175	
t Critical one-tail	1.651281	
P(T<=t) two-tail	0.964351	
t Critical two-tail	1.969982	

P-Value=0.4822

test t=0.04472
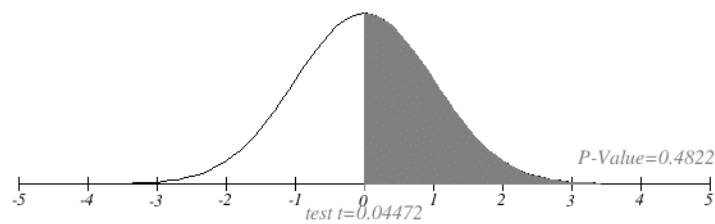
Graph 15 – T-test; Source: Own elaboration.

Despite observing slightly higher returns in smart beta portfolios compared to the broader market, the statistical analysis and hypothesis testing do not warrant the rejection of the null hypothesis (H0). The null hypothesis suggests that smart beta portfolios will, on average, yield returns equal to or lower than those of the market.

Table 12 – VONV compared to S&P 500

t-Test: Two-Sample Assuming Unequal Variances

	VONV	GSPC
Mean	0.008935	0.009287
Variance	0.001985	0.001824
Observations	120	120
Hypothesized Mean Difference	0	
df	238	
t Stat	-0.06251	
P(T<=t) one-tail	0.475104	
t Critical one-tail	1.651281	
P(T<=t) two-tail	0.950209	
t Critical two-tail	1.969982	

P-Value=0.5249

test z=-0.06251
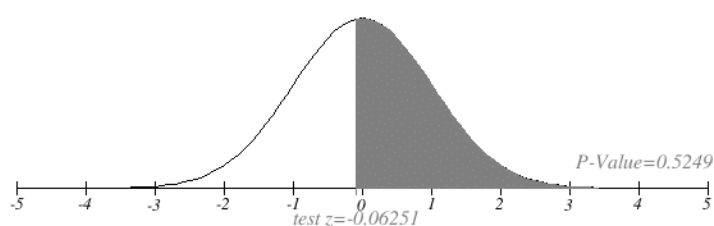
Graph 16 – T-test; **Source:** Own elaboration.

By observing significantly lower returns in smart beta portfolios compared to the broader market, the statistical analysis and hypothesis testing do not provide sufficient evidence to reject the null hypothesis (H0). The null hypothesis states that smart beta portfolios will, on average, yield returns equal to or lower than those of the market. Being this accurate taking in consideration the graph yielded.

Table 13 – VOE compared to S&P 500

t-Test: Two-Sample Assuming Unequal Variances

	VOE	GSPC
Mean	0.00992	0.009
Variance	0.002391	0.0018
Observations	120	1
Hypothesized Mean Difference	0	
df	234	
t Stat	0.10839	
P(T<=t) one-tail	0.45688	
t Critical one-tail	1.65139	
P(T<=t) two-tail	0.91377	
t Critical two-tail	1.97015	
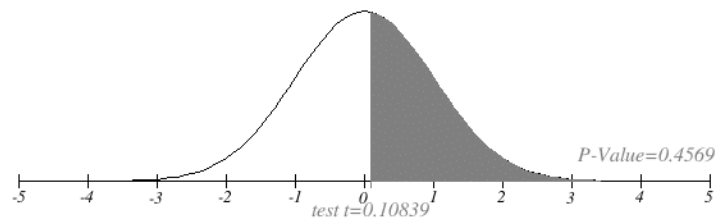
Graph 17 – T-test; **Source:** Own elaboration.

Despite observing slightly higher returns in smart beta portfolios compared to the broader market, the statistical analysis and hypothesis testing do not warrant the rejection of the null hypothesis (H0). The null hypothesis suggests that smart beta portfolios will, on average, yield returns equal to or lower than those of the market.

4.9 Hypothesis testing conclusions

Upon conducting the statistical analysis by consciously evaluating historical data, it is plausible to accept the null hypothesis (H0) that smart beta portfolios, on average, register returns that are either equivalent to or lower than the market's returns. The results were not higher enough to dismiss the null hypothesis, despite the majority of portfolios registering on average better returns than those of the market. For instance, 8 out of the 10 Vanguard portfolios registered a better average return than that of the market, whilst having similar values of variance. The evaluation is positive however not statistically significant for the confidence level defined.

This acceptance holds significant implications for both investors and financial analysts. However, and despite the result, an acceptance of this null hypothesis is not a dismissal of the merits of smart beta strategies. Instead, it underscores the importance of realistic expectations and a thorough understanding of investment dynamics. Smart beta strategies are designed to integrate certain factors or criteria that deviate from traditional market capitalization-weighted indices. These strategies may prioritize different factors not as typical in traditional strategies such as value, low volatility, dividend yield, or other fundamental metrics in portfolio construction as stated previously. Smart beta funds should not be disregarded as their usage throughout recent years has been increasing.

However, the consistent observation of smart beta portfolios achieving results in line with or slightly better but not statistically significant enough, than the broader market suggests that these alternative weighting methods may not always outperform the market as initially anticipated. It is important to understand that the financial landscape is complex and dynamic, influenced by multifaceted variables and market dynamics in which smart beta strategies may not consistently be exploited to generate higher returns. Accepting this hypothesis prompts

investors and asset managers to reevaluate their investment strategies and align their expectations with empirical evidence. It emphasizes and justifies the need for a balanced and diversified investment approach that considers the broader economic context, market conditions, and the inherent uncertainties in financial markets. Ultimately, and what we are striving for in this work is clearly the acknowledgment which enables investors to make more informed decisions, optimize their portfolio allocations, and construct strategies that align with their risk tolerance and long-term financial objectives. By accepting the null hypothesis, the investment community can engage in a more evidence-based and prudent approach to achieving financial growth and stability, whilst avoiding poor performances.

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5. Conclusion

The primary question that we wanted answered in this thesis was the capacity of Smart Beta funds to generate results higher than the S&P 500. It is possible to conclude that on average, and according to this sample, Smart Beta Funds are capable of achieving so by indulging on more risk, shown by the risk adjusted ratios. However, on a statistical level it is hard to tell that the Smart Beta Funds are able to do it so with statically significance.

Answering the second most import question of this thesis regarding the creation of a crisis proof portfolio it is still not clear and despite not providing a definitive answer on Smart Beta funds being able to do so some conclusions can be retrieved. The effects and the study of smart beta portfolios can lead to multiple findings of asset management and portfolio theory and confirm past prepositions from many authors. While it is not possible to create a completely crisis-proof financial portfolio, there are strategies that employed can potentially mitigate risk and increase the resilience of investments during challenging times or even recessions. Following are some of these considerations:

1. Diversification: Building a well-diversified portfolio across different asset classes, sectors, and geographic regions can help reduce the impact of specific market downturns or events. By spreading investments across various types of assets, such as stocks, bonds, real estate, and commodities, can potentially offset losses in one area by registering profits in other areas.

2. Quality Investments: Focusing on investing in high-quality assets or companies that have a history of stability, strong financials, and a competitive advantage. These types of investments tend to be more resilient during crises compared to those with higher risk profiles.

3. Defensive Sectors: Certain sectors, such as consumer staples, healthcare, utilities, and essential services, are considered more defensive or recession-resistant. These sectors tend to be less affected by economic downturns and can provide stability to your portfolio during crises.

4. Risk Management: Implementing risk management strategies, such as stop-loss orders or options strategies, can help protect your investments from significant declines. These tools can limit potential losses and provide downside protection in times of market stress.

5. Cash and Liquid Reserves: Maintaining an adequate cash reserve or holding highly liquid assets allows you to have funds readily available during emergencies or market downturns. This provides you with flexibility and the ability to take advantage of opportunities that may arise during crises.

It's important to note that no strategy can guarantee complete protection against all financial crises. Market conditions can be unpredictable, and even well-diversified portfolios may experience losses during severe downturns. Regular monitoring, periodic rebalancing, and adjusting the portfolio based on changing market conditions and personal circumstances are essential elements of successful long-term investing.

Nevertheless, as part of this thesis conclusion Hybrid Portfolio Management Strategies have a bright future. Portfolio Management is not a static "science" it's changing, and dynamic and technological improvements and the creation of new financial products are responsible for its constant renewal.

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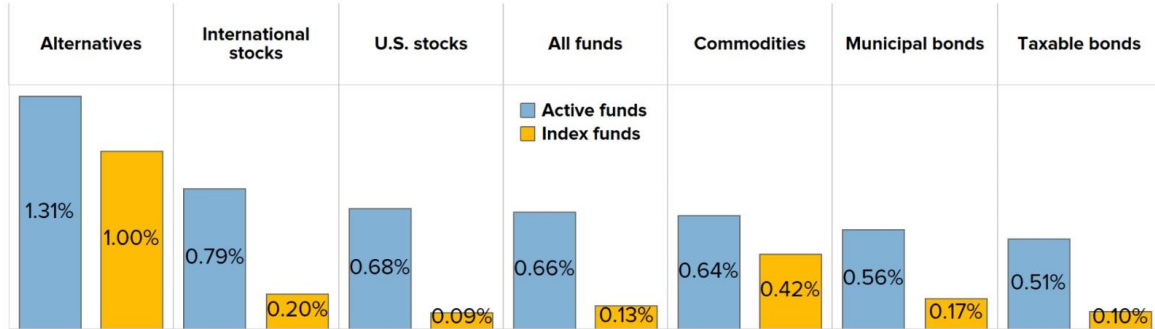
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7. Appendix

## Appendix A - Average fund cost by category

Source: Morningstar Direct

Appendix B - Types of ETF´s

| Types of ETFs	Description
Passive ETFs	Utilized as the name indicates in passive strategies. Passive ETFs are typically replicas of well diversified indexes or specific sectors
Active ETFs	They consist of a portfolio of multiple assets and it is considered active since it has portfolio manager that is responsible for the asset allocation and stock selection.
Bond ETFs	These type of ETFs are responsible for steady streams of income. Their income distribution originates from the performance of the bonds present in the financial instrument, these can vary from: government bonds, corporate bonds, state and local bonds.
Stock ETFs	Are normally used to track a specific industry or a sector. Offering a diversified block of stocks comprising of top performers and growth companies in the sector.
Sector ETFs	Are normally used to track a specific sector, similar to Stock ETFs, this type is used to gain advantage on the rise of certain sectors, including also companies with propensity for growth. Taking advantage of economic cycles.
Commodity ETFs	Are comprised of commodities typically aggregated by category and provide exposure to certain resources. Mainly utilized in periods of high volatility and economic crisis.
Currency ETFs	As the name states this type of ETF is comprised of currency pairs, consisting of international and national currencies. It is mainly used to hedge against inflation and volatility in foreign exchange markets.
Inverse ETFs	This ETF performance is based on the decline in the price of the assets selected, it consists of a major short position on the portfolio. Understand a short position by selling a stock and then purchasing it at a lower price. In order to short stocks the ETF utilizes derivatives.
Leveraged ETFs	As the name states this type of ETF functions normally apart from its leverage effect on the returns, meaning if the ETF is levered by a multiple of 2, the return will be registered in double.

Source: Investopedia

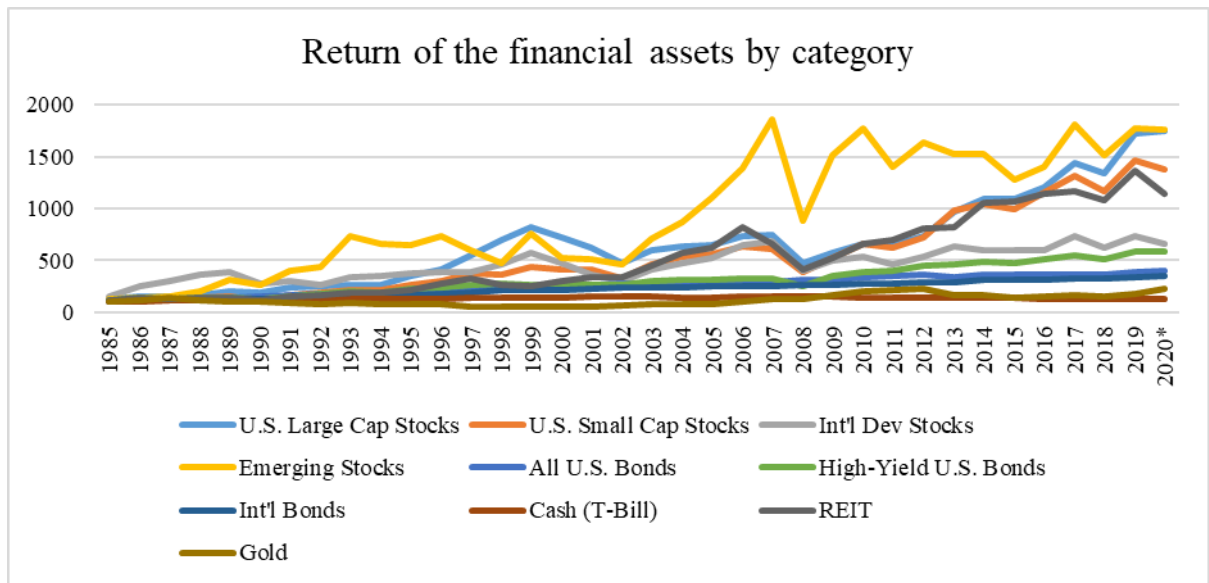**Appendix C -** Number of ETFs in the United States from 2003 to 2021

Number of exchange traded funds (ETFs) in the United States from 2003 to 2021
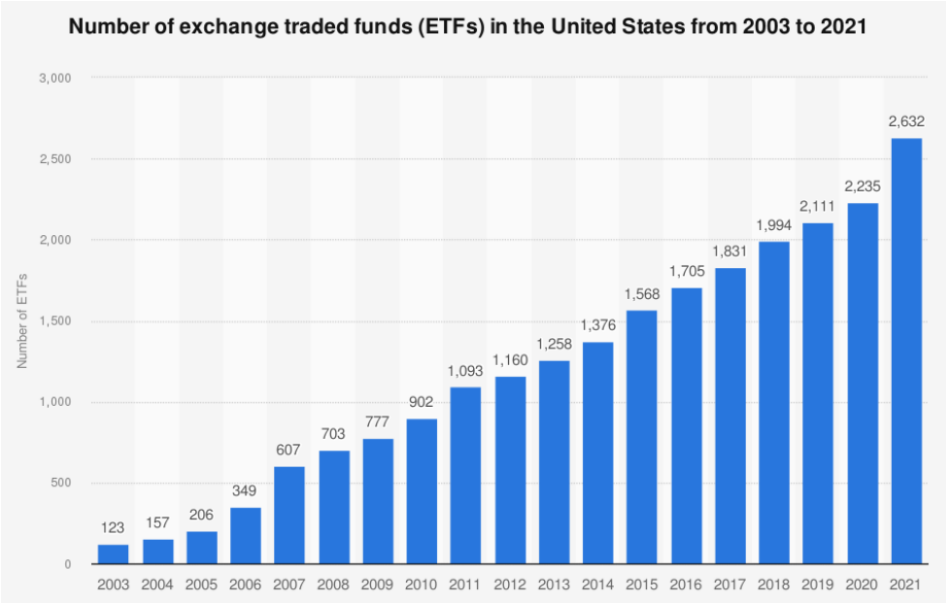
Source: Statista

Appendix D - Number of ETFs entering or exiting the industry

Number of ETFs entering or exiting th industry
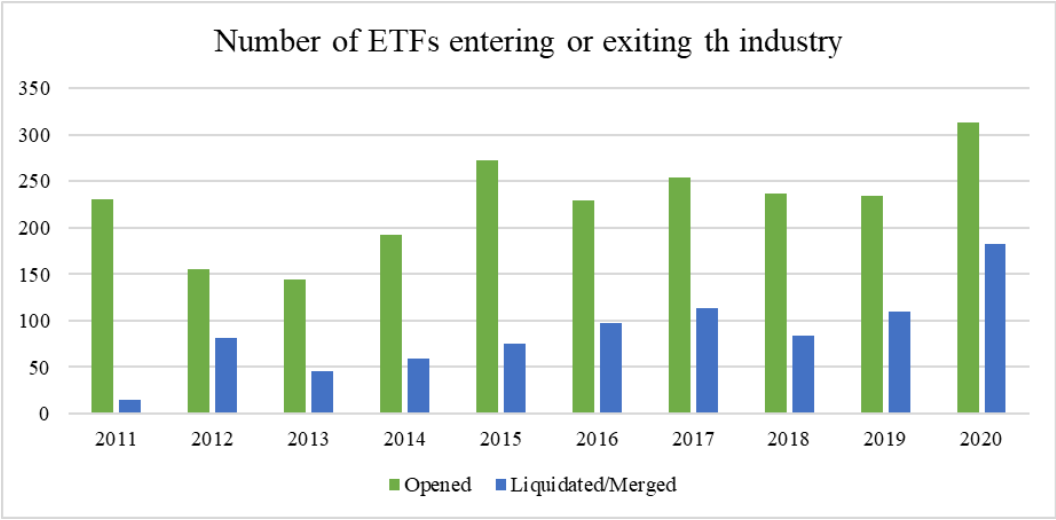
Source: Data about etfs

Appendix E - Return of the financial assets by category

Source: The Measure of a plan 2020

Appendix F - Investment process

Source: Meier, A., 2015. Behavioral Finance: The Psychology of Investing.

Appendix G - Types of Stocks

| Type	Characteristics
Blue Chip stock	The type of stock most liked by value investors, these stocks normally have a large cap and have solid historical credibility. They are utilized in long term investment and are a solid stream of income. Generally these stocks do not suffer from extreme volatility, on the other hand they present steady fluctuations and over the years have a tendency for growth at a stable pace.
Dividend stocks	The type of stock which is also utilized by value investors, they consist in the ownership of a company that has a regular track record of paying dividends. In the form of cash or in more ownership of the company represented by more shares. The dividend is normally paid yearly however each company defines its own format.
Defensive stocks	Also utilized mostly in value investing, these type of stock consists of ownership in a company that has low propensity for unstable fluctuations. They are comprised of companies with low levels of volatility and low sensitivity to the market. Typically, they also have low betas in comparison to the market average. As the name indicates they are used to avoid uncertainty and provide a solid stream of income to the investor
Cyclical stocks	Utilized more specifically in growth investing these stocks are extremely correlated with the market they are inserted upon. Having a beta very close to 1 making it almost identical to the market. Its fluctuations are aslo very coherently tight to those of the overall economy.
Growth stocks	Obviously as the name indicates the most used stocks for growth investing. These stocks are expected to generate a high return performed by an exponential expansion of the companies' ratios, revenue and earnings. Associated also with rapid and quick fluctuations these companies are normally associated with the technology sector or innovative products.
Penny stocks	Characterized by their cheap and small price, penny stocks are below 5 dollars a share. Accessible and very flexible, these type of stocks are normally bought in the expectancy of high fluctuations while needing a small investment. They are very volatile and typically attractive to new or unexperienced investors.

Source: Investopedia
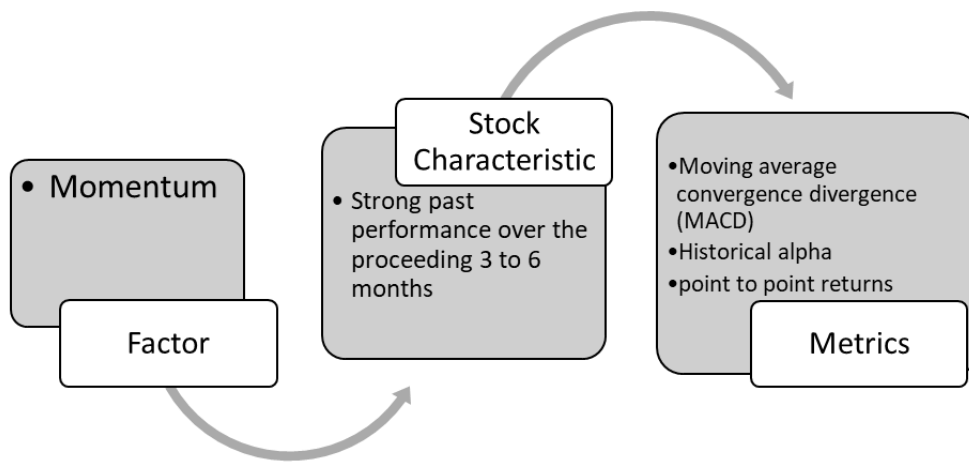
Appendix H - Value Factor explained
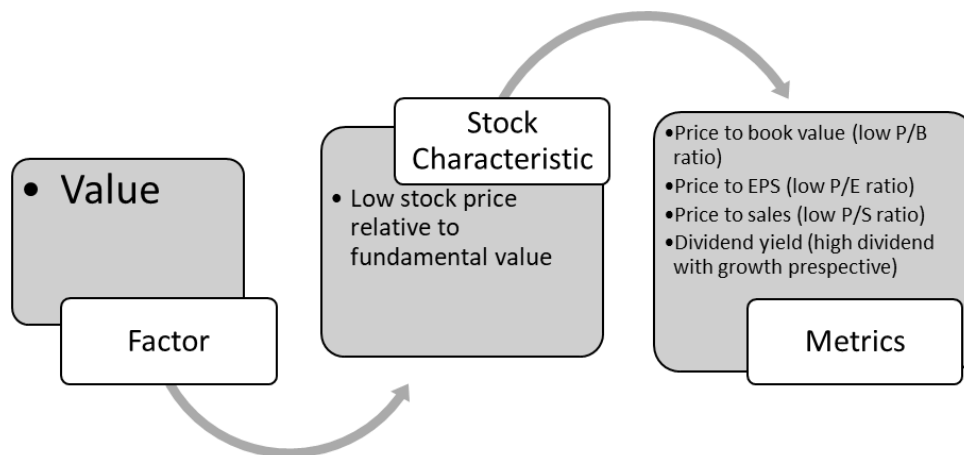
Appendix I - Size factor explained
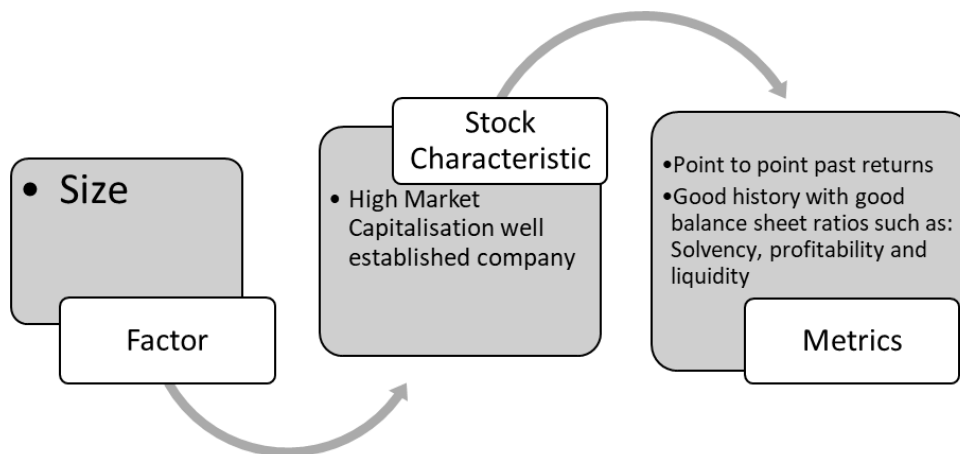
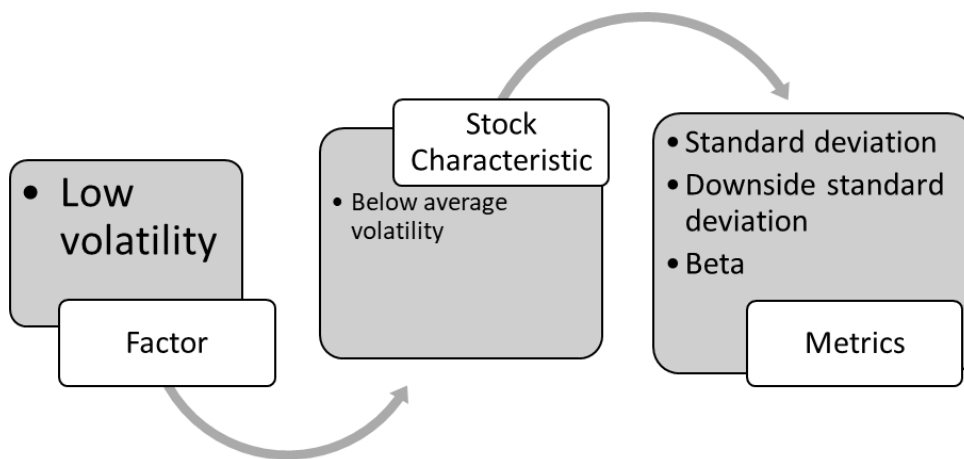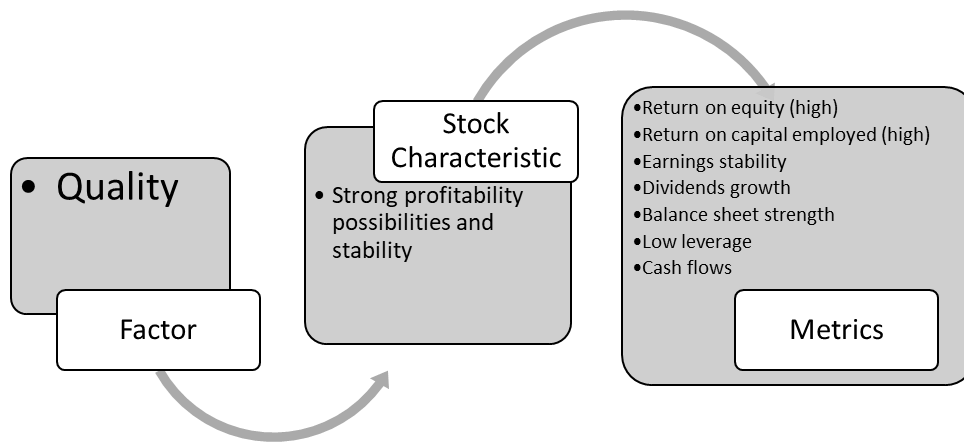**Appendix J** - Momentum Factor explained

Source: ETmoney

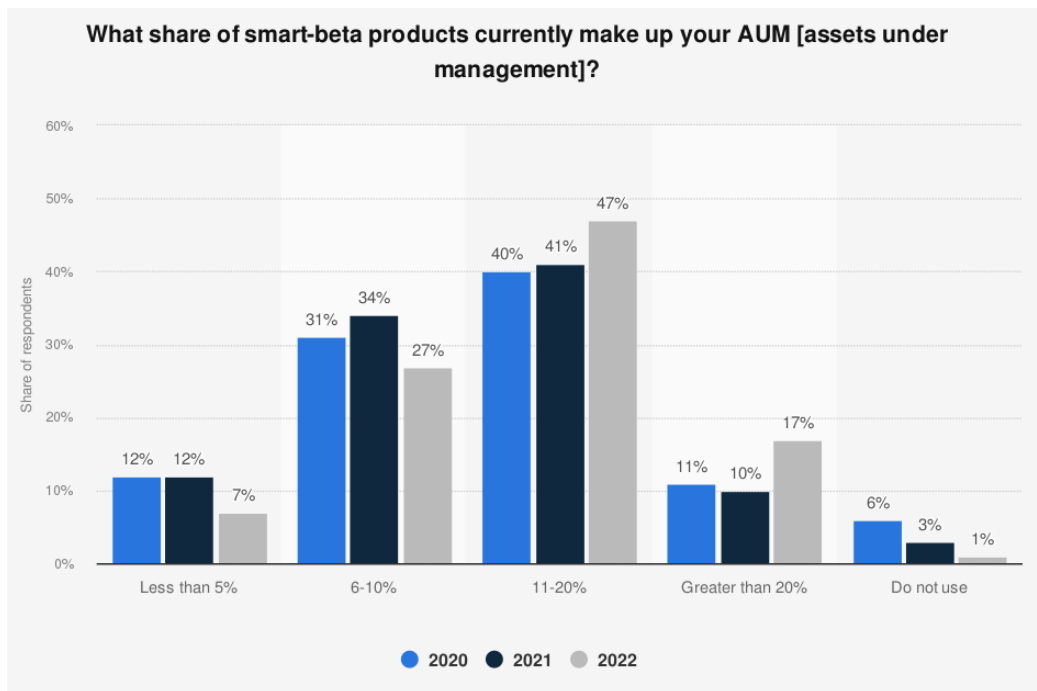**Appendix K -** Low volatility factor explained

Source: ETmoney

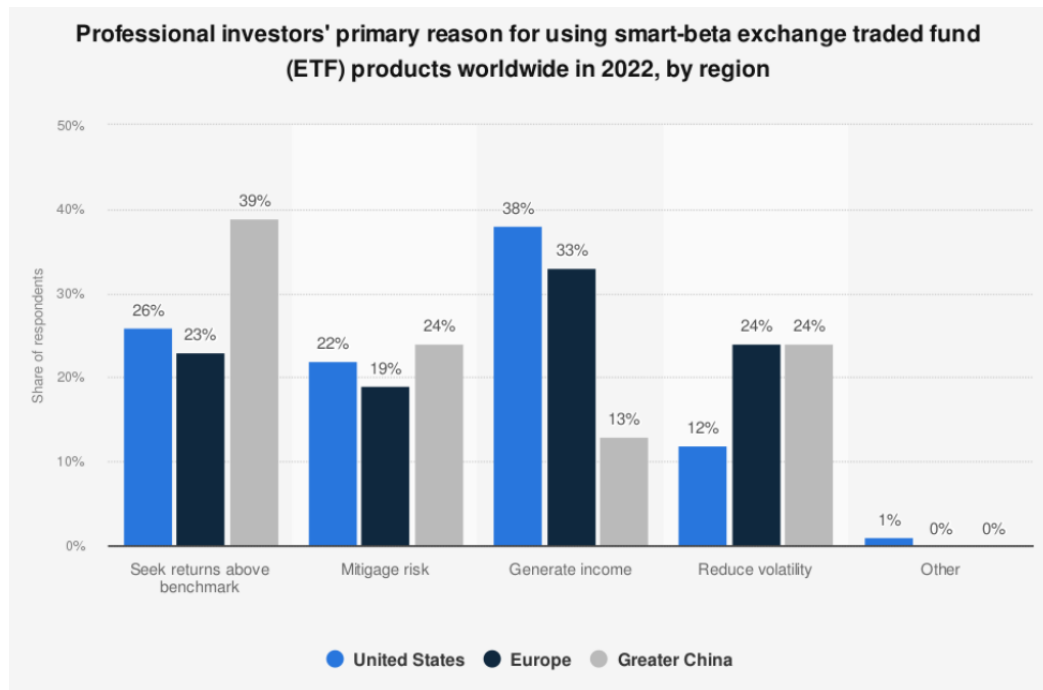**Appendix L** - Quality Factor explained

Source: ETmoney

Appendix M - Percentage of Smart Beta products in assets under management

Source: Statista

Appendix N - Primary reasons for using smart beta funds by region

Professional investors' primary reason for using smart-beta exchange traded fund (ETF) products worldwide in 2022, by region

Source: Statista