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Master's Degree in Corporate Finance

Graduate Program Advanced Corporate Finance

From stability to Ukraine War: an Investigation of Passive and Smart Beta Strategies in Investment Management

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INTRODUCTION

In the contemporary financial environment, Exchange-Traded Funds (ETFs) are an increasingly common and popular investment tool among investors. Their simplicity, liquidity, and diversification make them an attractive choice for those seeking to expand their investment portfolio. However, as technology advances and the financial landscape evolves, new types of ETFs have emerged that go beyond simply replicating market indexes: Smart Beta ETFs.

Smart Beta ETFs, also known as factor-weighted ETFs, offer an investment methodology that aims to outperform traditional market indices by selecting and weighting securities based on specific factors such as volatility, size, momentum, quality, or value. This new class of ETFs promises to offer investors higher return opportunities than traditional ETFs, however, it is important to fully understand the performance differences and investment implications between the two approaches.

This dissertation aims to examine and compare the performance of traditional ETFs with that of Smart Beta ETFs in two distinct historical periods. The first period, from 01/01/2015 to 12/31/2019, is characterized by relative economic stability. The second period, on the other hand, runs from 01/01/2022 to 31/12/2023, and is marked by the outbreak of one of the most significant geopolitical crises of the millennium: the armed conflict between Russia and Ukraine.

The objective is to provide a clear and in-depth overview of the distinctive features of both investment approaches during different economic contexts. This analysis will provide a better understanding of how traditional and Smart Beta ETFs perform during stable market conditions and during periods of geopolitical turbulence.

Specifically, the traditionally replicating ETF selected for analysis was the iShares Core MSCI World ICITS ETF, while the Smart Beta ETFs under analysis are iShares Edge MSCI World Size Factor UCITS ETF, iShares Edge MSCI World Value Factor UCITS ETF, iShares Edge MSCI World Momentum Factor UCITS ETF, iShares Edge MSCI World Quality Factor UCITS ETF and iShares Edge MSCI World Minimum Volatility Factor UCITS ETF. These ETFs were chosen because of their high capitalization and the singularity of Smart Beta factors, which are able, upon analysis, to provide relevant indications for determining how completely different classes of securities work.

In the first chapter, the theories underlying portfolio construction methodologies will be explored, serving as an essential foundation for the entire research work. Through an in-depth analysis of traditional and contemporary financial theories, such as the Markowitz Model and the Capital Asset Pricing Model (CAPM), an attempt will be made to understand the conceptual foundations and methodological tools that guide the selection and management of assets within a portfolio.

In the second chapter, the focus will be on the study of ETFs, examining the dynamics of their development, creation, functioning and liquidity of these financial instruments. In addition, a detailed overview of the main Smart Beta factors under analysis will be provided to fully understand their impact on ETF performance and investment strategies. This section will provide a conceptual and empirical basis for understanding the growing role of ETFs and Smart Beta factors in the contemporary financial landscape, laying the foundation for the subsequent analyses and evaluations conducted throughout the research.

The third chapter of the dissertation will be devoted to an in-depth analysis of the composition of the indexes that serve as the basis for the Exchange-Traded Funds (ETFs) under study. Through this investigation, it is intended to examine the underlying indices in detail, understanding their structure, component selection methodology and weighting. Particular emphasis will be placed on analysing the impact that index composition has on the performance of related ETFs, exploring the relationships between index structure and price fluctuations of the underlying assets.

In the fourth chapter, the focus will be on analysing the performance of ETFs during the two separate time periods. This analysis will include an in-depth assessment of the returns achieved by ETFs, the volatility of returns, and the composition of efficient portfolios. In addition, six crucial performance indicators will be interpreted and discussed: the Sharpe ratio, Treynor ratio, Modigliani Miller ratio, Jensen's alpha, Information ratio, and Sortino ratio. The objective of this chapter will be to provide a comprehensive and detailed assessment of ETF performance, with a focus on its implications for investors and financial market participants, to support informed investment decisions and optimal allocation strategies. In the fifth chapter of the dissertation, a detailed analysis of the liquidity of the ETFs considered during both study periods will be conducted. This analysis will focus primarily on investigating the bid-ask spreads of ETFs, which are a key measure of the liquidity of these financial instruments. Through a thorough investigation of bid-ask spreads, it is intended to assess the ease and convenience with which investors can buy or sell ETF shares in the market. In addition to the analysis of bid-ask spreads, the trend of assets under management (AuM) of ETFs over the two time periods considered will be examined. This will provide insight into the evolution of the size and popularity of ETFs in the financial market environment.

Finally, considerations of the percentage change in ETFs' assets under management will be provided, analysing changes over time, and identifying possible correlations with the outbreak of war in Ukraine and other market factors.

CHAPTER 1. INVESTMENT METHODS AND INDEXES

1.1 TRADITIONAL METHODS

1.1.1 THE MODERN PORTFOLIO THEORY

Prior to 1952, the financial landscape was marked by a high degree of uncertainty and randomness: investors faced decisions without a formal framework for assessing and balancing risk and return.

In the year 1952, Harry Markowitz developed the revolutionary theory that formed the traditional foundation of financial investment: the Modern Portfolio Theory (MPT).

The model he devised in his paper "Portfolio selection[1]“, which secured him the Nobel Prize in Economics in 1990, is based on the concept of portfolio optimization through the selection of stocks and other financial instruments such that the risk-return ratio is minimized, aiming to achieve the highest possible return for a given level of risk or the lowest possible risk for a targeted level of return.

In these terms, portfolio risk is represented by the variance[2] of returns (*Var*), while return is represented by the expected portfolio return (*r*).

For this reason, the model elaborated by Markowitz is also known as “Mean-Variance Approach[3]”.

To deeply comprehend the selection criteria adopted by Markowitz in choosing which securities to add to the portfolio, it is useful to represent the above variables in a Cartesian plane. In this plane, the x-axis represents the risk of each security, while the y-axis represents the expected return of each security.

Following the stochastic dominance criterion[4], one can readily identify stocks that are dominated, dominating, or indeterminate.

Figure 1 illustrates the fundamental concept of dominance in the model.

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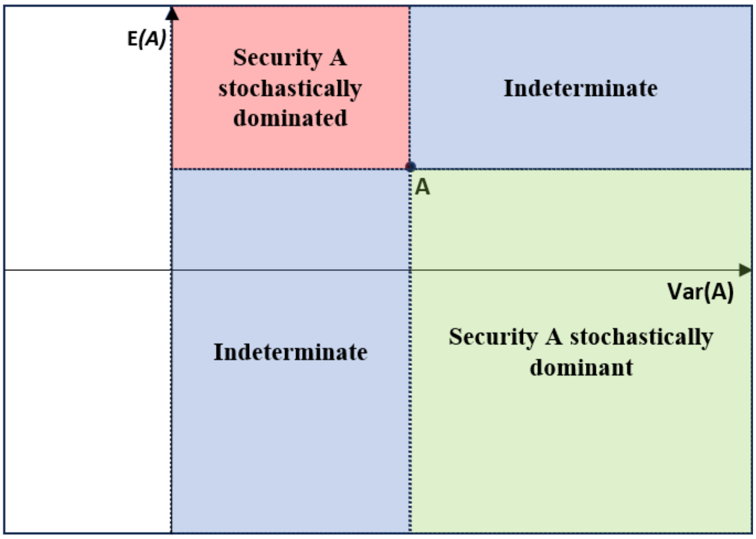
[1] Markowitz, Harry. “Portfolio Selection.” *The Journal of Finance* 7, no. 1 (1952): 77–91. https://doi.org/10.2307/2975974.

[2] Variance is a statistical measurement of the distance of data from the mean of a data set.

[3] Hakansson, Nils H. “Capital Growth and the Mean-Variance Approach to Portfolio Selection.” *Journal of Financial and Quantitative Analysis* 6, no. 1 (1971): 517–57. https://doi.org/10.2307/2330126.

[4] Levy, Haim. “Stochastic Dominance, Efficiency Criteria, and Efficient Portfolios: The Multi-Period Case.” *The American Economic Review* 63, no. 5 (1973): 986–94. http://www.jstor.org/stable/1813922.

Figure 1. Stochastic dominance criterion



Source: *Personal*

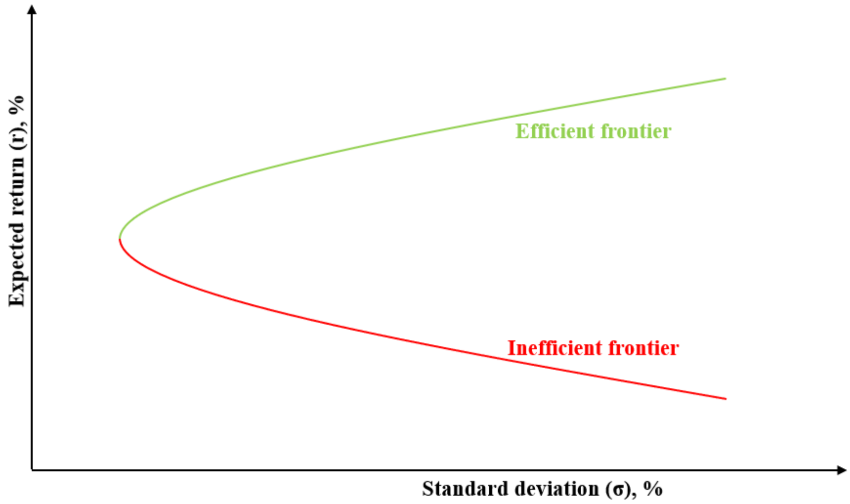
The Cartesian plane is partitioned into four regions. The blue areas indicate stocks where establishing a preference is not feasible. In the red quadrant, stocks dominate over security A, displaying lower variance and higher expected return. Conversely, in the green quadrant, stocks are dominated by A, marked by higher variance and lower expected return.

The basis for identifying securities such that the risk-return ratio is minimized is that there is no perfect correlation[5] between them. In fact, it would render null and void any effect of investing in securities that are different from each other. In his theory's culmination, Markowitz delineates the "efficient frontier" as portfolios arranged along a curve, offering the utmost return for a determined level of risk and the least risk for a determined level of expected return.

Figure 2 illustrates a visual representation of the efficient frontier derived from the mean-variance criterion.

[5] Two variables are said to be perfectly correlated when a linear relationship exists between the two such that a change in one is followed by a proportional change in the other, either along the same direction (perfectly positive correlation), or in the opposite direction (perfectly negative correlation).

Figure 2. Markowitz's efficient frontier



Source: *Personal*

According to the Modern Portfolio Theory, portfolios graphically positioned below the level of the efficient frontier represented by the green curve of Figure 2 must be considered inefficient because there constantly exists a portfolio delivering superior risk-adjusted returns for an equivalent risk amount, and another presenting lower risk for the same return level.

Furthermore, in accordance with the MPT, there are no portfolios that can offer a higher return than those positioned on the efficient frontier given the same level of risk.

After objectively identifying the efficient frontier through mean-variance criteria, each investor will go on to subjectively select the portfolio to hold situated on the efficient frontier, aligning with his or her level of risk tolerance.

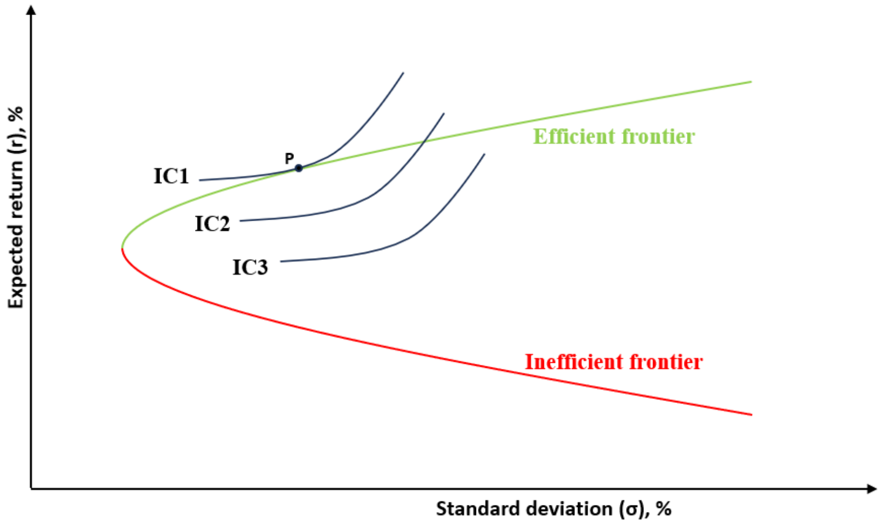
To facilitate this selection process, it is crucial to map out investors' indifference curves[6], which represent investors' preferences as risk and return variables fluctuate. Specifically, all portfolios whose risk and return characteristics give investors the same level of utility[7] are placed on the same indifference curve.

Figure 3 visually shows a representation of some indifference curves on the Cartesian plane.

[6] Kennedy, Charles. "The Common Sense of Indifference Curves." *Oxford Economic Papers* 2, no. 1 (1950): 123–31. http://www.jstor.org/stable/2661752.

[7] The total satisfaction that comes from the consumption of a good or service.

Figure 3. Indifference curves and optimal portfolio



Source: *Personal*

Depending on the individual investor's risk tolerance, he or she will go financially into the corresponding indifference curve.

As the investor's degree of risk acceptance increases, it will correspond to an indifference curve more shifted toward the top-right side of the efficient frontier. Conversely, the more risk-averse the investor, the more the indifference curve will shift toward the bottom-left side of the efficient frontier. Referring to Figure 3, indifference curve IC3 can be attributed to a less risk-averse investor than indifference curves IC1 and IC2.

In each of the above cases, the point of tangency between the indifference curve and the efficient frontier enshrines the optimal portfolio for the investor. In the case of Figure 3, that portfolio is represented by the point P.

As mentioned earlier, Markowitz's theory is grounded in the concept of mitigating risk by investing in a set of financial instruments whose performance is not perfectly correlated. However, it is necessary to further investigate the concept of risk to determine whether it is fully mitigable or, on the contrary, only a portion of it is eliminable through diversification.

The total risk of a portfolio can be expressed through the following equation:

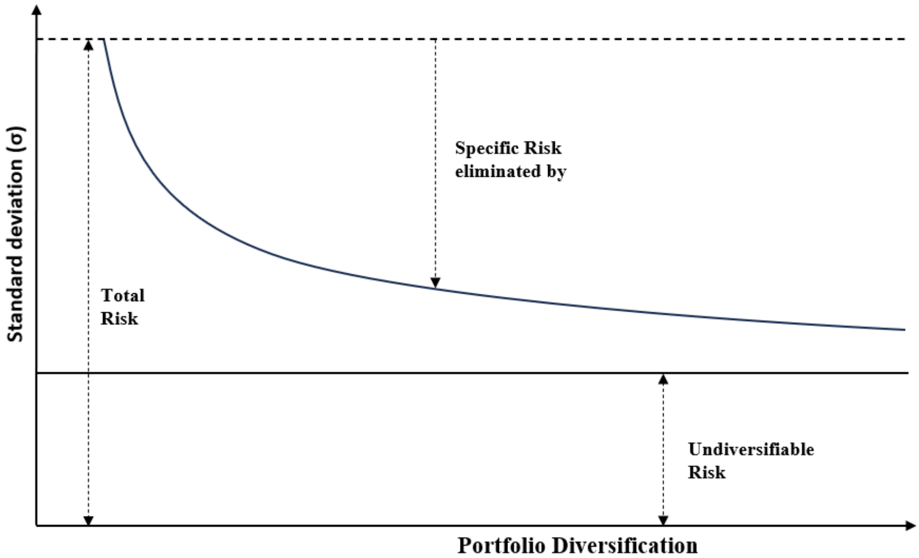
Total Risk= Systematic Risk + Specific Risk

Where:

- Systematic Risk is the portion of the total risk that is attributable to the market and that is not manageable by the entity issuing the security as it is caused by factors that are external to it. It comprehends the market risk[8], the interest rate risk[9], the inflation risk[10], and the exchange rate risk[11]. This portion of risk is not mitigable through diversification strategies.
- Specific Risk is the portion of the total risk that is attributable to the peculiar entity, sector, or industry. It comprehends the business risk[12], and the financial risk[13]. This portion of risk is mitigable through diversification strategies.

Figure 4 shows the trend of the two risks as a function of the number of the number of securities included in the portfolio.

Figure 4. Systematic Risk, Specific Risk, and diversification



Source: *Personal*

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[8] Risk related to the uncertainty of investing in financial markets.

[9] Risk of a loss of value of a financial asset due to changes in interest rates.

[10] Risk that a higher-than-expected inflation will erode the future real value of an asset.

[11] Risk that the profitability of an asset will be eroded by fluctuations in exchange rates between currencies.

[12] The risk that a company will not succeed from an operational viewpoint.

[13] Risk associated with the failure of the company to fulfil its financial obligations.

Based on historical risk and return performance, it is possible to compute the two main variables considered by this model: the expected return and the variance of the portfolio. The expected return (R_p) of a portfolio consisting of N securities can be estimated by the following formula:

$$R_p = x_1 R_1 + x_2 R_2 + \cdots x_n R_n = \sum_{i=1}^{N} x_i R$$

Where:

- $x_1 \dots x_n$ are the weights of the investments in each of the securities of the portfolio.
- $R_1 \dots R_n$ are the returns of each security held in the portfolio.
- $\sum_{i=1}^{N} x_i = 1$ if the investor chooses to allocate the entire wealth into investments in the portfolio.

The Variance (σ_p^2) of a portfolio consisting of N securities can be estimated by the following formula:

$$\sigma_p^2 = \sum_{i=1}^{N} x_i^2 \sigma_i^2 + 2 \sum_{i=1}^{N} \sum_{j=i+1}^{N} x_i x_j \sigma_{i,j}$$

Where:

- $\sum_{i=1}^{N} x_i^2 \sigma_i^2$ is the sum of the variances of the securities of the portfolio. This term of the equation is always positive.
- $\sum_{i=1}^{N} \sum_{j=i+1}^{N} x_i x_j \sigma_{i,j}$ is the sum of the covariances. This term of the equation could be both positive and negative.

In cases where the portfolio consists of only two securities, or where investors simply want to compare these securities to assess their performance and the diversification benefits of including them in the portfolio, it is essential to calculate their correlation coefficient.

The correlation coefficient (ρ) can be computed through the following formula:

$$\rho_{i,j} = \frac{\sigma_{i,j}}{\sigma_i \sigma_j}$$

The correlation coefficient may take any value in the interval [-1;1]. The closer the correlation coefficient values are to the extremes of this range, the stronger the correlation will be.

To summarize, Markowitz's theory is incredibly important because it not only aims to select the best stocks in terms of mean-variance, but also demonstrates the significant benefits of having a diversified portfolio based on the concept of correlation.

However, despite its indisputable pioneering nature, the model developed by Markowitz presents several drawbacks, such as:

- Strong sensitivity to inputs, as historical data are used in both the calculation of expected return and the calculation of securities risk in the market. A slight correction or update of these sequences would completely change the composition of the optimal portfolio.
- The use of standard deviation as a proxy for risk, which does not provide for any information about the Value at Risk[14] of the portfolio.
- Frequent commission of estimation errors, as it is proven that the model tends to overestimate[15] securities with high expected returns and low variance.

1.1.2 CAPITAL ASSET PRICING MODEL

The model devised by Markowitz, despite its limitations, set the stage for the creation of the Capital Asset Pricing Model (CAPM). This pioneering model, formulated in 1964, was the brainchild of scholar William Sharpe, who later received the Nobel Prize in Economics for his contribution. Additionally, economists John Lintner and Jan Mossin independently and concurrently made significant contributions to its development in 1965 and 1966 respectively.

The CAPM sets out to show that only the portion of systematic risk that cannot be diversified is rewarded by the market through higher returns.

[14] Measure that refers to the amount of maximum potential losses related to holding a portfolio.

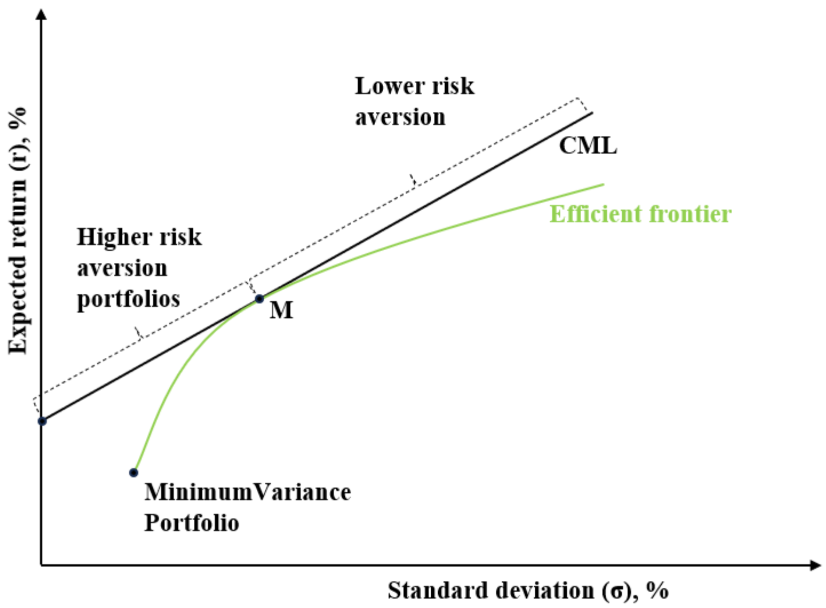
[15] Karoui, Noureddine El. "high-dimensionality effects in the Markowitz problem and other quadratic programs with linear constraints: risk underestimation." *The Annals of Statistics* 38, no. 6 (2010): 3487–3566. http://www.jstor.org/stable/29765272.

The CAPM is based on the following assumptions:

- Perfect capital markets: CAPM assumes that markets are perfectly efficient, meaning that all available information is reflected in asset prices.
- Investors are rational: CAPM assumes that investors make decisions based only on expected return and risk aimed at maximizing their utility.
- Homogeneous expectations: CAPM assumes that all investors, having access to the same information, have the same expectations for the future.
- There are no taxes and transaction costs.
- One-period investment horizon: CAPM assumes that investors have a single investment horizon and do not consider multiple periods.
- Investors can borrow and lend at the risk-free rate: the risk-free rate represents the return on a risk-free asset such as Treasury bills.
- Assets are infinitely divisible: CAPM assumes that investors are allowed to hold infinitely small fractions of assets.

Based on these assumptions, the straight line underlying the theory takes shape: the Capital Market Line (CML), represented in Figure 5.

Figure 5. Capital Market Line



Source: *Personal*

Figure 5 highlights the main features of the model, specifically:

- The CML passes through the point representing the risk-free asset (r_f).
- The CML is tangent to the Markowitz efficient frontier at a point M.
- Point M represents the market portfolio, which includes the set of risky securities held by investors under the efficiency assumption.

Thus, Tobin's Separation Theorem[16] was formulated, stating that each investor will go to invest in a portfolio placed on the CML and that the optimal allocation of his or her funds will depend solely on his or her risk appetite. Figure 5 highlights that the portfolios placed to the right of the M point on the CML are the portfolios held by investors inclined to accept a higher risk load, while the portfolios placed to the left of the M point on the CML are the portfolios held by the more risk-averse investors.

The following equation identifies the CML:

$$R_p = r_f + \frac{r_m - r_f}{\sigma_m}\sigma_p$$

Where:

- R_p is the return of the portfolio.
- r_f is the risk-free rate.
- r_m is the return of the market.
- σ_m is the standard deviation of market returns.
- σ_p is the standard deviation of portfolio returns.
- $\frac{r_m - r_f}{\sigma_m}$ is the slope of the CML and corresponds to the Sharpe ratio[17] of the market portfolio.

From the Capital Market Line, through some algebraic operations, it is possible to derive the Security Market Line (SML) equation, which aims to estimate the required return necessary for an investor to take the risk of investing in a security or portfolio.

The following equation identifies the SML:

$$r_i = r_f + \beta(r_m - r_f)$$

[16] Kroll, Yoram, and Haim Levy. "Further Tests of the Separation Theorem and the Capital Asset Pricing Model." *The American Economic Review* 82, no. 3 (1992): 664–70. http://www.jstor.org/stable/2117330.

[17] The Sharpe ratio is a financial metrics used to compare the return of an asset with its risk.

To understand this equation, it is essential to better understand the meaning of the β variable. This coefficient represents the mode and magnitude of the percentage change in a stock relative to a one percentage point increase in the market.

The following formula can be used to estimate β of a security *i*:

$$\beta_i = \frac{\sigma_{i,m}}{\sigma_m^2}$$

Where:

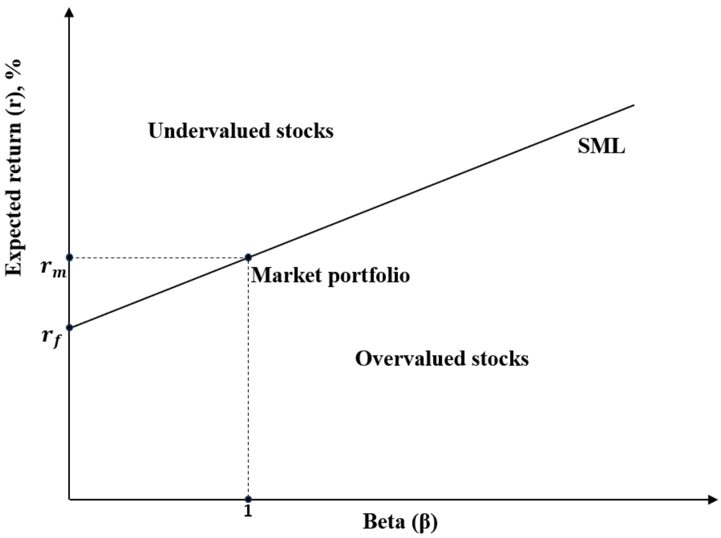
- $\sigma_{i,m}$ is the covariance between the returns of the security *i* and the returns of the market.
- σ_m^2 is the variance of the returns of the market.

Three cases are distinguished:

- β > 1 indicates that the security is more volatile than the market.
- β = 1 indicates that the security moves exactly as the market.
- 0 < β < 1 indicates that the security is less volatile than the market.

β is thus a measure of the non-diversifiable systematic risk of a security and represents the slope of the SML, as shown in Figure 6.

Figure 6. The Security Market Line



Source: *Personal*

The SML is also important because it allows the identification of possible overvalued and undervalued portfolios or stocks.

As is illustrated in Figure 6, securities above the SML are undervalued, while those standing below it are overvalued. However, should the identification of such circumstances occur, under the assumption of market efficiency, undervalued securities would be instantly acquired and overvalued securities would be instantly eliminated from the portfolio, eliminating the mispricing. A final factor to consider when studying the CAPM is α, a variable that represents the difference between the actual return of the security or portfolio and the return predicted by the CAPM, considering systematic risk as measured by the β variable.

Three cases are distinguished:

- $\alpha > 0$ implies that the realized return of the security or portfolio is higher than the required return.
- $\alpha < 0$ implies that the realized return of the security or portfolio is higher than the required return.
- $\alpha = 0$ implies that the realized return of the security or portfolio is equal to the required return.

The α coefficient can be estimated through the following formula:

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

As a result of the introduction of α in the model, the equation of the CAPM representing the return of the portfolio or security becomes the following:

$$r_i = r_f + \beta(r_m - r_f) + \alpha$$

CAPM, from its conception to the present, has been subject to numerous criticisms. The following are some of them:

- It is not realistic to assume that investors have homogeneous expectations; rather, investors have heterogeneous expectations because of gradual information flow, limited attention, and heterogeneous priors[18].
- There is evidence of the fact that, low beta stocks outperformed high beta stocks on some occasions, which is exactly the contrary of what is predicted by CAPM. This anomaly[19] is known as “high beta effect[20]”.
- Beta is a static factor, computed using past returns and therefore may not capture an increased or decreased probability of financial distress in the future.
- CAPM does not consider macroeconomic events that could strongly influence the return of the assets.
- There is no real possibility of testing the model because it is impossible to know the exact composition of the market portfolio, which should include any asset, including non-financial assets, to which a market value can be attributed. This is perhaps the best-known criticism of the model and is known as "Roll's criticism[21]”.

1.2 MULTI-FACTOR MODELS

1.2.1 THE ARBITRAGE PRICING THEORY

As a result of the many criticisms of the CAPM, there were numerous trials to develop alternative methods that considered factors other than just market risk. One of the attempts to explicate the functioning of market equilibria that is worth mentioning is the one implemented in 1976 by the American economist Stephen Ross, which is known as Arbitrage Pricing Theory (APT).

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[18] Holcombe, Randall G., and Richard P. Saba. “The Effects of Heterogeneous Expectations on the Capital Structure of the Firm.” *Southern Economic Journal* 51, no. 2 (1984): 356–68. https://doi.org/10.2307/1057817.

[19] An anomaly is any financial movement that cannot be explained by any theory of asset pricing.

[20] Tendency of high beta stocks to underperform relatively to low beta stocks in some periods of time.

[21] R.Roll "A critique of the asset pricing theory's tests Part I: On past and potential testability of the theory." *Journal of Financial Economics* 4, no. 2 (1977): 129-176. https://doi.org/10.1016/0304-405X(77)90009-5

As previously mentioned, one of the main criticisms levelled against the CAPM was that it did not consider the occurrence of events at the macroeconomic level that could affect the return of the assets being analysed.

In contrast, the model proposed by Ross is based on the idea that a set of macroeconomic variables, which are in a linear relationship with the expected return of the asset, are those that capture and describe the non-diversifiable systematic risk. These variables are made to coincide with the change in the inflation rate, the change in oil prices, the change in interest rates, the level of unemployment, changes in exchange rates, and housing market conditions.

The assumptions on which this model is based are the following:

- Perfect competition: APT assumes that markets are perfectly competitive, meaning that there are no barriers to entry or exit, and all investors have access to the same information and can trade freely without transaction costs.
- No arbitrage opportunities: APT assumes that there are no arbitrage opportunities available in the market. In other words, investors cannot consistently earn riskless profits by exploiting price differentials between assets.
- Linear relationship between risk factors and returns: APT assumes that the relationship between risk factors and asset returns is linear. This means that changes in each factor have a proportional effect on the expected return of the asset.
- Factors are uncorrelated with each other: APT assumes that the systematic risk factors are uncorrelated with each other. This implies that each factor provides unique information about asset returns and cannot be diversified away.
- Investors are rational: APT assumes that investors are rational and make decisions based on maximizing their utility, considering the expected returns and risks associated with different investments.

Ross devises the following formula as explanatory of an asset's performance:

$$r_i = r_f + \beta_{i1}\lambda_1 + \beta_{i2}\lambda_2 + \cdots + \beta_{ik}\lambda_k + \varepsilon_i$$

Where:

- r_i is the expected return of asset i.

- r_f is the risk-free rate.
- β_{ik} is the beta coefficient of asset *i* with respect to the risk factor *k*.
- λ_k is the risk premium associated with the risk-factor *k*.
- ε_i is the standard error representing all the sources of risk not explained by the considered risk factors.

In light of the above considerations, the APT model is found to have primarily one key advantage, which translates into its flexibility to adapt to specific market circumstances, with the individual being able to set and calculate the return on the asset based on specific and customizable risk factors.

However, this advantage also reveals the main cons of this model: the ability to include numerous "customizable" risk factors within the model implies that the relevant and considerable risk factors are potentially infinite, revealing a major difficulty in implementing APT in practice[22]. In addition, the APT model neglects the fact that a particular stock may be more or less sensitive to a particular factor of than another stock and fails in any way to suggest to the investor which risk factors the stock is more or less sensitive to[23] and the magnitude of those risk factors.

1.2.2 FAMA-FRENCH THREE-FACTOR MODEL

The Arbitrage Pricing Theory has laid the foundation to inspire numerous multifactor models aimed at describing the performance of financial instruments. One of the most famous of them is the three-factor model proposed by Eugene Fama and Kenneth French in 1993 in the Journal of Financial Economics.

This model was developed by the two economists based on an econometric regression to understand why, especially during the period between 1963 and 1990, securities with lower beta (as measured by the CAPM) tended to perform better than securities with high beta, contrary to what the CAPM predicts.

Similarly, the two economists empirically observed that stocks of small-cap companies tend to outperform stocks of large-cap companies.

[22] Ingersoll, Jonathan E. "Some Results in the Theory of Arbitrage Pricing." *The Journal of Finance* 39, no. 4 (1984): 1021–39. https://doi.org/10.2307/2327610.

[23] Roll, Richard, and Stephen A. Ross. "An Empirical Investigation of the Arbitrage Pricing Theory." *The Journal of Finance* 35, no. 5 (1980): 1073–1103. https://doi.org/10.2307/2327087.

Considering these observations, Fama and French developed a three-factor model that could account for these systematic risk factors neglected by the CAPM and link them to the expected return of the stock or portfolio.
The three factors are:

- The market risk: this factor reflects, similarly to the CAPM, the overall market risk.
- The premium for the size factor, or size risk: this factor reflects the differential return between small-cap and large-cap companies.
- The premium for the value factor, or value risk: this factor reflects the differential return between value stocks with a lower beta and growth stocks, with a higher beta.

The following formula describes the expected return of asset *i* according to this model:

$$R_i = \alpha_i + \beta_{i,m}(r_m - r_f) + \beta_{i,SMB} r_{i,SMB} + \beta_{i,HML} r_{i,HML} + \varepsilon_i$$

Where:

- α_i , ε_i are equivalent to those considered in the APT model.
- $r_{i,SMB}$ (Small Minus Big) represents the size premium and is calculated by subtracting from the return of a diversified portfolio of smaller capitalization companies the return of a diversified portfolio of larger capitalization companies.
- $r_{i,HML}$ represents the value premium and is calculated by subtracting from the return of a diversified portfolio of companies with low price-to-book value the return of a diversified portfolio of companies with high price-to-book value.
- $\beta_{i,m}$, $\beta_{i,SMB}$, $\beta_{i,HML}$ are the beta coefficients measuring the sensitivity of asset *i* with respect to the three risk factors, specifically to the market risk, the size risk, and the value risk.

The three-factor model elaborated by Fama and French showed to be able to explain a significant part of the variation of assets' returns from those predicted by the CAPM. However, it is useful to point out that this model has some critical issues, including:

- Limitations in factor interpretation: the interpretation of risk factors can be subject to controversy. The value factor, for example, may be subject to factors not strictly related to the value of the company, making its use misleading.

- Dependence on historical data: like many other models, Fama's model may not be suitable for predicting future returns because it is completely based on historical data to identify coefficients.
- Other factors not considered: liquidity, volatility factors, or macroeconomic events are not included within the model.

1.2.3 CARHART FOUR-FACTOR MODEL

Fama and French's three-factor model represents the starting point used by U.S. academic and economist Mark Carhart in 1995. Carhart reflects that there may be an additional factor of extreme importance that can greatly affect the performance of a security: this factor is identified in the "momentum factor."

The momentum effect can be defined as a financial phenomenon that refers to the tendency for assets that have performed positively in the recent past to continue to exhibit positive performance in the immediate future, and vice versa for assets with negative performance in the recent past.

This effect is mainly due to two factors:

- Slow information diffusion, as it is shown that the momentum effect is more pronounced among small stocks with less analyst coverage.
- Slow information reaction, as investors may be slow to react to the release of new information.

This model turns out to be innovative compared to other multifactor models because, for the first time, by considering the momentum factor, it hypothesizes that investors may also deviate from the tracks of rationality when investing in financial markets.

In fact, among the main reasons for the existence of the momentum effect are:

- Investors' overconfidence: If an investor is very overconfident, he or she will believe that his or her information is very valuable.

  At the same time, when new information is released, the investor will tend to disregard the importance of such information and therefore prices will take longer to incorporate the new public information. This also explains why momentum effect is stronger in western countries[24], where people are generally more overconfident, than in Asian countries.

- Conservative bias: people are generally conservative and do not react as fast as they could. Therefore, the momentum effect may be catalysed.
- Disposition effect: it is the tendency of investors to sell winning stocks too early and hold losing stocks for too long, because they do not want to admit themselves that they have taken wrong decisions in the past, regardless of the information that is released.
- Anchoring bias: sometimes investors tend to anchor to some key price levels (i.e., the purchasing price, the maximum price of a stock...) without buying or selling the stock until it reaches that psychologically relevant price.

The formula elaborated by Carhart becomes the following:

$$R_i = \alpha_i + \beta_{i,m}(r_m - r_f) + \beta_{i,SMB} r_{i,SMB} + \beta_{i,HML} r_{i,HML} + \beta_{i,UMD} r_{i,UMD} + \varepsilon_i$$

Where:

- $\beta_{i,UMD}$ is the coefficient measuring the sensitivity of asset i with respect to the momentum effect.
- $r_{i,UMD}$ represents the momentum premium and is calculated by subtracting from the return of a diversified portfolio of high-momentum stocks the return of a diversified portfolio of low momentum stocks.

1.2.4 FAMA-FRENCH FIVE-FACTOR MODEL

In a subsequent elaboration done in 2014, Fama and French added two additional factors to their primordial three-factor model because, in the meantime, numerous other studies demonstrated the limitations of that model in predicting portfolio returns. These two additional factors are the profitability factor and the investment factor.

The five-factor formula proposed by Fama and French is the following:

[24] Chui, Andy C.W., Sheridan Titman, and K.C. John Wei. "Individualism and Momentum around the World." *The Journal of Finance* 65, no. 1 (2010): 361–92. http://www.jstor.org/stable/25656294.

$$R_i = \alpha_i + \beta_m(r_m - r_f) + \beta_{i,SMB} r_{i,SMB} + \beta_{i,HML} r_{i,HML} + \beta_{i,RMW} r_{i,RMW} + \beta_{i,CMA} r_{i,CMA} + \varepsilon_i$$

Where:

- $\beta_{i,RMW}$ is the coefficient measuring the sensitivity of asset i with respect to the profitability factor.
- $r_{i,RMW}$ is the difference between the returns of a portfolio composed of high return stocks and a portfolio composed of low return stocks.
- $\beta_{i,CMA}$ is the coefficient measuring the sensitivity of asset i with respect to the investment factor.
- $r_{i,CMA}$ is the difference between the returns of a portfolio composed by stocks of companies characterized by low investments (conservative companies) and a portfolio composed by stocks of companies characterized by high investments (aggressive companies).

Although this model cannot fully explain all stock and portfolio returns because of the enormous complexity of financial markets, it can be considered one of the most comprehensive evaluation tools available to investors to consider multiple factors simultaneously as they set out to make investment decisions, as it multiple approach allows investors to account for various market dynamics, risk factors and performance metrics.

1.3 OVERVIEW AND EVOLUTION OF TRADITIONAL INDEXES

A market index is a statistical measure that represents the aggregate value of a group of financial securities within a specific financial market. Such a group of securities may be representative of an entire asset class or a specific market basket. The function of indexes is basically to track the overall performance of a market or a subset of it over time.

The mechanism leading to the establishment of an index is based on the weighted average of certain representative factors (usually the market price or capitalization) of the publicly traded securities included within the index.

1.3.1 GENERAL WEIGHTING METHODS

Based on the general weighting criterion adopted, indices can be divided into the following groups:

- Price-weighted indexes: in a price-weighted index, stocks are weighted according to their market price. This means that stocks with higher prices have a greater impact on the index than those with lower prices, regardless of the capitalization of the company. The most famous example of a price-weighted index is the Dow Jones Industrial Average (DJIA), in which the price of each stock is summed, and the total is divided by an adjustment factor that is useful in defining the value of the index.
- Equal-weighted indexes: in an equal-weighted index, the stocks that make up the index are equally weighted and each stocks affects the index in the same way, regardless of the stock price or capitalization.

  A famous example of an equal-weighted index is the S&P 500 Equal Weight U.S. Index, which corresponds to the equal-weight version of the S&P 500.

  One factor to consider when investing the same capital in each stock is the magnitude of transaction costs. They, in fact, tend to be particularly high in the case of equal-weighted indexes because of the higher frequency of rebalancing compared to value-weighted indexes, since the change in stock prices can result in a deviation from the desired uniform weighting.

  In addition, equal-weighted indexes often include small and medium-sized stocks that may be less liquid than the stocks of large companies included in market-capitalization-based indexes, and the lower liquidity may result in higher transaction costs, as it will be more difficult to find buyers or sellers willing to trade large quantities of shares without affecting market prices.
- Value-weighted indexes: in a value-weighted index, the stocks that make up the index are weighted according to their market capitalization, that is, the individual share price multiplied by the number of shares outstanding. This means that companies with higher capitalization have a greater weight in the index than companies with lower capitalization. This weighting principle makes value-weighted indexes more representative of the market, since they consider the relative size of the companies they seek to include.

The most famous example of an index weighted in this way is the S&P 500, where the weight of each stock is proportional to its market capitalization relative to the sum of the market capitalizations of all the companies in the index.

Figure 7 shows the distribution of weights according to each general weighting method.

Figure 7. Weights distribution according to each indexing approach

Source: *Zaher (2019)*

In accordance with Figure 7, it can be seen that if one were to decide to construct an index based on the one thousand largest U.S. companies through the weighting principle based on market capitalization, 50% of the index's cumulative weight would be made up of about sixty equities; in contrast, the price-weighted and equal-weighted methods prove to be much more homogeneous in terms of weight distribution.

Although the weighting principle based on market capitalization can be considered, as mentioned above, more representative of the market itself, and has many advantages (i.e. high diversification, stability over time, and low liquidity risk), it is based on the stringent assumption that the financial markets are efficient.

However, numerous studies confirm that there are several types of anomalies that cannot be explained by the rational principles of traditional finance. The consequence of this demonstration coincides with the fact that the price of shares may not reflect their intrinsic value under certain circumstances. Therefore, it is possible that during the process of composing a stock index, the weight given to each stock is fundamentally flawed because it is based on a capitalization that considers market prices deviating from their value.

1.3.2 FUNDAMENTAL WEIGHTING METHODS

Another approach to weighting the securities included within an index is to weight the weights according to some fundamental measures of the companies under consideration, rather than relying solely on the market capitalization of those companies. The main characteristics of an index constructed in this way are:

- Weighting based on fundamentals: net income, turnover, EBITDA, EBIT, cash flows or other financial indicators deemed relevant are the determining factors for weighting purposes.
- High diversification: fundamentally weighted indexes tend to be more diversified in terms of sectors and company sizes than indexes based on market capitalization, a feature that reduces the risk arising from the potential overweighting of highly capitalized companies.
- Risk balancing: as mentioned in the previous point, fundamentally weighted indexes can reduce the risk of over-concentrating the portfolio in a small number of stocks or sectors, as selected companies are weighted according to financial measures that most reflect their financial health.
- Active or passive approach: fundamentally weighted indexes may be actively managed by fund managers, who may weight companies based on fundamentals, while other managers may more passively use fixed rules or algorithms to make up or maintain the index.

Analysing the performance of fundamentally constructed indexes, Arnott, Hsu, and Moore (2005) use as target the S&P500 and show how fundamentally weighted indexes outperformed cap-weighted indexes by 1.97 percentage points per year, on average, over the period from 1962 to 2004.

Although this superior return may be accounted for by other factors than just better index construction, including exposure to additional risk or price inefficiencies, empirical evidence suggests that there is greater efficiency in terms of mean and variance in fundamentally weighted indices than in capitalization-weighted indices. The result obtained turns out to be considerably robust and consistent over the considered period, able to survive even the many macroeconomic vicissitudes that have occurred in the interim.

Despite the previously mentioned demonstration of superior performance, it should be noted that in benefits associated with indexes based on fundamentals can only be achieved and preserved through careful and frequent rebalancing and data analysis processes, which can prove very time-consuming and costly in terms of both time and transaction costs. In addition, allocating weights to stocks based on fundamental measures exposes index performance to the subjectivity of the choice of fundamental indicator. In conclusion, it should be kept in mind that the construction of these indexes is based on fundamental measures that reflect only the past, leaving out critical issues that may arise in the future.

1.3.3 RISK-ADJUSTED METHODS

Risk adjusted indexes are indexes constructed based on historical risk information defined as the ratio of mean to variance. These indexes employ various methods to weight assets within them, aiming to optimize risk-return profiles.

The main risk adjusted indexing methods include:

- Minimum volatility: this weighting criterion is based on giving more weight to companies with less price variation over time than those with greater price variation.
- Equal risk contribution (ERC): this weighting criterion is based on assigning weights such that each asset equally contributes to the overall risk of the index. This output is obtained through processes such as convex optimization[25] or iterative algorithms such as the "Risk Parity[26]" approach.
- Key ratios allocation: this weighting criterion is based on assigning weights based on different key ratios, such as Sharpe Ratio.

[25] It consists of the process of minimizing or maximizing a convex function over a convex set. Convex optimization techniques are often used to construct ERC portfolios because the optimization problem aimed at achieving equal risk contribution usually leads to a convex objective function and convex constraints. By solving this problem, an individual can find the optimal portfolio that splits risk equally while maximizing return or meeting other constraints.

[26] Bollerslev, Tim, Benjamin Hood, John Huss, and Lasse Heje Pedersen. "Risk Everywhere: Modeling and Managing Volatility." *The Review of Financial Studies* 31, no. 7 (2018): 2729–73. https://www.jstor.org/stable/48615518.

- Maximum diversification: the aim of this method is to maximize the benefits of diversification within the index by weighting the assets in a way such that the correlation between them is minimized.

In general, an investment that offers a higher return than the associated level of risk will score better in the corresponding risk-adjusted index, leading to more capital allocation towards them.

CHAPTER 2. ETFs

2.1 THE RISE OF ETFs

Exchange Traded Funds (ETFs), often referred to as low-cost investment vehicles, represent a distinctive class of financial instruments traded on stock exchanges, similarly to conventional stocks.

The primary objective of ETFs is to accurately replicate the performance and therefore the returns of underlying stock, bond, or commodity indexes.

The first indexed financial product comparable to what are now known as ETFs was introduced by the U.S. bank Wells Fargo in the early 1970s, which grouped all the major tradable stocks in the United States under a single instrument, similarly to the modern iShares Core S&P 500 UCITS ETF. Although Wells Fargo's creation was intended only for institutional-sized investors and did not feature the many flexibility options that modern ETFs offer, the idea behind it was essentially the same.

The availability of an index fund accessible to private investors did not materialize until 1976 when John Bogle and Burton Malkiel introduced the Vanguard 500. However, it was not classified as an ETF at that time because it was not listed on an exchange.

The birth of ETFs in the modern sense can be traced back to 1993, when Standard & Poor's Depositary Receipts, an ETF that replicates the performance of the S&P500, as the name suggests, was launched on the American Stock Exchange. This was followed by the launch of two more ETFs, the "Diamonds" and "Cubes," which replicate the performance of the Dow Jones and Nasdaq 100, respectively.

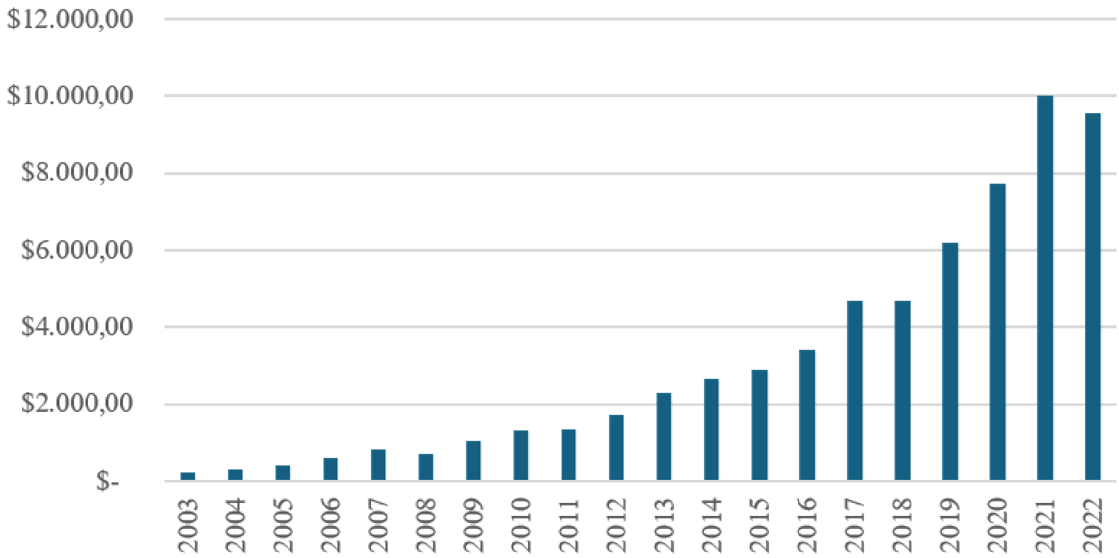
Following the successful introduction of these revolutionary financial instruments, the growth of ETFs became unstoppable: numerous ETFs were born that could replicate multiple sections of the major U.S. indices segmented according to a wide variety of criteria, such as the sector in which the companies operate, growth prospects, and the number of dividends paid.

Starting in the early 2000s, ETFs also began to spread in Europe, beginning in Frankfurt and then spilling over to the other major financial centres of London, Zurich, and Stockholm. Figure 8 highlights how the growth of assets under management[27] managed by ETFs has increased exponentially over the years, robustly withstanding

[27] The sum of the market value of all the investments managed by a fund or a group of funds on behalf of third parties.

macroeconomic events of the magnitude of the 2008 financial crisis and the COVID-19 pandemic.

Figure 8. Worldwide ETF assets under management (2003-2022)



Source: *Personal*

Among the reasons that have led to such rapid and exponential development of ETFs are:

- Liquidity and flexibility: ETFs are listed and traded on the exchange like stocks and can therefore be traded easily throughout the opening hours of the exchange. In addition, they have no maturity dates, so each investor can manage his or her investment based on his or her own relevant time horizon.
  Finaly, flexibility is also provided by the fact that there is no minimum lot to be purchased, a factor that ensures access to this type of financial instrument for investors of all sizes.
- Cost efficiency: The passive approach to ETF management, combined with ETF listing, significantly reduces costs associated with active management, such as those associated with analyst manpower and distribution. This gives investors access to markets and investment strategies that would otherwise be difficult to access, all with significantly lower management fees.
- Transparency: ETFs, by replicating well-known market indexes, provide investors with a clear understanding of the risk-return relationship of their investment and

the composition of the underlying portfolio. In addition, they feature a price that constantly updates in real time based on changes in the components of the reference index. This property allows investors to effectively monitor the value of their ETF investment, thanks in part to the daily publication of the ETF"s official value (NAV[28]).

- Diversification: ETFs offer exposure to a wide range of underlying assets, allowing investors to effectively diversify their portfolios without having to select individual stocks or bonds.
- Access to a wide range of markets: ETFs are instruments that can combine securities from different markets in terms of geography, sectors, asset classes, investment strategies, and alternative markets such as real estate and infrastructure that might be difficult to access or too expensive if approached directly.
- Innovation and adaptability: the ability of ETF issuers to constantly innovate and introduce new products responsive to investor needs and emerging market trends plays a key role in the continued development of the ETF industry.
  This dynamic of adaptation and innovation not only enriches the range of products available to investors, but also helps to keep the industry in line with the changing needs of the global financial market. Such flexibility and attention to new investment opportunities ensure that ETFs continue to play a significant role in the financial instrument landscape, providing investors with an ever-widening range of options to build diversified portfolios and meet their long-term investment goals.
- Issuer risk[29] abatement: an ETF constitutes a fund whose assets are strictly reserved for the holders of its units, as stipulated by law. As a result, in the event of the insolvency of the companies involved in the management, administration and promotion of the fund, the assets of the ETF would remain intact and unaffected.

[28] Net Asset Value is computed as the difference between all the assets and all the liabilities of a fund, divided by the number of shares outstanding and gives insights about the fair value of a share of the fund.

[29] Risk that the issuer of a financial instrument cannot meet the obligations it has contractually entered because of issuer insolvency, credit rating changes or legal actions that significantly damage the security value.

2.2 THE FUNCTIONING OF ETFs

2.2.1 THE CREATION AND REDEMPTION PROCESS

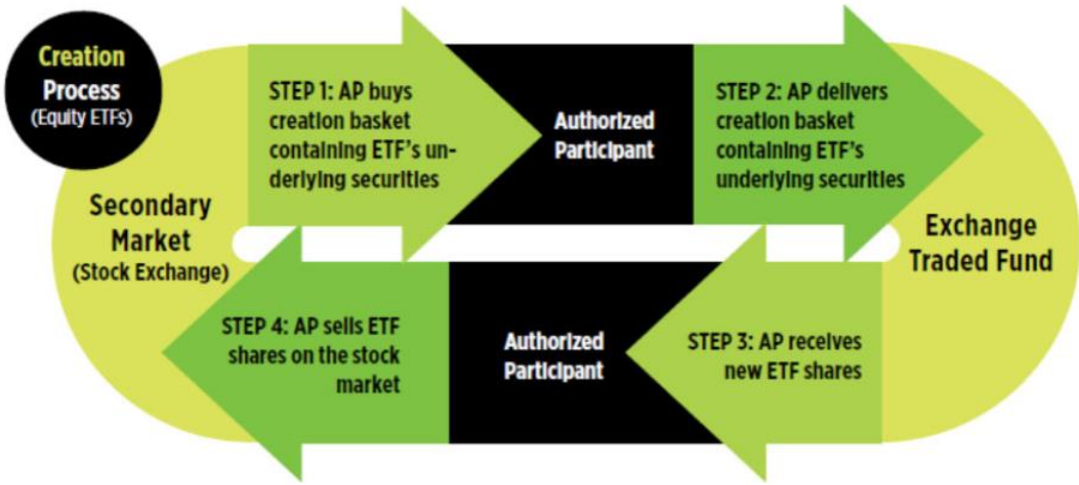
To best understand the benefits of investing in ETFs, it is essential to best understand their nature in financial terms. As previously mentioned, a fundamental condition for the existence of an ETF is its listing on an exchange, a feature that allows investors to purchase or obtain full or partial redemption of the capital contributed with ease throughout the opening hours of the relevant exchange. From this possibility we can see the great flexibility that ETFs present.

In addition, ETFs differ from traditional closed-end funds in that they do not have a fixed number of outstanding shares but, instead, manage the number of units that can be purchased in the market based on the relationship between supply and demand.

In contrast, a closed-end fund (CEF) does not hold such flexibility from the standpoint of outstanding shares, but issues through an initial public offering a fixed number of units that will then be traded by investors in the secondary market.

The mechanism that allows ETFs to expand or contract depending on the magnitude of supply and demand is called the "creation and redemption process". The creation process is depicted in Figure 9.

Figure 9. ETF creation process



Source: *www.etf.com*

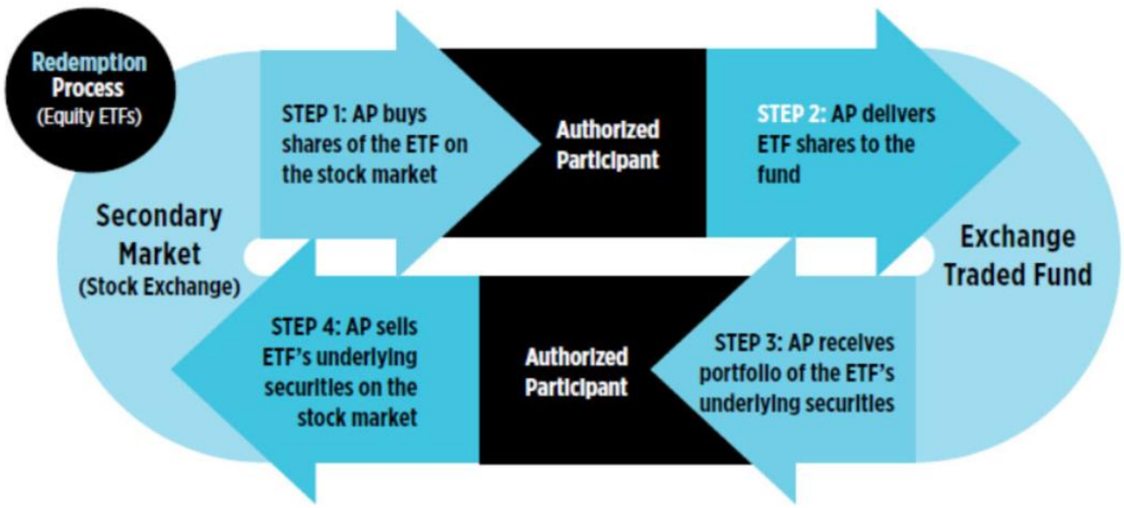
The creation process involves ETF shares buyer's orders being transmitted by financial intermediaries to authorized participants (APs), large financial firms such as banks or trading companies, which create baskets of securities composed in the same proportions by the same securities enclosed in the ETF. This bulk of shares is known as the "creation basket".

Subsequently, these securities are handed over to the ETF issuer, which will deposit the securities received with an independent depository that will ensure their untouchability. At this point, the ETF provider creates new shares of the ETF in the agreed-upon quantity and supplies them to the authorized participants in exchange. This exchange is usually done "in kind", allowing both parties to avoid having to make cash transactions.

Once the ETF shares are received, the authorized participants will distribute them in the secondary market, again through intermediaries, allowing to individual investors to trade them like normal shares.

Figure 10, on the other hand, illustrates the opposite process, that of redemption.

Figure 10. ETF redemption process



Source: *www.etf.com*

Similarly, the redemption process stipulates that when investors wish to sell part of their investment in ETFs, they will go and hand over their units to authorized participants, again using financial intermediaries.

The APs, once having collected these units, will go on to exchange in kind with the ETF issuer, who in the meantime will have prepared the so-called "redemption basket" containing the fragmented securities contained within the ETF. Once the in-kind exchange, in the opposite direction from the creation process, has taken place, the ETF shares returned to the issuer will be deleted from the market and can no longer be traded by investors.

The complexity of the creation and redemption mechanism lends great security and transparency to the process. In particular, the funds that are placed with the depository are guaranteed and untouchable even if the brokerage firm or authorized participant should fail.

In addition, authorized participants can keep the relationship between the price of the ETF and the price of its component securities stable through arbitrage transactions.

Specifically, two cases are distinguished:

- If the NAV of the ETF is lower than the NAV of its constituent securities, the authorized participants purchase the units from the financial intermediary, disassemble them at the depository company, and finally sell the broken-down securities individually in the market.
- If the NAV of the ETF is greater than the NAV of its constituent securities, the authorised participants will purchase these broken-down securities and exchange them in kind with financial intermediaries, receiving ETF shares in return. These units will then be sold in the secondary market, guaranteeing a profit for the APs.

This arbitrage mechanism, in addition to ensuring a secure profit for the authorized participants, keeps the ETF's NAVs aligned with that of the underlying securities, avoiding situations of market inefficiency and extreme price volatility.

2.2.2 THE COSTS OF ETFs

As previously mentioned, ETFs are financial instruments that have low costs compared to other types of investments. As an example, at the end of the second half of 2023, equity ETFs are found to apply annual management costs of between 0.04% and 0.95%, while active equity funds tend to have much higher costs, ranging from 1.5% to 1.8%[30]. Despite the low level of commission expenses compared to other financial instruments, like any form of investment, investing in ETFs also incurs expenses to keep exposure to these financial instruments open.

[30] https://extraetf.com/it/accademia/costi-degli-etf

Specifically, the costs that an ETF unit holder incurs during the year are:

- Management fees: these costs refer to the expenses necessary to administer the ETF. ETF management fees cover various services, including managing the allocation of investments within the portfolio, security selection, fees related to any dividend distributions by the ETF management company, legal fees, accounting fees and financial advisory fees.
- Custody fees: these kinds of fees refer to charges imposed by brokers for holding ETFs within an investor's account. These fees are distinct from ETF management fees, which are paid to the ETF manager for overseeing and administering the ETF. The amount of custody fees depends on the broker utilized by the investor and the type of account held. While some brokers may provide custody of ETFs for free, often subject to meeting specific criteria such as maintaining a certain trading volume or holding a minimum amount of assets with the broker, others may charge periodic custody fees. These fees can be structured based on factors such as the number of securities held or the total value of ETF holdings within the investor's account. Typically, custody fees are charged at regular intervals, such as monthly or annually.
- Licence fees: fee that may be charged to the investor because the ETF provider must pay a licence fee for tracking a specific index.
- Distribution fees: these costs refer to fees applied to cover the marketing costs and the preparation of distribution documents.
- Transaction fees: the application of these fees occurs whenever the investor wishes to buy a new ETF share or sell a portion of the ETF share, he or she owns. In these cases, the broker used by the investor may retain either a fixed fee or a value of money equivalent to a percentage of the order placed by the investor.
- Bid-ask spread: this indicator represents the difference between the bid price, i.e., the price at which one investor is willing to buy, and the offer price, i.e., the price at which another investor is willing to sell a share of the ETF.

  In other words, when trading an ETF, the price at which a share can be bought is slightly higher than the price at which that share can be sold. This difference constitutes the so-called "implicit cost" of trading, and represents the commission that brokers receive to provide liquidity to the market.

The discrepancy between bid price and ask price is closely related to the liquidity and trading volume of the ETF. Due to increased competition among market makers, ETFs with greater liquidity will tend to have smaller bid-ask spreads. Conversely, ETFs with lower liquidity will tend to have higher bid-ask spreads due to reduced competition in the market makers' market.

- Performance fees: performance fees are a form of compensation charged by fund management companies based on the fund's performance. These fees are charged when the fund exceeds a certain level of performance, often defined in relation to a benchmark. In essence, if the fund exceeds its investment objective, generating an additional return relative to the benchmark, performance fees are charged as a percentage of the excess returns. However, if the fund fails to outperform the benchmark, performance fees may not be charged.
- Other costs: these costs include swap fees and income from securities lending.

To give a more complete view to an investor who wants to include within his or her portfolio a share in ETFs, it is useful to analyse and understand the meaning of the TER (Total Expense Ratio), which provides key information on the annual costs incurred in view of such an investment. It, however, does not include all cost components, as highlighted by Table 1.

Table 1. Components of TER

Costs included in the TER ratio	**Costs excluded by the TER ratio**
Management fees	Transaction fees
Custody fees	Bid-ask spread
Licence fees	Performance fees
Distribution fees	Other costs

Source: *Personal*

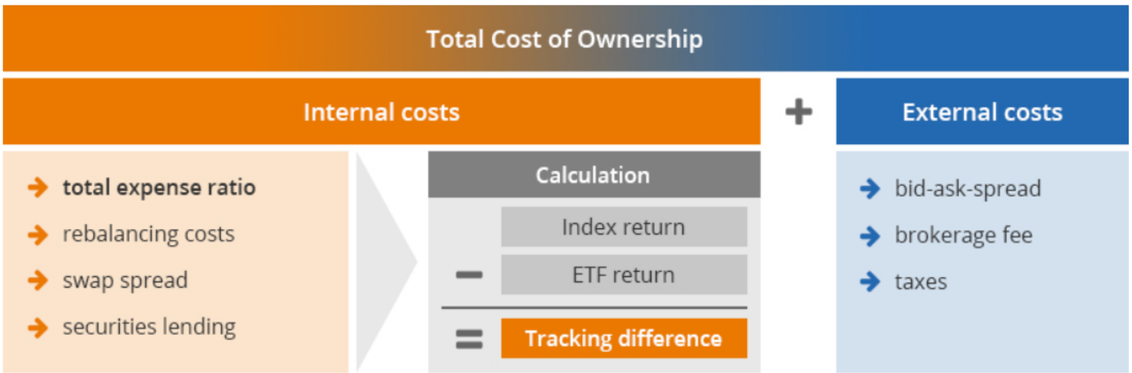
Although the TER is a key measure for estimating the major cost components arising from an ETF investment, it is necessary to delve further into the study of other financial indicators that may be more explanatory of the total cost incurred by the investor. Indeed, it is not necessarily the case that an ETF with a lower TER than another will provide a greater return than an ETF with a higher TER, nor will it necessarily be less expensive. To help understand what the total cost will be from investing in ETFs, it is useful for investors to calculate the TCO (Total Cost of Ownership).

TCO includes other internal expenses additional to Total Expense Ratio, such as rebalancing costs, gains from securities lending, and synthetic replication swap fees, if applicable. These expenses are inherent in the management of any investment fund and therefore must be carefully considered.

In addition, there are various external costs that are more visible to investors, including platform fees, taxes, and the bid-ask spread incurred during ETF trading. These external costs are relatively transparent because platforms disclose their fees and commissions, and investors can verify bid-offer spreads by checking ETF prices.

Figure 11 shows the components of the TCO.

Figure 11. Components of the Total Cost of Ownership



Source: *www.justETF.com*

Figure 11 gives relevant information about how to compute the Total Cost of Ownership. It shows how to be able to include in the cost calculation internal costs that are not included in the TER.

This consideration is done through the calculation of the tracking difference, expressed as the difference between the return of the index replicated by the ETF and the return of the ETF. Once the tracking difference is calculated, the TCO is calculated adding the external costs to the internal costs represented by the tracking difference[31].

[31] https://www.justetf.com/it/academy/la-replica-sintetica-degli-etfs.html

For example, if an index produces a return of 12% and the corresponding ETF produces a return of 10%, the tracking difference will be 2%. In this scenario, the ETF's internal expenses cause it to yield 2 percentage point less than the underlying index.
In this scenario, the TCO will be equal to the sum of the 2 percentage points, plus the external costs. Occasionally, the difference in tracking can benefit the ETF. This is due to various factors that contribute favourably to the performance of the ETF. For example, the ETF can generate additional income through activities such as securities lending. In addition, it can benefit from more advantageous tax regulations than those reflected in the index performance calculation. In addition, subtle differences in the composition of the ETF relative to the index could also play a role, providing an advantage to the ETF for a time.
In this regard, it is indeed necessary to distinguish between two forms of replication:

- Physical replication ETFs: physical ETFs that track an underlying index can take two main approaches: full replication and sampling.
  Full replication involves buying all the securities in the index in the proportions indicated by the index itself.
  On the other hand, in the sampling approach, the ETF buys only a subset of the index securities, attempting to adequately represent the overall performance of the index. This may be due to various factors, such as the size of the index or the liquidity of the markets, which make it difficult or inefficient to own each individual security.
- Synthetic replication ETFs: synthetic replication ETFs are exchange-traded funds that seek to replicate the performance of a particular index or benchmark using derivatives, such as swap contracts, rather than physically owning all the securities included in the index. Instead of buying and holding all the underlying securities, synthetically replicating ETFs use an arrangement with a counterparty, usually a bank or other financial institution, to exchange the index returns for an interest rate or other series of cash flows.

The type of replication should be considered by ETF investors, since it, like other factors, including the countries from which the securities that make up the ETF are drawn and the liquidity of the underlying securities, can greatly affect the costs incurred.

Physical replication funds, in fact, having to buy the component securities of the ETF, will be subject to much more frequent rebalancing transactions than synthetic replication ETFs, thus contracting more onerous management costs.
On the other hand, although costs are undoubtedly lower, synthetic replication ETFs are characterized by higher risk, as investors could lose their money if the counterparty fails to honour its contractual obligations. This risk is called "counterparty risk."
Table 2 summarizes the main pros and cons of the two different types of replication systems:

Table 2. Pros and Cons of physical and synthetic replication systems

	Physical replication	Synthetic replication
PROS	• More transparency • Easier to be understood	• Access to markets potentially inaccessible through physical replication • Lower costs
CONS	• Access to some specific markets may be limited • Higher costs	• Counterparty risk

Source: *Personal*

2.3 THE LIQUIDITY OF ETFs

A key characteristic of ETFs is their liquidity, referred to as the ease with which they can be bought and sold on the market. Liquidity is extremely important for investors, as it impacts their ability and willingness to execute operations efficiently at the price they desire.
Some of the several factors that play a crucial role in the determination of the ETFs' liquidity are:

- The volume of trades: ETFs with high trading volume are distinguished by their greater liquidity, as they offer a wide range of opportunities for investors to execute trades without incurring substantial price changes. In other words, greater trading activity on ETFs indicates the presence of a more dynamic and accessible market, allowing investors to buy or sell shares more easily and quickly. This liquid circulation of securities reduces the risk of price impact due to large transactions, improving the overall efficiency of the ETF market.

In addition, if trading volume is high, authorized participants will be more likely to maintain affordable spreads to ensure their ongoing profitability, benefiting the ETF's liquidity.

- Bid-ask spread: ETFs that offer a narrower bid-ask spread tend to have greater liquidity because investors can trade more efficiently and competitively.
- ETFs’ underlying composition: in cases where the composition of ETFs consists of highly liquid securities, Authorized Participants will be able to execute creation and redemption transactions more easily and dynamically, increasing the overall level of liquidity of the ETF.
- ETFs’ size: the larger the size of ETFs, the greater their liquidity, as they will be able to accommodate large buy or sell orders without causing excessive price fluctuations.
- Market volatility: periods of high market volatility can cause significant declines in ETF liquidity, as investors generally tend to be more conservative during more financially turbulent periods.
- The degree of competition among Authorized Participants: as ETFs become increasingly popular in the investment landscape, more and more APs tend to compete in the market. To keep their competitiveness and profitability high, APs must offer increasingly advantageous spreads to investors, who will tend to trade more often, thereby increasing the liquidity of ETFs.

As highlighted, the liquidity of Exchange-Traded Funds (ETFs) is influenced by several factors, including the trading volumes of the underlying securities. This concept is known as “implied liquidity[32]” and plays a significant role in determining the trading capacity of ETFs in the market.

Various research conducted on the U.S. financial market has identified an interesting phenomenon: equities that are more heavily represented within Exchange-Traded Funds

[32] https://www.etf.com

show a tendency to exhibit higher volatility than similar stocks that are not as widely held by such funds[33].

Indeed, the empirical evidence produced by these studies shows that, due to their accessibility for trading, Exchange-Traded Funds appear to attract a new wave of noise-investors[34], whose sudden surges in demand can transmit to the underlying securities. This triggers arbitrage activity that constantly occurs between ETFs and their underlying baskets.

The implications of these results are significant and suggest the possibility of an increase in the overconcentration of assets toward passive funds in the future. This could lead to an increase in the overall liquidity of the underlying securities, as passive funds tend to facilitate trading and market access.

However, there could also be an increase in the volatility of underlying securities, as the increased concentration of investments in ETFs could increase the risk of sudden and unexpected price movements of their component securities.

This dynamic seems to be closely related to the creation and redemption system and thus is common to all ETFs. However, due to their greater complexity, it is useful to delve more deeply into the issue of liquidity in Smart Beta ETFs.

2.4 THE COSTS OF TRADITIONAL ETFs vs ETFs SMART BETA

Smart Beta Exchange-Traded Funds, due to their more complex nature compared to traditional ETFs, may entail higher management costs and additional challenges related to liquidity.

Although higher fees may be linked to the use of more advanced indexing strategies and more sophisticated selection factors, the issue of liquidity can become critical for some categories of Smart Beta ETFs. For example, some studies[35] have shown how investment

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[33] Ben-David, Itzhak, Francesco Franzoni, and Rabih Moussawi. "Do ETFs Increase Volatility?" *The Journal of Finance* 73, no. 6 (2018): 2471–2535. http://www.jstor.org/stable/26656025.

[34] Traders who base their trading behaviour on emotions and feelings rather than on financial and economic fundamentals

[35] Feifei Li, Tzee-Man Chow, Alex Pickard, and Yadwinder Garg. "Transaction Costs of Factor-Investing Strategies", *Financial Analysists Journal* 75, no.2 (2019): 62-78. 10.1080/0015198X.2019.1567190

strategies based on the Smart Beta factor "Momentum" can cause transaction costs up to five times higher than those based on the "Quality" factor.

This circumstance is strongly linked to the more abrupt need to rebalance portfolios built based on the Momentum factor and the higher turnover of the securities in them, which can result in higher trading fees and lower overall liquidity of the ETF.

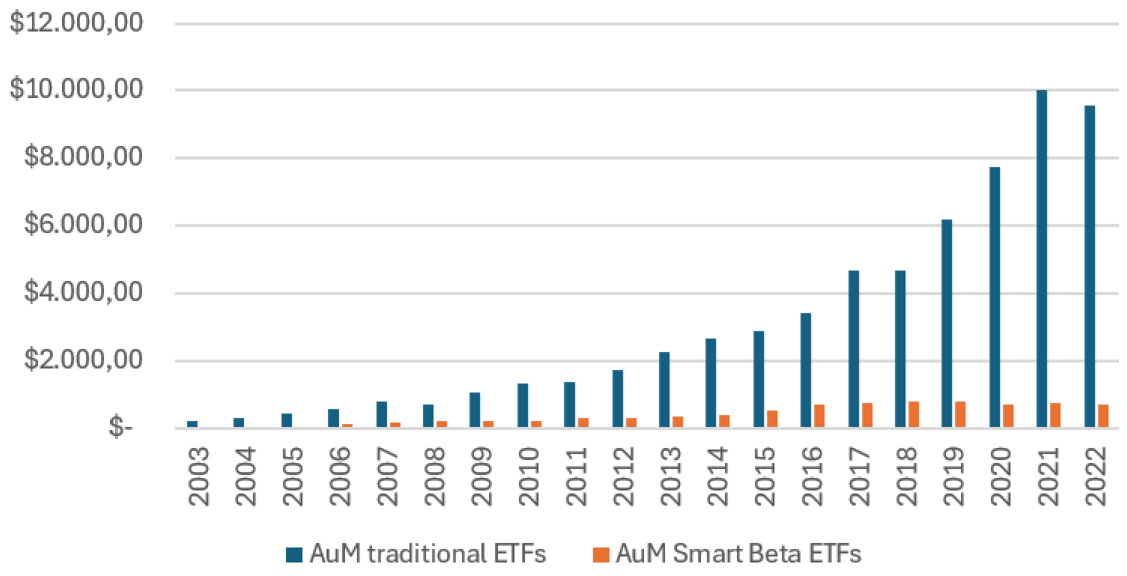
Some of the main differences between traditional ETFs and Smart Beta related to costs can be attributed to the following items:

- Management fees: traditional ETFs tend to have lower management fees than Smart Beta ETFs because they often follow a simple replication of a market index. Smart Beta ETFs, on the other hand, may require slightly higher management fees, as they often involve more active research and selection of securities within the portfolio.
- Transaction costs: Smart Beta ETFs may incur slightly higher transaction costs than traditional ETFs because they may involve more frequent portfolio rotation or rebalancing transactions to maintain consistent exposure to the investment strategy.
- Spread bid-ask: this indicator takes effect only when the investor decides to buy or sell shares of the ETF of interest. This indicator varies constantly over the course of trading days, however, taking on significantly higher values during periods of increased volatility. Smart Beta ETFs tend to have higher bid-ask spreads than traditional ETFs because the complexity of the investment strategy affects the liquidity and tradability of their shares.
- Index replication costs: traditional ETFs tend to replicate a market index passively, which results in relatively low replication costs. Smart Beta ETFs, on the other hand, may use more active or complex investment strategies to track a specific index or strategy, which could result in higher replication costs.
- Variation in AuM: As empirical evidence suggests[36], there is an indirect relationship between the amount of assets under management managed by a fund

[36] Mehmet, Saæglam, Tuzun, and Wermers. "Do ETFs increase liquidity?" *CFR Working Papers 21-03*, University of Cologne, Centre for Financial Research (CFR), (2021).

and the amount of transaction costs incurred by investors investing in that fund. Despite the growing popularity of Smart Beta ETFs, they still manage a smaller amount of assets than traditional ETFs, as shown in Figure 12.

Figure 12. Traditional and Smart Beta ETFs' AuM comparison



Source: *Personal*

However, should the trend in the Smart Beta direction continue over the next few years, it is possible that the discrepancy between the liquidity risk of traditional ETFs and Smart Beta may taper off until it disappears.

Nowadays, however, although Smart Beta ETFs offer investors the opportunity to access more sophisticated and targeted investment strategies, it is important to carefully evaluate the costs and potential liquidity impacts before investing in such products.

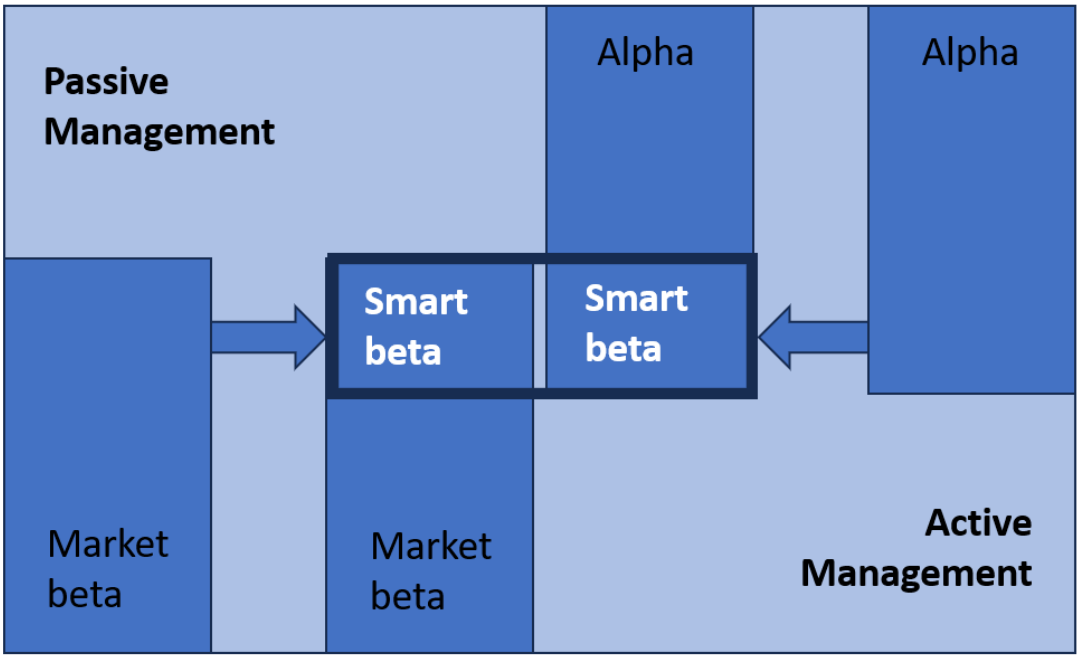
2.5 MANAGING SMART BETA ETFs

Smart Beta Exchange-Traded Funds represent an interesting middle ground between active and passive management in the investment environment. These financial products are distinguished by their ability to offer investors a diversified approach that draws on the advantages of both extremes of investment management.

While Smart Beta ETFs do not adopt traditional active management, they differ significantly from passive ETFs in the way they compose their portfolios. Rather than simply replicating a market capitalization-weighted index, Smart Beta ETFs follow stock selection methodologies based on specific factors. These factors are Size, Value, Quality, Momentum and Low Volatility.

As shown in Figure 13, this “smart” stock selection aims to achieve superior returns or improved diversification relative to the benchmark index by capturing some of the Jensen’s alpha[37] sought by active managers, but without requiring the same management activity associated with active investments and maintaining the ETFs’ benefits.

Figure 13. Smart Beta between active and passive management



Source: *Personal*

To sum up, Smart Beta ETFs offer investors the opportunity to adopt a more dynamic investment strategy than traditional passive ETFs. This approach offers the potential for increased returns while avoiding the complexities and uncertainties typically associated with active management.

As a result, Smart Beta ETFs offer investors an opportunity to participate in a more dynamic investment approach than traditional passive ETFs, but without the burdens and risks associated with active management.

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[37] Gupta, Pranay., Skallsjo, Sven R.., Li, Bing. Multi-Asset Investing: A Practitioner's Framework. United Kingdom: Wiley, (2016).

2.5. THE SMART BETA FACTORS

2.5.1. SIZE

This factor takes shape based on the three-factor model developed by economists Fama and French in 1992 and considers how the size of the firm under consideration may affect the return generated by investing in that firm. Specifically, the size factor is based on the asset pricing anomaly known as the "small firm effect." Observation of this anomaly finds that, during the period from 1963 to 1990, not only did stocks with low betas outperformed stocks with higher betas, but also stocks of smaller firms from a capitalization standpoint significantly outperformed higher capitalization firms.
Table 3 highlights these results.

Table 3. Stock percentage returns based on betas and capitalization (1963-1990)

	All firms	Low betas	High betas
All firms	15.0	16.1	13.7
Small cap firms	18.2	20.5	17.7
Large cap firms	10.7	12.1	6.7

Source: *Personal*

In addition, the study shows that, over the time span considered, stocks of small-cap companies provide higher returns than large-cap companies given the same level of risk. The magnitude of these differences in returns is 1.01% per month.
The discrepancy between low-capitalization and high-capitalization stocks became particularly evident during the period between 1975 and 1983. Some of the reasons for this differential increase in the size premium are traced to fewer restrictions on institutional investors who wished to invest in small-cap stocks and to a shift in investors' sentiment[38] toward small stocks.
An interpretation based on Sharpe's model, assumes greater exposure to market risk by small-cap stocks. However, this hypothesis was disproved in a study[39] dating back to 1995

[38] The overall attitude that investors have toward a particular market, asset, or investment strategy. It includes factors such as optimism, pessimism, confidence, fear, and risk aversion, which may influence decisions to buy, sell, or hold investments in a certain period.

in which Berk debunked any possible inverse relationship between firm size and the market risk to which it is exposed. His studies, however, confirmed the significant improvement in predictive accuracy of traditional asset pricing models following the inclusion of the Size factor in them.

Further studies[40] trace the size premium to a higher liquidity risk of smaller capitalization stocks. The latter motivation seems to be particularly effective considering the consequences of increased institutional ownership in small stocks after 1983. Institutional investors, in fact, once they had noticed the small firm effect, began to invest more heavily in small-cap companies in search of higher returns, increasing their liquidity while at the same time mitigating their returns.

It is therefore useful to examine whether ETFs that follow the Size factor have generated profits in recent years, considering the exposure to liquidity and volatility risks typical of mid- and small-cap companies.

2.5.2. VALUE

The Value factor also takes shape based on the three-factor model developed by Fama and French in 1992 on the basis that their studies confirmed that, in some time periods, value stocks outperform growth stocks with the same level of risk.

Under this perspective, value stocks are defined as stocks of firms with cyclical and traditional businesses with low prospects for earnings growth comprising so-called "old economy stocks[41]."

On the other hand, growth stocks are defined as stocks of companies that generate substantial cash flows and whose cash flows are expected to grow faster than those of

[39] Berk, Jonathan B. “A Critique of Size-Related Anomalies. “*The Review of Financial Studies”* 8, no. 2 (1995): 275–86. http://www.jstor.org/stable/2962273.

[40] Crain, Michael A., “A Literature Review of the Size Effect” (October 29, 2011). Available at SSRN: https://ssrn.com/abstract=1710076

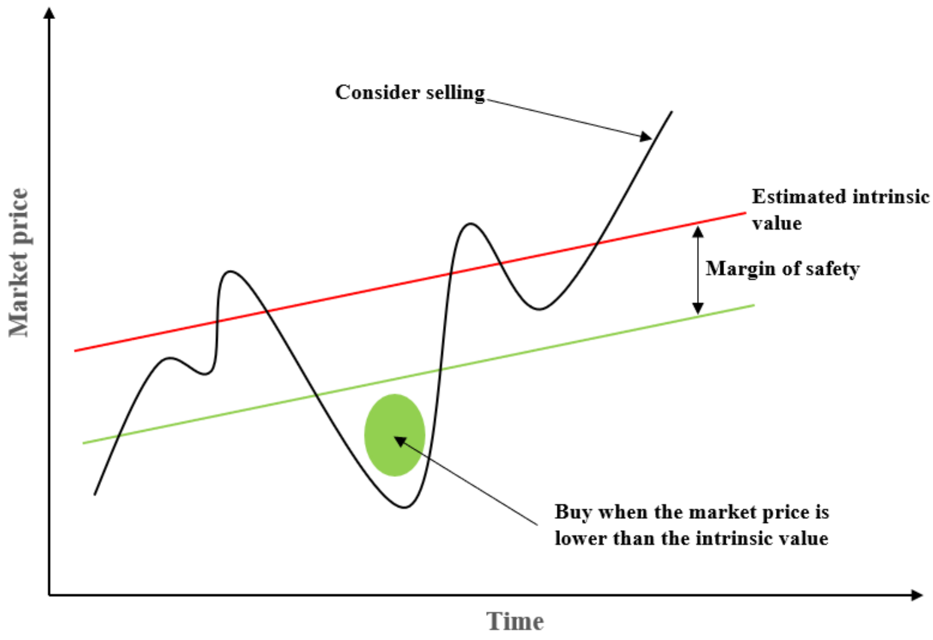
[41] Stocks of publicly traded companies that operate primarily in traditional and established sectors of the economy. These sectors tend to be less affected by technological innovations and rapid growth and are often characterized by greater stability and maturity.

competitors. Examples of growth stocks include "new economy stocks[42]" and “glamour stocks[43]”.

The concept behind value investing is rather straightforward: with some financial metrics, the value investor seeks to understand the intrinsic value of the company. Should the intrinsic value of the stock be higher than its market price, the investor will proceed to purchase the stock.

Figure 14 illustrates the process.

Figure 14. Value investing process



Source: *Personal*

Some of the most widely used methods of estimating intrinsic value are:

- P/E (price-to-earnings) ratio: this ratio compares the market value of a share with the earnings per share of the company. A lower P/E ratio relative to the market or sector may be considered more attractive to value investors.

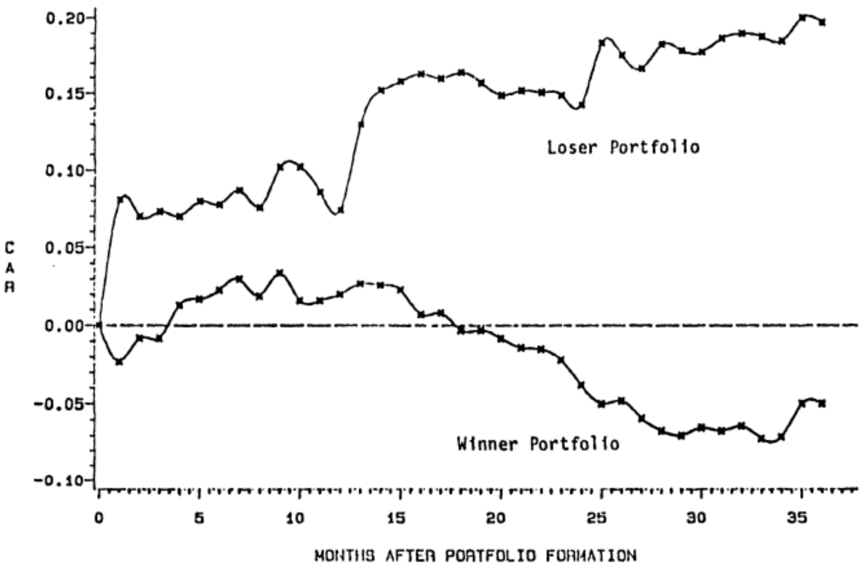
[42] Stocks of publicly traded companies operating primarily in sectors associated with the new digital and technology economy.

[43] Stocks of publicly traded companies that are considered attractive or glamorous to investors because of their characteristics of high growth and outstanding market performance.

- P/B (price-to-book value) ratio: this ratio compares the market price of a stock with its book value per share. Ideally, a value stock should have a P/B ratio of less than 1. However, to understand the meaning of this ratio, it is useful to always compare the reference stock with the industry of which it is a part.
- Free cash flow: estimating free cash flow is extremely useful to understand the intrinsic value of the company, as it reflects the company's ability to generate positive cash flows over the long term, assesses the sustainability of dividends, analyses reinvestment capabilities, and provides crucial information on the company's potential risk of insolvency.

Underlying the principle of value investing is a strong belief related to the fact that financial markets are inefficient. This belief is based on the principle of behavioural finance that investors tend to overreact to information events, leading prices to deviate significantly from their intrinsic value. A luminary study by scholars De Bondt and Thaler dating back to 1985 shows that, following an extremely negative information announcement, the most losing stocks achieved a greater return than stocks less affected by the news by about 25% in the three years following the announcement.
Figure 15 depicts this discrepancy.

Figure 15. Past losers vs. past winners post negative information event



Source: *W. F. M. De Bondt, R. Thaler, 1985.*

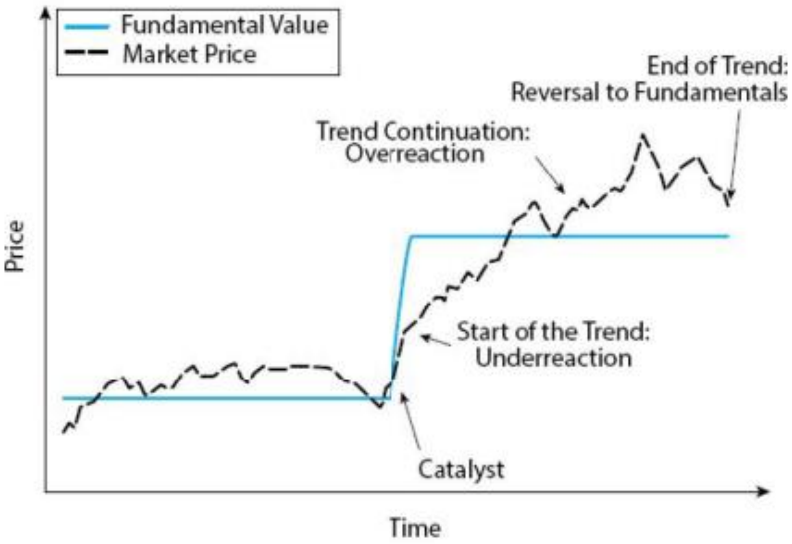
The study thus demonstrates how fluctuations in financial markets, often caused by factors beyond corporate control, can favour value strategies and turn into great profit opportunities for their respective investors.

However, given the poor performance of Value strategies in recent years and the current appeal of technology companies globally, many investors wonder whether value investing is now obsolete. Recent research[44] has dispelled these concerns, showing that companies' annual performance forecasts have been in line with fundamental analysis. What requires improvement is the selection of indicators, which need to be updated to better reflect the current time and information environment.

2.5.3. MOMENTUM

The momentum factor is based on the idea that financial assets that have performed well in the recent period starting from a catalyst event will tend, in the short-term future, to perform better than stocks that have performed worse in the recent past. This phenomenon was confirmed only in the short term and in the case of the market being a "bull" market, as evidenced by Figure 16.

Figure 16. The momentum effect



Source: *N. Jeegadesh, S.Titman, 1993*

[44] Greenwald, Bruce C., Judd Kahn, Paul D. Sonkin, Michael van Biema, and Tano Santos. Value Investing: From Graham to Buffett and Beyond. *New York: John Wiley & Sons*, (2020).

Evidence of this phenomenon was provided by scholars Jeegadesh and Titman[45], who conducted an experiment consisting of dividing stocks that were part of the NYSE into deciles, based on the performance achieved over the previous six months.
The conclusion was that the best performers significantly outperformed the worst performers over the next six months of about 12%.

2.5.4. QUALITY

The quality factor refers to key characteristics that identify companies with high financial quality.
These characteristics include:

- Profitability: solid corporate profitability, as indicated by sustained profit margins, returns on invested capital, and positive cash flows.
- Financial solidity: low leverage, high liquidity, and ability to generate consistent cash flows.
- Stable growth: steady revenue and profit growth over time.
- Management efficiency: operational efficiency and ability to maintain high quality standards in products and services offered.

Contrary to how it might initially appear, there are significant differences that distinguish a good company in terms of "value" and a good company in terms of "quality." Specifically, while the value factor focuses on buying stocks considered undervalued by the market in relation to their intrinsic value, the quality factor focuses on buying stocks of companies with sound financial fundamentals and efficient management. The quality factor, in essence, could recommend buying stocks of companies overvalued by the market as well, if they demonstrate compliance with the quality metrics listed above.
Usually, these criteria are met by extremely established companies over time. Consequently, choosing to invest in established companies implies that during recessionary periods they may hold up better than smaller companies or those that have experienced rapid price increases.
This is due to their financial strength and efficient management, which tend to protect them during periods of economic turbulence.

[45] Jegadeesh and Titman. "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency." *The Journal of Finance* 48, no. 1 (1993): 65-91. https://doi.org/10.1093/rfs/15.1.143

However, it is important to note that some research, such as that conducted by Fama and French in 2007, has shown that investments based on the quality strategy historically have produced lower average returns than other strategies[46].

This suggests that investing in funds with quality-oriented strategies may be better suited for portfolios geared toward capital preservation or during periods of recession but may be less profitable during periods of economic expansion.

In sum, while quality-based investments may offer greater security during downturns in the business cycle, they may be less profitable during phases of economic growth.

2.5.5. LOW VOLATILITY

The Low or Minimum Volatility type strategy is based on risk-adjusted indices, which consider the volatility and correlation between stocks in the portfolio. This method has become known for the so-called Risk-Return Paradox, which negates the necessary inverse correlation between risk and return of an investment.

This paradox was formulated in 1972 by scholar Robert Haugen, who authored numerous publications to promote what he termed the "hidden factor." He refers to this factor as the capacity of some portfolios to achieve returns equivalent to the market portfolio, but with a lower level of risk, expressed through its variance.

His studies show that the Sharpe ratio of low volatility stocks is not only greater than that of other stocks, but significantly surpasses that of stocks with higher volatility[47].

The roots of the low-volume anomaly have been thoroughly explored and add to its surprising character, essentially because they are mainly based on human cognitive biases. Basically, low-volatility stocks are often overlooked because they are found to be unpopular; statistically, positive surprises are more often observed among little-followed stocks than among those that are better known and visible. From a behavioural point of view, the preference for the latter can be explained by investors' overconfidence, tendency to overestimate their own capabilities, and representativeness bias.

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[46] E. F. Fama and K. R. French. "The Anatomy of Value and Growth Stock Returns." *Financial Analysts Journal* 63, no. 6 (2007): 44-54. https://doi.org/10.2469/faj.v63.n6.4926

[47] Haugen, R. A., & Heins, A. J. “On the evidence supporting the existence of risk premiums in the capital market”. (1972) *Available at SSRN 1783797*.

Moreover, the low-volume phenomenon is obscured by the structure of the asset management industry, which prioritizes market capitalization indexes as benchmarks. Most investors and asset managers focus on outperforming the returns of a benchmark index, usually a market capitalization-weighted index of a specific geographic area and within a short time frame.

As a result, they are often more interested in generating superior relative returns[48] rather than carefully considering absolute returns and their Sharpe ratio. This dynamic contributes to the low volume anomaly because, when compared to market capitalization indices, investors and asset managers have an incentive to prefer riskier securities and avoid less risky ones.

[48] Relative return is measured through the Information Ratio.

CHAPTER 3. DATA AND METHODOLOGY

3.1 RATIONALE OF THE EXPERIMENT

This chapter outlines the rationale for conducting the experiment, providing an overview of the main criticisms of Smart Beta ETFs, and illustrating the methodological framework adopted to address these issues.

It will also analyse the choice of examining two distinct time periods, one characterized by stability and the other by geopolitical crisis, and how these were compared with the Benchmark MSCI World Index through different financial indicators for comparison. Finally, the issue of liquidity will be addressed, focusing on the comparison of bid-ask spreads versus assets under management (AuM) of selected passive funds, examining any correlations with returns, and assessing the implication of growth in assets under management on the reduction of transaction costs.

Before proceeding with the description of the experiment, it is essential to examine the main criticisms of Smart Beta ETFs.

Some of the most common criticisms include:

- Absence of advantages over traditional ETFs[49]: some scholars question the effectiveness of using Smart Beta factors, questioning the ability of such instruments to outperform traditional ETFs in the long run.
- The risk of over fitting[50]: the risk of overfitting refers to the possibility that the stock selection strategy used to construct the ETF has been overfitted to historical data, without considering the robustness of the strategy in future market environments.
- The cyclicality of factors[51]: this critique points out that under the assumption of factor cyclicality, Smart Beta ETFs will certainly have periods of underperformance relative to other financial instruments.

The objective of the proposed performance analysis is to evaluate the performance of five Smart Beta ETFs and one traditional ETF over two time periods to identify the most

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49 Malkiel, Burton G. "Is Smart Beta Really Smart?" The Journal of Portfolio Management 40 (2014): 127-134.

50 Suhonen, Antti, Marko Lennkh, and Fabrizio Perez. "Quantifying Back Test Overfitting in Alternative Beta Strategies." (2017). Available at SSRN: https://ssrn.com/abstract=3025530

51 Carson, B., S. Shores, and N. Nefouse. "Life-Cycle Investing and Smart Beta Strategies." The Journal of Retirement 5, no. 2 (2017): 66-82.

effective strategies during these time periods. Given the importance of understanding the behaviour of Smart Beta ETFs in different market contexts, it was decided to analyse two separate periods: one from 01/01/2015 to 31/12/2019 and one from 01/01/2022 to 31/12/2023.
The outbreak of the War in Ukraine is indeed a geopolitical and macroeconomic event of global significance, therefore, the selection of the above two periods of analysis aims to highlight the differences in performance of ETFs in a period of relative geopolitical stability (period 01/01/2015 to 31/12/2019) and crisis (period 01/01/2022 to 31/12/2023).
To evaluate the performance of the Smart Beta ETFs, five of them were compared to the MSCI World Index Benchmark. This benchmark represents a broad cross-section of the global stock market and provides a meaningful benchmark for evaluating the performance of the instruments considered.
The analysis is carried out first for the period of economic stability and then for the period of crisis. It involves an initial graphical comparison of the performance trend of financial products and a subsequent comparison through relevant KPIs.
Finally, special attention was paid to the liquidity of Smart Beta ETFs and their associated transaction costs. The relationship between bid-ask spreads and assets under management of selected passive funds was analysed to better understand their impact on returns. In addition, the relationship between growth in assets under management and reduction in transaction costs was examined to assess whether an increase in AuM would lead to a decrease in operating costs for investors.

3.2 MSCI INDEXES

Below, the indices on which the ETFs analysed are based in terms of performance and liquidity will be exposed. The choice fell on MSCI indices.
MSCI, an acronym for Morgan Stanley Capital International is an American company founded in 1986 that focuses on giving insights at the analytical level regarding portfolio risk, performance trends, and corporate governance tools to institutional investors and investment funds.
Certainly, what MSCI is best known for are its equity indices, which are differentiated by capitalization and geography and form the basis for numerous ETFs. In total, MSCO offers and provides data for more than 160,000 indexes.

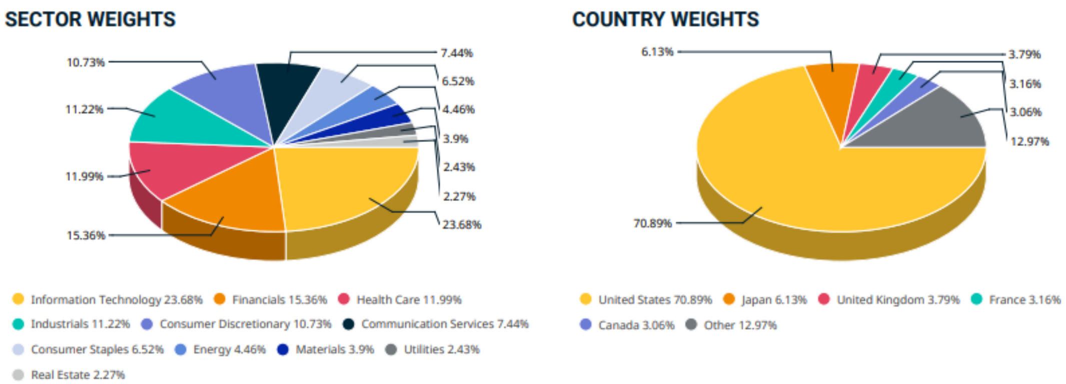
The information and data referred to in the following paragraphs are taken from MSCI's documents updated as of March 2024.

3.2.1 MSCI WORLD INDEX

The MSCI World Index comprehensively represents large and mid-cap stocks from 23 Developed Markets nations. Including, as reported by MSCI's latest update dating back to March 2024, 1,465 components, the index comprises about 85% of each country's free float-adjusted market capitalization.

The MSCI World Index, of which Figure 17 shows the composition by sector and geographical area, is used as a yardstick for the factorial indices belonging to the World category.

Figure 17. Sectoral and geographical composition of the MSCI World index



Source: *www.msci.com*

As can be seen from the graphs shown, the predominant sector within the index proves to be Information Technology[52], with a weight of 23.68%. The three companies Microsoft, Apple, and Nvidia turn out to be the three largest companies in this sector, obtaining, respectively, a weight of 4.57%, 3.88%, and 3.44% compared to the entire index.

As for the second largest sector included in the index, namely the Financials[53] sector, a remarkable 0.89% captured by JP Morgan Chase & Co. is evident.

[52] This industry includes companies producing software, hardware, and semiconductor equipment.

[53] This industry includes that provide financial services to commercial and retail customers. The Financial industry includes banks, insurance companies and investment companies.

Finally, Amazon dominates the Consumer Discretionary[54] sector with a relative weight to the entire index of 2.58 %.

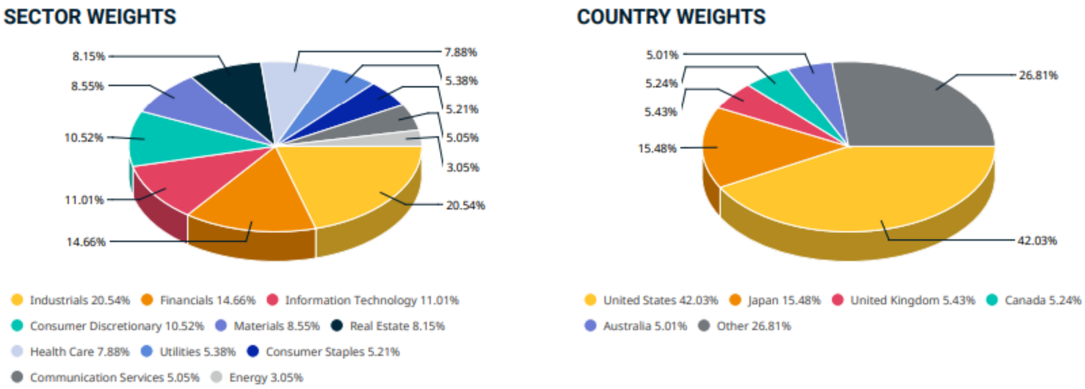
In terms of the geographical distribution of stocks, however, there is an extreme skew toward U.S. companies, constituting 70.89% of the index's weight. To a much lesser extent, the index weight is distributed over Japanese (6.13%), English (3.79%), French (3.16%), Canadian (3.06%), and other States (12.97%) companies.

3.2.2 MSCI WORLD MID CAP EQUAL WEIGHTED INDEX

The MSCI World Mid Cap Equal Weighted Index is a subset of the MSCI World Index, from which it takes only mid-cap stocks. As the name of the index suggests, it is not based on the market capitalization weighting principle, like the MSCI World Index, but on the equal-weighted principle, which requires that, semi-annually, the weights of the component securities are equally rebalanced to mitigate discrepancies related to the rise or fall in price of the securities in the basket.

Figure 18 shows the composition of the index by sector and geographic area.

Figure 18. Sectoral and geographical composition of the MSCI World Mid Cap Equal Weighted Index



Source: *www.msci.com*

The first aspect that jumps out at the eye when examining the sectoral composition of the index is certainly the non-primacy of the Information Technology sector, which occupies

[54] This industry includes companies providing goods and services that are not necessarily essential but rather desirable if buyers have enough income to purchase them.

only 11.01% of the index's total weight here, less than half of what it occupied in the MSCI World index. This consideration is symptomatic of the considerable power held by tech giants such as Microsoft, Apple, and Google nowadays. In the case of the MSCI World Mid Cap Equal Weighted Index, the dominant sector appears to be Industrials[55], with a weight of 20.54%, followed by the financial sector, which occupies 14.66% of the total weight. In general, a more homogeneous sector distribution is evident compared to the MSCI World Index. The same statement can be made regarding the geographic distribution of the companies that are part of the index, where the weight occupied by U.S. companies falls by about 30% compared to the MSCI World index in favour of other countries, first and foremost Japan with 15.48%. Figure 19 shows a comparison of the net performance of the MSCI World Mid Cap Equal Weighted and MSCI World indexes over the period from March 2009 to 2024.

Figure 19. USD graphical comparison (net) between MSCI World Index and MSCI World Mid Cap Equal Weighted Index (March 2009-March 2024)

Source: *www.msci.com*

As shown in Figure 19, the performance of the two indices appears to be strongly aligned during the period between the years 2009 and 2019, with the MSCI World Mid Cap Equal Weighted Index often slightly above its benchmark. Starting from 2020, in addition to a general negative effect of the Covid-19 pandemic on the returns of both indices, there is an incremental gap between the two returns, the discrepancy of which increases

[55] This industry includes companies manufacturing goods like machineries, chemicals, and constructions.

consistently until March 2024 in favour of the MSCI World index. The reason underlying this over-performance can be traced to the geographic composition of the two indices: due to the strong performance of U.S. companies in recent years and the greater presence of U.S. stocks in the MSCI World index, it is possible that the latter has achieved higher returns than the MSCI World Mid Cap Equal Weighted Index.

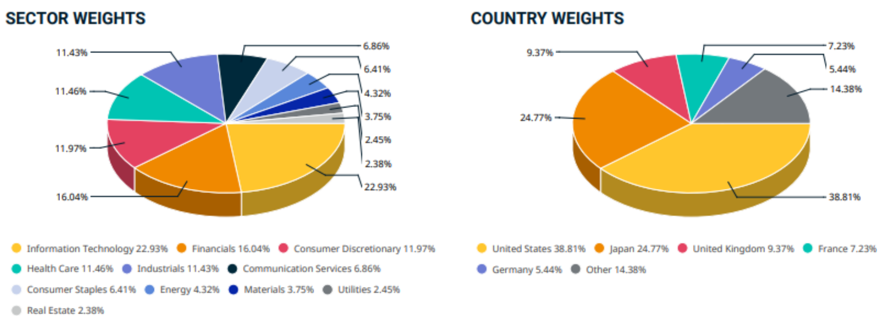
3.2.3 MSCI WORLD ENHANCED VALUE INDEX

The MSCI World Mid Cap Equal Weighted index is a subset of the MSCI World index, from which it takes only stocks of companies evaluated according to the values of three ratios:

- Price-to-book value[56]
- Price-to-forward earnings: this ratio is computed by dividing the current market price per share by the estimated Earnings per Share for a future period, usually one year. A low price-to-forward earnings ratio suggests that the stock might be undervalued and that there might be an opportunity for a value investment.
- Enterprise value-to-cash flow from operations: this ratio is computed by dividing the enterprise value (market capitalization plus total debt minus cash and cash equivalents) by the cash flow from operations. A low enterprise value-to-cash flow from operations suggests that the stock under consideration may be undervalued and that there may be an opportunity for a value investment.

Figure 20 shows the sectoral and geographical composition of the index.

Figure 20. Sectoral and geographical composition of the MSCI World Enhanced Value Index



Source: *www.msci.com*

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[56] Please, see Paragraph 2.5.2

Comparing this index with the benchmark from a sectoral point of view, there are no remarkable differences.

More interesting, however, is the comparison from the geographical point of view, where a clear thinning can be seen between the weight captured by U.S. companies (38.81%) and Japanese companies (24.77%). Among the Japanese companies most present within the index it is worth mentioning Toyota, with a weight of 2.19%, which is classically in the third position by capitalization within the index, preceded only by the two American IT companies Intel (3.33%) and Cisco (2.74%). Figure 21 shows a comparison of the net performance of the MSCI World Enhanced Value and MSCI World indexes over the period from March 2009 to 2024.

Figure 21. USD graphical comparison (net) between MSCI World Index and MSCI World Enhanced Value Index (March 2009-March 2024)

Source: *www.msci.com*

Again, as in the previous comparison between MSCI World Index and MSCI World Mid Cap Equal Weighted Index the lower presence of U.S. companies within the index may have caused, in recent years, the performance discrepancy highlighted by Figure 21 since the outbreak of the pandemic. In both cases, up to that time, both indexes were often found to outperform the benchmark, without, however, deviating too much from its performance.

In both cases, moreover, the outbreak of the armed war in Ukraine, which is traced back to February 2022, caused the performance of all indices to drop.

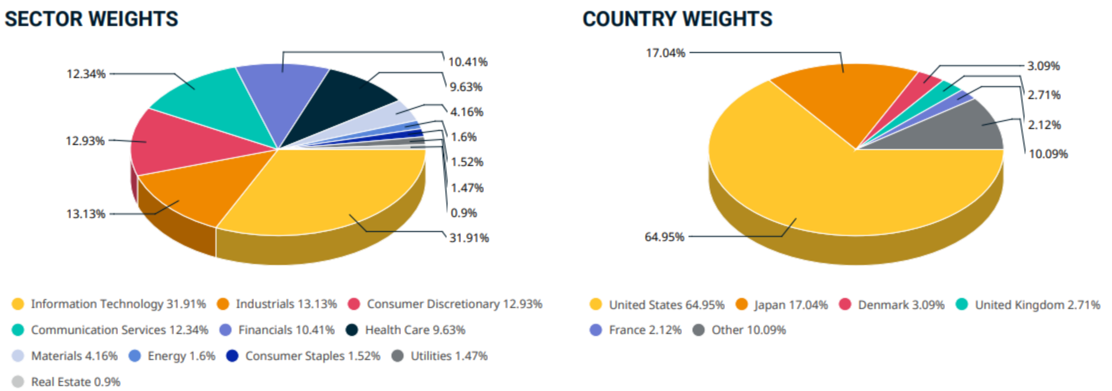
Finally, it is interesting to note that in both cases analysed so far, the MSCI World index was least affected by both the effects of the pandemic outbreak and the outbreak of the war in Ukraine.

3.2.4 MSCI WORLD MOMENTUM INDEX

The MSCI World Mid Cap Equal Weighted index is a subset of the MSCI World index, from which it takes only stocks of companies that are having a high degree of Price momentum. At the same time, the index aims to maintain a high level of trading liquidity, investment capacity[57], and a moderate level of stock turnover.

Figure 22 shows the sector and geographic composition of the index.

Figure 22. Sectoral and geographical composition of the MSCI World Momentum Index



Source: *www.msci.com*

Analysing the sectoral distribution of the index, one can see an even stronger skew toward the Information Technology sector than the benchmark (31.91% versus a 23.68%).

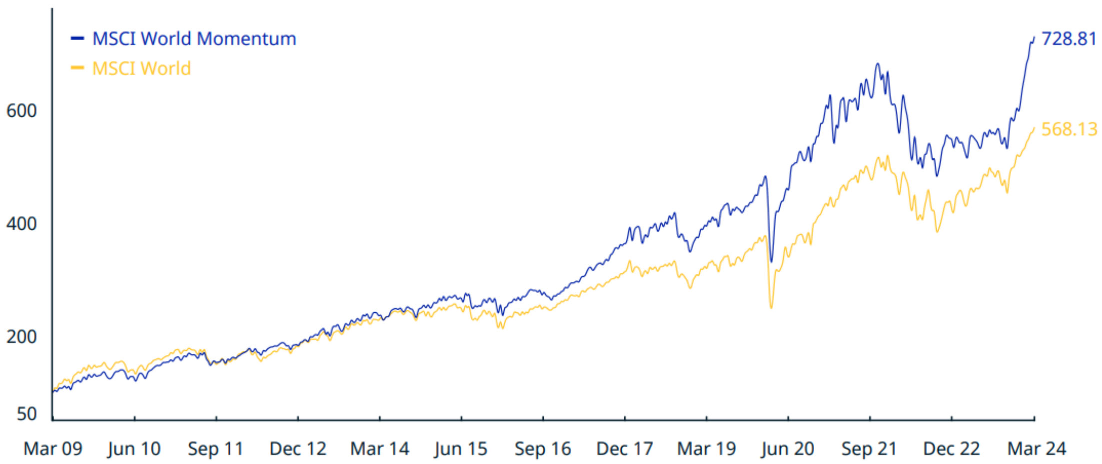
Also noteworthy is a moderate reduction in the Financials category within the MSCI World Momentum Index compared to the benchmark (10.41% versus a 15.36%) and a significant increase in the weight occupied by stocks related to companies active in the

[57] It refers to the ability of the index to accommodate investment flows without significantly impacting its performance or composition.

Communication Services sector within the index based on the Momentum factor compared to the benchmark (12.34% versus a 7.44%).

The increase in the weights allocated to the Information Technology and Communication Services sectors can certainly be attributed to the growing popularity of AI, which is now highly prevalent in the communication sector due to its "generative" ability to create digital advertising products in an innovative and competitive way. For the IT sector, the U.S. company Nvidia wins the top weighting with a weight of 7.24%, while for the Communication Services[58] sector the U.S. company Meta stands out with a weight of 5.77%. The Industrials (13.13 %), Consumer Discretionary (12.93%) and Health Care (9.63%) categories deviated relatively less from the benchmark. Figure 23 shows a comparison of the net performance of the MSCI World Momentum and MSCI World indexes over the period from March 2009 to 2024.

Figure 23. USD graphical comparison (net) between MSCI World Index and MSCI World Momentum Index (March 2009-March 2024)



Source: *www.msci.com*

As evidenced in Figure 23, there is a clear graphical gap between the two indices, especially over the past eight years, with the MSCI World Momentum Index coming out on top. This trend has also manifested itself during recent periods of turbulence, such as the Covid-19 pandemic-related crisis and the escalation of conflicts in Ukraine.

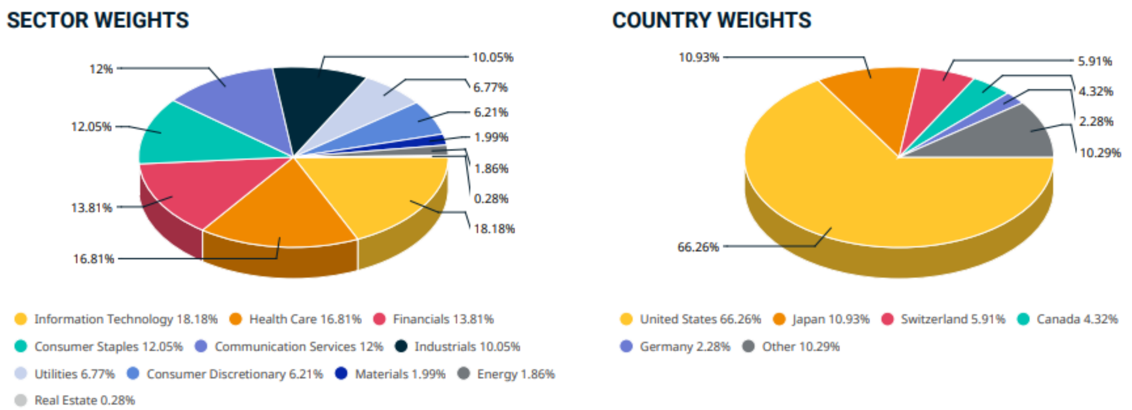
[58] This industry includes companies providing advertising and marketing services, fixed-line networks, wireless access and services and entertainment contents and services.

Also noteworthy is a marked spike in the Momentum Index, attributable, among other reasons, to the extraordinary performance of the Nvidia company, which recorded a remarkable 82.5 % increase in its market value in the first quarter of 2024 alone and Meta, which recorded a 50.5% increase in its market price during the same period.

3.2.5 MSCI WORLD MINUMUM VOLATILITY INDEX

The MSCI World Minimum Volatility index is a subset of the MSCI World index, from which it takes only stocks of companies that showed the lowest absolute level of risk in terms of standard deviation under some specific risk-adjusted constraints, to keep the level of return in line with that of the benchmark. Figure 24 shows the sector and geographic composition of the index.

Figure 24. Sectoral and geographical composition of the MSCI World Minimum Volatility Index



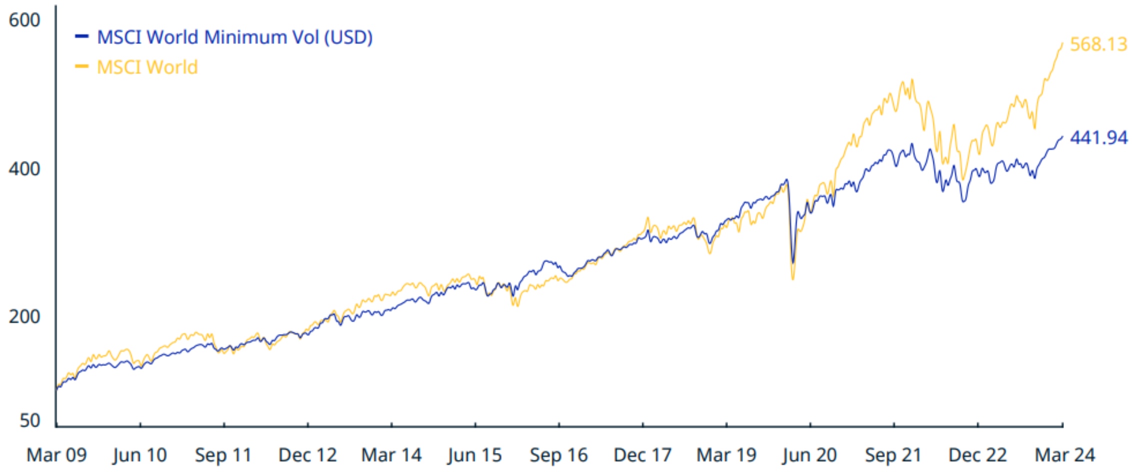
Source: *www.msci.com*

As can be seen by analysing its sector composition, The MSCI World Minimum Volatility Index is the index in which the weight allocated to the Information Technology sector is smallest (18.18%).

The weight allocated to the Energy sector is also sharply trimmed compared to the benchmark (1.86 % versus 4.46 %). The most important aspect to highlight when talking about sector distribution compared to the indices analysed so far is the strong inclusion of companies operating in Consumer Staples[59] industry (12.05% against a 6.52% of the benchmark).

In terms of the geographical distribution of securities, the United States secures most of the allocation, with a weight of 66.26%; it is followed by Japan with a weight of 10.93%. Switzerland and Canada secure third and fourth place with 5.91% and 4.32%, respectively, followed by Germany with a weight of 2.28%. Figure 25 shows a comparison of the net performance of the MSCI World Minimum Volatility and MSCI World indexes over the period from March 2009 to 2024.

Figure 25. USD graphical comparison (net) between MSCI World Index and MSCI World Minimum Volatility Index (March 2009-March 2024)



Source: *www.msci.com*

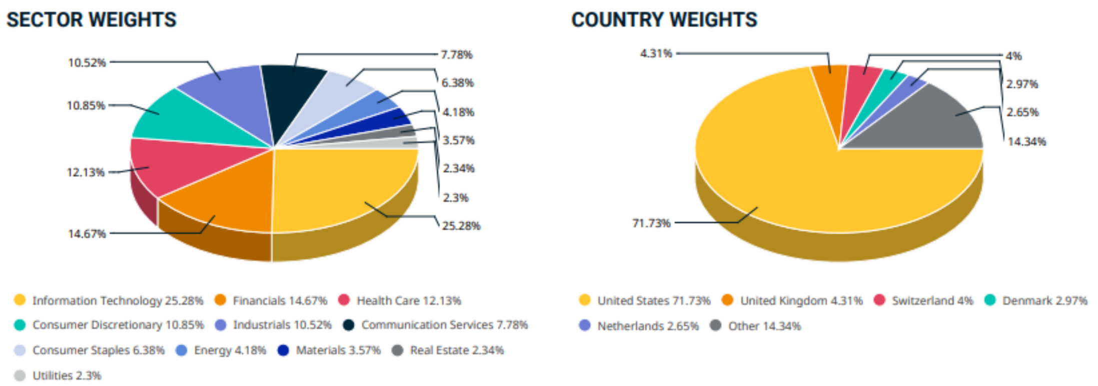
Analysing the graph, a strongly aligned trend is evident until the beginning of 2021. Thereafter, the benchmark index always remains above the graph of the index based on low volatility, even though the latter was less affected by the outbreak of war. Again, the outperformance of the benchmark is attributable to greater exposure to U.S. companies, especially those operating in the Information Technology sector.

[59] This industry includes companies providing essential products to consumers, like food, beverages, and other items that people primarily need to consume every day.

3.2.6 MSCI WORLD SECTOR NEUTRAL QUALITY INDEX

The MSCI World Minimum Volatility index is a subset of the MSCI World index, from which it takes only stocks of companies that showed high levels of Return on Equity[60], low earnings variability[61] throughout the years and low use of leverage[62]. Figure 26 shows the sector and geographic composition of the index.

Figure 26. Sectoral and geographical composition of the MSCI World Sector Neutral Quality Index



Source: *www.msci.com*

The sector-weighted distribution appears aligned with the sector distribution of the benchmark, thus confirming the Sector Neutral nature. The most significant discrepancy is in the IT sector, where the ETF outperforms the benchmark by 1.6 %.

In terms of geographic composition, there is a strong alignment in the weighting assigned to U.S. equities. Subsequent positions, however, show more pronounced variations from the benchmark index.

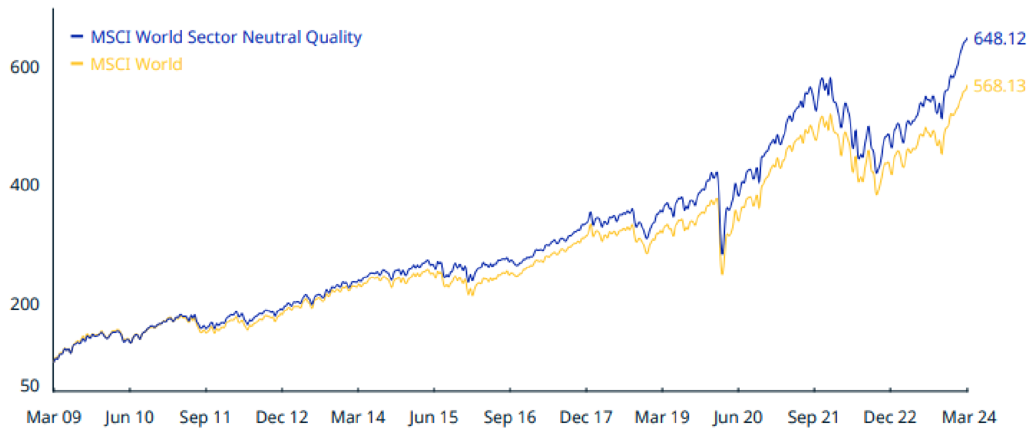
In fact, the U.S is followed by the UK at 4.31 %, rather than Japan. This is followed by Switzerland (4 %), Denmark (2.97%) and the Netherlands (2.65%). Figure 27 shows a comparison of the net performance of the MSCI World Sector Neutral Quality and MSCI World indexes over the period from March 2009 to 2024.

[60] Computed by dividing the net income by the total equity of the company.

[61] The stability of earnings distributed to investors.

[62] Use of debt to finance the company.

Figure 27. USD graphical comparison (net) between MSCI World Index and MSCI World Sector Neutral Quality Index (March 2009-March 2024)



Source: *www.msci.com*

As the chart points out, despite considerable slippage in conjunction with the Covid-19 pandemic and the outbreak of War, the MSCI World Sector Neutral Quality Index has always remained above the benchmark, with a discrepancy that, as of 2024 would appear to be expanding further.

3.3 CHOICE OF ETFs

The selection of the six ETFs subjected to subsequent performance and liquidity analyses centred on the iShares suite, a product line distributed and managed by BlackRock, a prominent global entity in asset management services.

The decision to opt for this suite was predicated on its larger scale relative to comparable products available in the market. This choice makes it possible to obtain and derive information that analysing smaller ETFs would not be possible to have, for the following reasons:

- Market representativeness: larger ETFs can serve as trend indicators for the entire ETF industry and for investing in general. Monitoring the performance of these ETFs can help investors identify market trends and adjust their investment strategies accordingly.
- Investors' sentiment indicators: the performance of larger ETFs can reflect investors' general sentiment toward the market. Monitoring the performance of

these ETFs can provide insights into investors' expectations and opinions about the economic and market outlook.

- Basis for proper benchmarking: larger ETFs often serve as benchmarks to compare the performance of other ETFs or investment portfolios. By analysing the performance of these ETFs, investors can assess whether other funds or investment strategies are outperforming or falling behind the benchmark market.

The Smart Beta ETFs under analysis are iShares Edge MSCI World Size Factor UCITS ETF, iShares Edge MSCI World Value Factor UCITS ETF, iShares Edge MSCI World Momentum Factor UCITS ETF, iShares Edge MSCI World Quality Factor UCITS ETF and iShares Edge MSCI World Minimum Volatility Factor UCITS ETF.

The traditional passive iShares Core MSCI World ICITS ETF is added as an additional object of analysis.

Table 4 shows the main characteristics of the selected ETFs:

Table 4. Selected ETFs' main features

ETF	ISIN	Replicated index	AuM ($M)	TER (%)
iShares Core MSCI World UCITS ETF	IE00B4L5Y983	MSCI World Index	66,822	0.20
iShares Edge MSCI World Size Factor UCITS ETF	IE00BP3QZD73	MSCI World Mid-Cap Equal Weighted Index	218.59	0.30
iShares Edge MSCI World Value Factor UCITS ETF	IE00BP3QZB59	MSCI World Enhanced Value Index	3,531	0.30
iShares Edge MSCI World Momentum Factor UCITS ETF	IE00BP3QZ825	MSCI World Momentum Index	1,845	0.30
iShares Edge MSCI World Minimum Volatility UCITS ETF	IE00B8FHGS14	MSCI World Minimum Volatility Index	2,288	0.30
iShares Edge MSCI World Quality Factor UCITS ETF	IE00BP3QZ601	MSCI World Sector Neutral Quality Index	3,378	0.30

Source: *www.justetf.com*

As can be seen from Table 4, the traditional ETF manages significantly more assets than the other Smart Beta ETFs.

Among the five Smart Beta ETFs, however, the most popular is the Value strategy-based ETF, an investment strategy that has been widely celebrated in part because of its use by financial luminaries such as Warren Buffet. It is followed by the iShares Edge MSCI World Quality Factor UCITS ETF and iShares Edge MSCI World Minimum Volatility UCITS ETF.

Occupying the last two positions are the Momentum-based ETF, probably because of its higher volatility than the others, and the Size-based Smart Beta.

3.3.1 ISHARES CORE MSCI WORLD UCITS ETF

The iShares Core MSCI World UCITS ETF was launched in 2009 and replicates the MSCI World index. It currently manages net assets of about $67 billion, with average annual management expenses of 0.20 % in terms of TER. The fund adopts a dividend accumulation policy and uses a physical replication methodology with optimized stock sampling, which means it does not necessarily hold all stocks in the index but only the most relevant components. Portfolio rebalancing occurs quarterly. The fund's risk profile, assigned by the manager, ranges from a minimum of 1 to a maximum of 7, and is currently rated at 6, indicating a high level of risk attributed to the fund.

3.3.2 ISHARES EDGE MSCI WORLD SIZE FACTOR UCITS ETF

The ETF, active since 2014 with current assets of about $220 million, replicates the MSCI World Mid-Cap Equally weighted index, which, as explained earlier, invests in mid-cap companies in developed markets. This selection partially diverges from the size-based strategy (Size), which instead focuses on investments in Small-Cap companies. This selection is motivated by the benefits of investing in companies that are not excessively small, leading to significant cost savings. The replication system remains of the optimized physical type, with dividend accumulation policy, a TER of 0.30%, and semi-annual portfolio rebalancing. In terms of risk, the company gives the fund a rating of 6, indicating it is a high-risk investment.

3.3.3 ISHARES EDGE MSCI WORLD VALUE FACTOR UCITS ETF

This ETF shares the same characteristics as the Size ETF: it adopts optimized physical replication, dividend accumulation policy, and semi-annual rebalancing, with a TER of 0.30%. Both funds were launched in October 2014, however, the Value Smart Beta ETF manages more than sixteen times the previous fund in terms of assets under management The risk profile attributed to this fund is ranked with a rating of 6.

3.3.4 ISHARES EDGE MSCI WORLD MOMENTUM FACTOR UCITS ETF

The Smart Beta ETF in question based on the MSCI World Momentum index shares many characteristics with the two Smart Beta ETFs pre-described above: with assets under management of about $1.8 billion, it adopts an optimized physical replication strategy, semi-annual rebalancing, a dividend accumulation policy, and a TER of 0.30%. Again, the risk rating is rated 6 out of 7.

3.3.5 ISHARES EDGE MSCI WORLD MINIMUM VOLATILITY UCITS ETF

This ETF replicates, as of the year 2012, the MSCI World Minimum Volatility index and has the following characteristics: optimized physical replication, semi-annual rebalancing, dividend accumulation policy, and a TER of 0.30 %. Currently, the fund's net assets amount to about $2.3 billion. Unlike other funds, the rating given to its risk profile is reduced to 5 out of 7.

3.3.6 ISHARES EDGE MSCI WORLD QUALITY FACTOR UCITS ETF

This ETF replicates, as of the year 2014, the MSCI World Sector Neutral index and has the following characteristics: optimized physical replication, semi-annual rebalancing, dividend accumulation policy, and a TER of 0.30 %. Currently, the fund's net assets amount to about $3.4 billion. The rating given to its risk profile is of 6 out of 7.

CHAPTER 4. PERFORMANCE ANALYSIS

4.1 PERFORMANCE ANALYSIS (01/01/2015- 31/12/2019)

4.1.1 RETURNS, VOLATILITY AND CORRELATION MATRIX

First, the returns and standard deviation of the ETFs under analysis were calculated. The annualized return of the ETFs was calculated by the following formula:

$$r_y = (\frac{P_t}{P_0})^{\frac{365}{t}} - 1$$

Where:

- P_0 is the hypothetical amount invested in the ETF at the beginning of the period.
- P_t is the value of the investment at the end of the holding period.
- t is the length in days of the period

The annualized volatility was calculated by the following formula:

$$\sigma_y = \sqrt{365} * \sqrt{\sum_{i=0}^{T} (r_i - r_y^{(\frac{365}{t})})^2}$$

Table 5 shows the returns and risk in terms of annualized volatility of the ETFs considered for the first period of analysis.

Table 5. ETFs' Annualized Risk and Return

ETF	σ(yy)	r(yy)
World	12,44%	10,74%
Size	12,79%	9,40%
Value	13,77%	8,00%
Momentum	12,92%	13,76%
M. Volatility	10,16%	11,40%
Quality	12,38%	11,80%

Source: *www.justetf.com*

As shown in Table 5, the ETF to demonstrate the highest annualized return is the Momentum factor-based ETF, with 13.76%. Only two other Smart Beta ETFs outperform

the traditional ETF: they are the iShares Edge MSCI World Minimum Volatility UCITS ETF and the iShares Edge MSCI World Quality Factor UCITS ETF, with a return of 11.40% and 11.80%, respectively, and a standard deviation of 10.16% and 12.38%, respectively.
The data for the ETF based on the Minimum Volatility factor are particularly interesting: in fact, it manages to achieve a 0.66 % higher return performance than the benchmark but at a lower volatility of 2.28%. Performing worse than the benchmark, on the other hand, in terms of volatility-adjusted return, are the Value and Size Smart Beta ETFs.
To understand how the performance of the examined funds are correlated during the period under consideration, correlation coefficients placed in the correlation matrix represented in Table 6 were calculated using the Data Analysis function of Excel. To calculate the correlation coefficients, the daily returns of the ETFs during the considered time frame were used as input data.

Table 6. Correlation matrix

	MSCI World	Size	Value	Momentum	M. Volatility	Quality
MSCI World	1,00					
Size	0,9659	1,00				
Value	0,9655	0,9984	1,00			
Momentum	0,9440	0,9206	0,9171	1,00		
M. Volatility	0,8990	0,8400	0,8174	0,8283	1,00	
Quality	0,9953	0,9551	0,9497	0,9498	0,9326	1,00

Source: *Personal*

From Table 6, the high degree of positive correlation linking the ETFs considered is evident. In fact, all values turn out to be very close to 1, a value that indicates a perfect positive correlation, which manifests on the diagonal of the correlation matrix.
The lowest values among the calculated correlations occur, as can be guessed, between the Minimum Volatility ETF and the Momentum ETF, given the almost antithetical nature of the two funds and the considerable difference in terms of standard deviation and between the Minimum Volatility and Value ETFs (0.8283 and 0.8174, respectively).
The highest value assumed by the correlation is present between the Size fund and the Value fund (0.9984), a characteristic attributable to the strong alignment of their respective stock selection strategies.

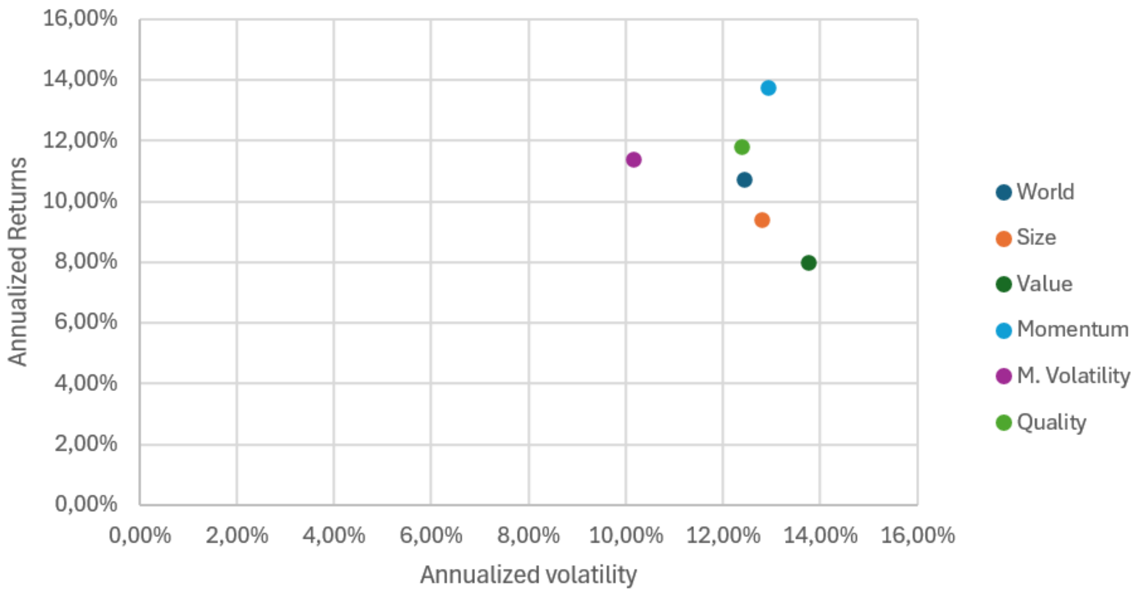
A strong correlation (0.9498) is also present between the Momentum and Quality ETFs, given the strong similarity in the sector and geographic composition of the two indices they replicate, both of which are highly shifted to the sector of U.S. companies operating in the technology sector.

As far as the benchmark is concerned, the highest affinity is with the Quality ETF (0.9953), while the lowest correlation is shared with the Minimum Volatility fund, which, due to its more different selection strategy than the others, proves to have, in general, the overall lowest correlation values.

4.1.2 EFFICIENT FRONTIER

Based on the concepts regarding stochastic dominance described in Section 1.1.1, Figure 28 depicts the risk and return of the various ETFs examined on the Cartesian plane to understand which securities offer a better combination of risk and return.

Figure 28. ETF on the Cartesian plane



Source: *Personal*

As can be seen from the Cartesian Plan, the Minimum Volatility ETF is in stochastic dominance over the traditional World ETF and the Value and Size Smart Betas as it demonstrates higher annualized return net of lower annualized volatility. On the other hand, the Momentum fund dominates stochastically over the Size and Value funds.

To determine the weighted allocation of portfolios that are part of the efficient frontier defined by Markowitz in Modern Portfolio Theory, the Excel solver was used, a tool for analysing, from an arbitrarily balanced initial portfolio, how portfolio risk and return ratios vary as the weighting changes.

From the minimum volatility expressed by the analysed ETFs, which correspond to that of the Minimum Volatility Smart Beta ETF, nine additional standard deviations were arbitrarily chosen.

The following constraints were also included within the weighting analysis:

- The weight allocated to each ETF cannot be lower than 0, a condition that implies that securities cannot be sold short.
- All available capital must be invested, a condition that implies an overall sum of allocated weights equal to 100 %.

Table 7 shows the results obtained by the solver:

Table 7. Optimal portfolio allocation

Standard deviation	Portfolio Return	World	Size	Value	Momentum	M.volatility	Quality
10,16%	11,40%	0%	0%	0%	0%	100%	0%
10,41%	11,82%	0%	0%	0%	18%	82%	0%
10,66%	12,12%	0%	0%	0%	30%	70%	0%
10,91%	12,36%	0%	0%	0%	41%	59%	0%
11,16%	12,58%	0%	0%	0%	50%	50%	0%
11,41%	12,78%	0%	0%	0%	58%	42%	0%
11,66%	12,96%	0%	0%	0%	66%	34%	0%
11,91%	13,13%	0%	0%	0%	73%	27%	0%
12,16%	13,30%	0%	0%	0%	80%	20%	0%
12,92%	13,76%	0%	0%	0%	100%	0%	0%

Source: *Personal*

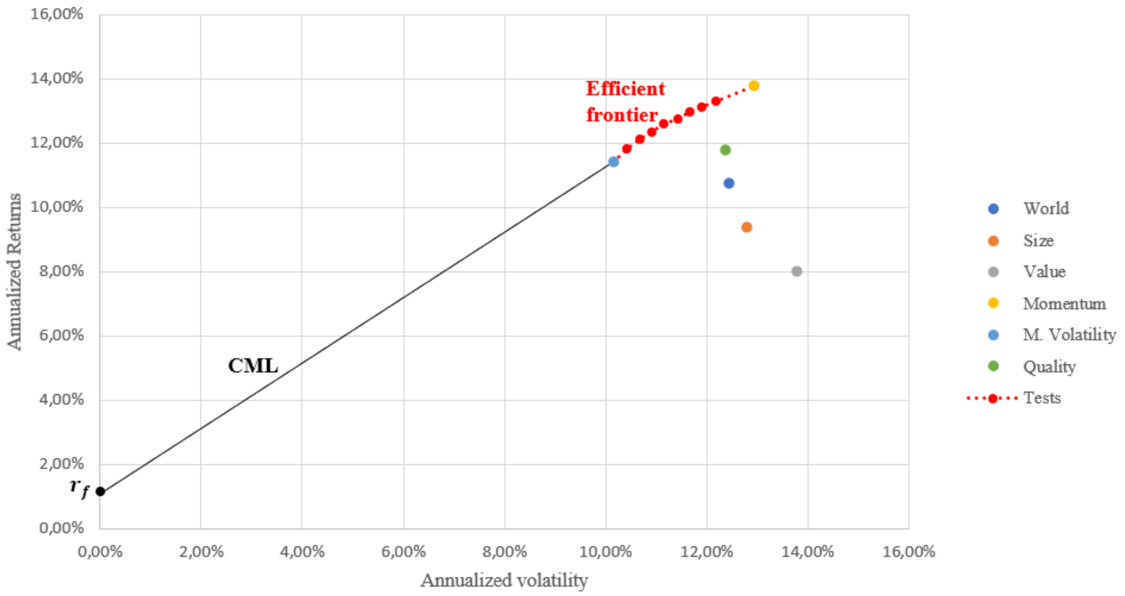
The results of the analysis confirm the clues provided earlier by the correlation matrix; since all correlation values are very close to 1, it is expected that the composition of the efficient portfolios is not very broad in terms of diversification.

As can be seen, all portfolios are in fact composed of only two ETFs: the iShares Edge MSCI World Minimum Volatility UCITS ETF and the iShares Edge MSCI World Momentum UCITS ETF.

The efficient portfolios described in Table 7 were then plotted in Figure 29, which depicts the efficient frontier and the Capital Market Line, which combines the risk-free product with the market portfolio.

The points defined in the legend as "Tests" are the points that have as their abscissa the arbitrarily chosen standard deviations and as their ordinate the corresponding return calculated using the Excel Solver.

Figure 29. CML and Efficient Frontier



Source: *Personal*

4.1.3 KEY RATIOS ANALYSIS

The next stage of performance analysis involves the evaluation of several indices that are considered fundamental to evaluating the funds under consideration. These indices include the Sharpe ratio, Treynor ratio, Modigliani-Miller ratio, Jensen's alpha, Information ratio, and Sortino ratio.

To evaluate the funds, the MSCI World Index was used as the market benchmark, while the Treasury Bill rate with annual maturity was used as the risk-free security.

Table 8 shows the first step of the analysis, which aims to calculate the beta values of the various ETFs. These were calculated using information on the returns and standard deviation of each fund, previously used to obtain the test points belonging to the efficient frontier shown in Figure 29.

To calculate the various beta coefficients, a regression was run using Excel. This step is essential for understanding the relationship between the fund's performance and the performance of the market benchmark (MSCI World Index), thus helping to assess how sensitive the fund is to market fluctuations.

Table 8. ETFs' betas

ETF	σ(yy)	r(yy)	β
World	12,44%	10,74%	1,00
Size	12,79%	9,40%	1,00
Value	13,77%	8,00%	1,05
Momentum	12,92%	13,76%	0,95
M. Volatility	10,16%	11,40%	0,68
Quality	12,38%	11,80%	0,98

Source: *Personal*

The regression shows beta values close to 1, especially for ETFs that rely on the Size and Quality factors. The Value factor, with a beta of 1.05, represents the only one to increase, albeit by only 0.05 points, the magnitude of market fluctuations. It is observed that the ETF based on the Minimum Volatility factor has the lowest beta. This result is not surprising, considering that the inherent nature of the factor is geared toward minimizing turbulence relative to the benchmark.

It is particularly interesting to note that although ETFs based on the Momentum, Minimum Volatility, and Quality factors did not amplify market fluctuations, they achieved a higher annualized return than the benchmark. This contrasts with the Size and Value ETFs, which did not achieve the same return.

SHARPE RATIO

The Sharpe ratio was developed by William Sharpe, a renowned U.S. economist who received the Nobel Prize in Economics in 1990 for his contributions to the financial field. This indicator is designed to assess the additional return generated relative to the risk-free rate for each unit of total risk borne by a portfolio or investment fund. In other words, it provides a measure of relative return to risk and helps investors assess the efficiency and risk profile of an investment.

The Sharpe ratio is computed through the following formula:

$$SR = \frac{R_p - r_f}{\sigma_p}$$

Where:

- $R_p - r_f$ is the excess return of the fund over the risk-free rate.
- σ_p is the standard deviation of the fund.

Table 9 shows the Sharpe ratio values calculated for the funds considered.

Table 9. ETFs' Sharpe ratios ranking

ETF	SR ranking
M. Volatility	0,97
Momentum	0,95
Quality	0,83
World	0,74
Size	0,61
Value	0,47

Source. *Personal*

Table 9 shows the primacy of the Minimum Volatility and Momentum strategies over the others, with Sharpe Ratios of 0.97 and 0.95, respectively. These two values are, in the two cases, related to different characteristics of the two ETFs: in the case of the Minimum Volatility ETF, the value of the Sharpe ratio can be attributed to the low value assumed by the denominator of the formula related to the low volatility of the fund, while in the case of the Momentum ETF, the value of the Sharpe ratio can be attributed to the high performance of the fund, a factor that significantly increases the numerator of the fraction. The Quality fund also outperforms the benchmark, unlike the strategies based on the Size and Value factors. The latter occupies the last position in the ranking in terms of Sharpe ratio due to its high volatility and simultaneous low return.

TREYNOR RATIO

The Treynor ratio assesses the extra return generated by a portfolio considering market risk, as measured by the beta coefficient. In the case of poorly diversified portfolios, Treynor's ratio provides a more adequate measure than Sharpe ratio. This is because the Treynor ratio considers overall market risk, while the Sharpe ratio considers only the risk of the portfolio's underlying assets, which may not fully reflect the market. Treynor ratio is therefore calculated by the following formula:

$$TR = \frac{R_p - r_f}{\beta_p}$$

Table 10 shows the Treynor ratio values calculated for the funds considered.

Table 10. ETFs' Treynor ratios ranking

ETF	TR ranking
M. Volatility	0,14
Momentum	0,13
Quality	0,10
World	0,09
Size	0,08
Value	0,06

Source. *Personal*

As can be seen from Table 10, the ranking order, being the same with respect to the ranking calculated based on the Sharpe ratio, makes explicit the fact that idiosyncratic risk is found to be proportionate to systematic risk for each of the ETFs considered[63].

MODIGLIANI-MILLER RATIO

The Modigliani-Modigliani ratio (M^2) allows comparison of equivalent portfolios in terms of overall risk. When comparing an investment portfolio or mutual fund to a benchmark, they need to have the same standard deviation. Therefore, to make a meaningful comparison, it is necessary to construct a synthetic portfolio that has the same volatility as the market portfolio or benchmark.

The Modigliani-Miller ratio can be computed through the following formula:

$$M^2 = R'_p - R_b$$

Where:

- R'_p is the modified return of the synthetic fund.
- R_b is the return of the benchmark.

[63] Rosenberg, Barr, and W. McKibben. "The Prediction of Systematic and Specific Risk in Common Stocks." Journal of Financial and Quantitative Analysis 8, no. 2 (1973): 317–333. https://doi.org/10.2307/2330027

The modified return can be calculated by the following formula:

$$R'_p = SR_p * \sigma_b + r_f$$

This ratio is particularly relevant because it allows a direct comparison of the performance of two funds based on a common standard deviation.
Table 11 shows the Modigliani-Miller ratio values calculated for the funds considered.

Table 11. ETFs' Modigliani-Miller ratios ranking

ETF	MM ranking
M. Volatility	2,87%
Momentum	2,56%
Quality	1,11%
Size	-1,56%
Value	-3,36%

Source: *Personal*

Even in the case of the Modigliani-Miller ratio, the ranking remains unchanged, with the Low Volatility ETF occupying the first position, followed by the Momentum ETF. The last positive value belongs to the Quality ETF (1.11 %). In contrast, the Size and Value funds show a negative M^2 ratio value of -1.56% and -3.36%, respectively.

JENSEN'S ALPHA

The Jensen index, also known as Jensen's alpha (α), is named after economist Michael Jensen, who introduced this performance measure. Jensen's alpha represents the additional or extra-return of a portfolio or mutual fund relative to the return one would have expected based on the level of systematic risk as measured by the beta coefficient. This index is based on Capital Asset Pricing Model (CAPM) theory, in which beta is an indicator of the market risk or systematic risk of a financial asset. Jensen's alpha is calculated by comparing the portfolio's actual return with the expected return based on its beta and market return, according to the following formula:

$$\alpha_j = R_p - [r_f + \beta_p * (R_m - r_f)]$$

A positive alpha indicates that the portfolio has achieved a higher return than that predicted by the CAPM, while a negative alpha indicates a lower return.

Table 12 shows the values of the Jensen's alpha calculated for the funds considered.

Table 12. ETFs' Jensen's alphas ranking

ETF	Jensens's alpha ranking
M. Volatility	3,59%
Momentum	3,44%
Quality	1,25%
Size	-1,37%
Value	-3,19%

Source: *Personal*

Even in the context of Jensen's alpha computation, the disparities among the factors remain consistent, as evidenced by the Minimum Volatility and Momentum ETFs securing the top two positions with alphas of 3.59% and 3.44%, respectively. Specifically, the notable alpha of the Minimum Volatility ETF can be attributed to its lower beta coefficient compared to other ETFs (0.68), while the Momentum ETF's high alpha value correlates with its substantial fund return (13.76%).

Occupying the third position, albeit still with a positive alpha, is the Quality ETF, registering a value of 1.25%. Conversely, mirroring previous instances, the Size and Value funds claim the last two positions, showcasing alpha values of -1.37% and -3.19%, respectively.

INFORMATION RATIO

The Information ratio is a performance ratio that compares the portfolio's excess return relative to the benchmark with the volatility of the excess return. In other words. It measures the portfolio's ability to generate additional returns relative to the volatility of the additional return.

The following formula is used to calculate the Information ratio:

$$IR = \frac{R_p - R_b}{\sigma(R_p - R_{b)}}$$

The denominator of the above formula is named Tracking Error. A higher Information ratio indicates a better ability of the manager to generate returns above the benchmark per unit of Tracking Error.
Table 13 shows the Information ratio values calculated for the funds considered.

Table 13. ETFs' Information ratios ranking

ETF	Tracking error volatility	IR ranking
Momentum	5,15%	0,59
Quality	2,22%	0,48
M.Volatility	6,87%	0,10
Size	2,78%	-0,48
Value	4,44%	-0,62

Source: *Personal*

As can be seen from the data shown in Table 13, in the case of the Information ratio, the ranking changes. The Momentum ETF now stands at the top of the ranking, favoured by a high differential return over the benchmark.
The Quality ETF takes the second position due to the lowest Tracking Error Volatility (2.22%). The last ETF to obtain a positive Information ratio value is the Minimum Volatility ETF, penalized by the high Tracking Error Volatility. It is followed by ETF Size and Value which, with an Information ratio of -0.48 and -0.62, respectively, are in the last two positions.

SORTINO RATIO

The Sortino ratio is a modification of the Sharpe ratio, designed to distinguish negative volatility by focusing on the standard deviation of negative asset or portfolio returns (downward deviation), rather than considering the total standard deviation of returns.
Sortino ratio can be computed through the following formula:

$$SO = \frac{R_p - r_f}{\sigma_{downside}}$$

In calculating Sortino ratio, the return of the asset or portfolio is taken as a starting point and the risk-free rate is subtracted. Then, this value is divided by the downside deviation of the asset. Sortino's ratio is named after Frank A. Sortino, who contributed significantly to the development of this performance measure. The Sortino ratio is particularly useful because, by focusing on downside volatility, it provides a better understanding of the real risk associated with investments, especially for investors who are more sensitive to loss than general return volatility.

Table 14 shows the Information ratio values and downside volatilities calculated for the funds considered.

Table 14. ETFs' Sortino ratios and downside risks ranking

ETF	SO ratio ranking	σ downside
M. Volatility	1,24	5,99%
Momentum	1,08	9,01%
Quality	0,90	8,65%
World	0,72	9,32%
Size	0,57	9,45%
Value	0,40	10,03%

Source: *Personal*

In the ranking for Sortino ratio, the last of the key ratios analysed, the Low Volatility ETF ranks first, which, with a downside volatility of 5.99% shows a Sortino ratio of 1.24. In second place is the Momentum ETF with a Sortino ratio of 1.08. This is followed by the Quality ETF, the benchmark, and the Size ETF. In last place due to high downside volatility (10.03%) is the Value ETF, with a Sortino ratio of 0.40.

Table 15 summarizes the results of the key ratios for the first period of empirical analysis. The results shown show a primacy in terms of performance by the Minimum Volatility ETF, which, except as far as the Information ratio is concerned, ranks first in each of the ratios analysed.

As for the cause of the low Information ratio value, it can be attributed to high Tracking Error Volatility (6.87%) related to a more diverse portfolio composition. The Minimum Volatility ETF also exhibits the lowest values in terms of standard deviation and downside deviation, which, considering the calculations, do not appear to be contrasted with a lower return than the other riskier ETFs, confirming the results expressed by the Risk-Return paradox advocates[64].

[64] Fiegenbaum, A., and H. Thomas. "Attitudes toward Risk and the Risk–Return Paradox: Prospect Theory Explanations." Academy of Management Journal 31, no. 1 (1988): 85-106

The Momentum factor-based fund earns the highest return of all ETFs, despite, again, its volatility not being the highest. The baseline benchmark is consistently outperformed by the above-mentioned ETFs, confirming the hypothesis of the inefficiency of traditional replication models.

The last two places in the ranking are consistently occupied by Size and Value funds, confirming, respectively, the disappearance of the relative advantage of investing in small companies and the low return-to-risk ratio of intrinsic value-based strategies.

Table 15. Key ratios summary

ETF	SR	TR	MM	Jensen's alpha	IR	S0 ratio
M. Volatility	0,97	0,14	2,87%	3,59%	0,10	1,24
Momentum	0,95	0,13	2,56%	3,44%	0,59	1,08
Quality	0,83	0,10	1,11%	1,25%	0,48	0,90
World	0,74	0,09	-	-	-	0,72
Size	0,61	0,08	-1,56%	-1,37%	-0,48	0,57
Value	0,47	0,06	-3,36%	-3,19%	-0,62	0,40

Source: *Personal*

4.2 PERFORMANCE ANALYSIS (01/01/2022 - 31/12/2023)

As anticipated, we proceed to the second period of analysis, which, unlike the first, includes within it one of the most serious geopolitical crises in recent years: the outbreak of war between Russia and Ukraine, the date of which is traced back to 24/02/2022.

To give an idea of the severity of the war's aftermath, it is useful to report that because of the conflict the United Nations recorded the loss of more than 10,500 civilians with more than 20,000 wounded and the need by 14.6 million people to receive humanitarian assistance[65].

4.2.1 RETURNS, VOLATILITY AND CORRELATION MATRIX

Table 16 shows the calculated values for the annualized return and volatility measures for the second period of analysis.

[65] https://www.oecd.org/ukraine-hub/en/

Table 16. ETFs' annualized risk and return

ETF	σ(yy)	r(yy)
MSCI World	14,86%	10,20%
Size	16,16%	-0,35%
Value	13,48%	5,75%
Momentum	14,28%	-2,20%
M. Volatility	9,54%	0,25%
Quality	15,11%	3,05%

Source: *Personal*

During the second period analysed, a large discrepancy is noted in the annualized returns compared to the previous period. The Momentum fund had a particularly low return (2.2%), despite having performed better than the other funds during the first period.
The Size fund confirmed its low ranking in returns with -0.35%, despite its highest volatility (16.16%). The Minimum Volatility fund had a very low return (0.25%) but confirms the lowest volatility (9.54%). Surprisingly, the benchmark fund had the best return (10.20%), followed by the Value fund (5.75%) and Quality fund (3.05%). Table 17 shows the correlation for the funds examined during the second period.

Table 17. Correlation Matrix

	MSCI World	Size	Value	Momentum	M.Volatility	Quality
MSCI World	1,00					
Size	0,7035	1,00				
Value	0,5855	0,8958	1,00			
Momentum	0,7201	0,7924	0,7095	1,00		
M.Volatility	0,6300	0,7433	0,6287	0,8520	1,00	
Quality	0,7744	0,9059	0,8025	0,8704	0,8758	1,00

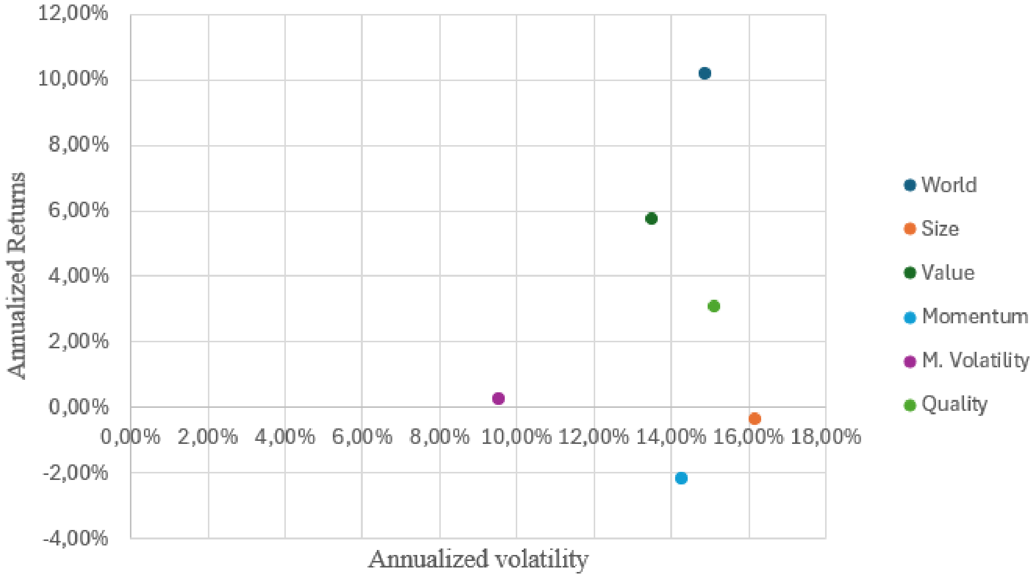
Source: *Personal*

Again, the correlation values show to be positive and close to value 1, demonstrating a strong alignment of performance even in the considered period of geopolitical crisis.

4.2.2 EFFICIENT FRONTIER

For the second period of analysis, the ETFs are represented on a Cartesian plane in Figure 30 based on their annualized risk and return characteristics.

Figure 30. ETF on the Cartesian Plane



Source: *Personal*

Based on the principles of stochastic dominance described in Section 1.1.1, it can be seen that the World fund is in a dominant situation with respect to the Quality and Size portfolios; the Value portfolio stochastically dominates over the Quality, Size, and Momentum portfolios, while the portfolio based on the Minimum Volatility strategy is dominant over the Size and Momentum portfolios. In light of these considerations, as had also been the case for the historical period ranging from 01/01/2015 to 31/12/2019, it is expected that the composition of efficient portfolios will consist of only the three funds that, in this case, prove to be dominant, specifically World, Value, and Minimum Volatility. Again, to determine the weighted allocation of portfolios that fall within the efficient frontier defined by Markowitz in Modern Portfolio Theory, the Excel solver was used, with the help of choosing an additional nine arbitrary standard deviations.

Again, the inability to short sell the portfolios and the requirement that the investor invest 100 % of his or her capital were imposed as constraints.

Table 18 shows the results obtained by the Solver.

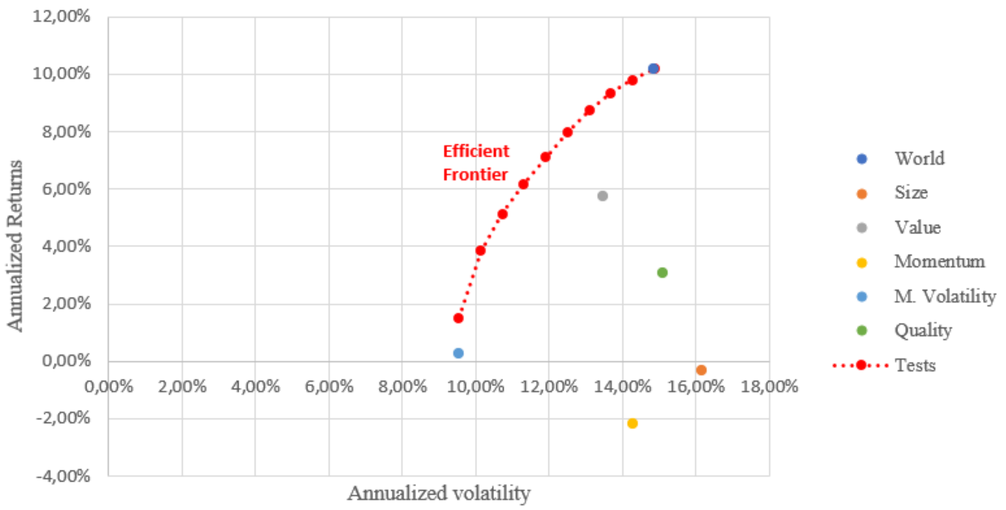
Table 18. Optimal Portfolio allocation

Standard deviation	Portfolio return	World	Size	Value	Momentum	M.Volatility	Quality
9,54%	1,52%	6%	0%	12%	0%	82%	0%
10,13%	3,84%	25%	0%	20%	0%	55%	0%
10,72%	5,14%	36%	0%	24%	0%	40%	0%
11,31%	6,19%	44%	0%	28%	0%	28%	0%
11,91%	7,12%	52%	0%	31%	0%	17%	0%
12,50%	7,97%	59%	0%	33%	0%	7%	0%
13,09%	8,74%	68%	0%	32%	0%	0%	0%
13,68%	9,35%	81%	0%	19%	0%	0%	0%
14,27%	9,80%	91%	0%	9%	0%	0%	0%
14,86%	10.20%	100%	0%	0%	0%	0%	0%

Source: *Personal*

The results confirm what was stated earlier, with the returns distributed among the Value ETF, Minimum Volatility, and traditional replication ETF. The efficient portfolios described in Table 18 were then plotted in Figure 31, which depicts the efficient frontier described by Markowitz. Again, the points defined in the legend as "Tests" are the points that have as their abscissa the arbitrarily chosen standard deviations and as their ordinate the corresponding return calculated using the Excel Solver.

Figure 31. Efficient Frontier



Source: *Personal*

4.2.3 KEY RATIOS ANALYSIS

For the second period examined, the same ratios considered for the first period are also analysed, again with the MSCI World Index used as the benchmark and the Treasury Bill rate with annual maturity as the risk-free security.

Again, the starting point is to calculate, using Excel's regression feature, the betas for the various ETFs, the magnitude of which is shown in Table 19.

Table 19. ETFs' betas

ETF	σ(yy)	r(yy)	β
MSCI World	14,86%	10,20%	1,00
Size	16,16%	-0,35%	0,77
Value	13,48%	5,75%	0,53
Momentum	14,28%	-2,20%	0,69
M. Volatility	9,54%	0,25%	0,40
Quality	15,11%	3,05%	0,79

Source: *Personal*

Interestingly, in this case, none of the funds considered amplify market movements. In particular, the Value factor-based ETF, which in the period of economic stability had shown a beta of 1.05 now reaches an extremely lower value (0.69). The Minimum Volatility ETF confirms having, again, the lowest beta on record. The beta of the Size ETF decreases from a value of 1 to a value of 0.77, while the betas of Momentum and Quality are reduced to 0.69 (from 0.95) and 0.79 (from 0.98), respectively.

SHARPE RATIO

Table 20 shows the Sharpe ratios computed for the second period of analysis.

Table 20. Sharpe ratios ranking

ETF	SR ranking
World	0,58
Value	0,31
Quality	0,10
Size	-0,12
M. Volatility	-0,14
Momentum	-0,26

Source: *Personal*

As shown in Table 20, no ETF manages to outperform the benchmark, which takes the first circumstantial place with a Sharpe ratio of 0.58. The worst performing funds turn out to be the Size, Minimum Volatility, and Momentum funds, with negative values of -0.12, -0.14, and -0.26, respectively. In all three cases, the variable to influence mainly corresponded with the low return obtained during the analysis period.

TREYNOR RATIO

Table 21 shows the Treynor ratios computed for the second period of analysis.

Table 21. Treynor ratio ranking

ETF	TR ranking
World	0,09
Value	0,08
Quality	0,02
Size	-0,02
M. Volatility	-0,03
Momentum	-0,05

Source: *Personal*

The ranking previously found by the Sharpe ratio proves unchanged in the analysis of the Treynor ratio, showing a direct proportionality between the risk coefficient outlined by the standard deviation used to calculate the Sharpe ratio representing total risk and the beta of funds used to calculate the Treynor ratio, representing instead only the portion of systematic risk. Again, therefore, the benchmark takes the top position in the ranking.

MODIGLIANI-MILLER RATIO

Table 22 shows the Sharpe ratios computed for the second period of analysis.

Table 22. Modigliani-Miller ratio ranking

ETF	MM ranking
Value	-4,02%
Quality	-7,18%
Size	-10,40%
M.Volatility	-10,67%
Momentum	-12,55%

Source: *Personal*

As can be seen from Table 22, all the calculated Modigliani Miller ratio values prove negative, highlighting the high performance of the benchmark over the selected time period.

The value that comes closest to zero is that of the Value ETF (-4.02%). The ranking remains unchanged from the other key ratios analysed so far.

JENSEN'S ALPHA

Table 23 shows the Jensen's alphas computed for the second period of analysis.

Table 23. Jensen's alpha ranking

ETF	Jensens's alpha ranking
Value	-0,39%
M. Volatility	-4,79%
Quality	-5,31%
Size	-8,52%
Momentum	-9,73%

Source: *Personal*

The Value ETF is the fund that obtains a value closest to zero for the selected ratio due to its low beta value (0.53) compared to an annual return of 5.75 %. In second position is the Minimum Volatility ETF with an alpha of -4.79 %. Although its beta is by far the lowest (0.40), the annualized return of 0.25 % is too low to bring the alpha value closer to the positive zone.

INFORMATION RATIO

Table 24 shows the Information ratios computed for the second period of analysis.

Table 24. Information ratio ranking

ETF	Tracking error volatility	IR ranking
Value	12,96%	-0,34
Quality	10,07%	-0,71
M. Volatility	11,54%	-0,86
Size	12,00%	-0,88
Momentum	10,91%	-1,14

Source: *Personal*

Analysing the results shown in Table 24, the Value ETF manages to top the ranking in relation to Information ratio, with a value of -0.34. This primacy is justified by a lower Tracking Error Volatility connected, by nature, to this investment strategy. In general, again, all funds achieve a negative Information ratio, with the lowest value reported by the Momentum ETF (-1.14).

SORTINO RATIO

Table 25 shows the Sortino ratios computed for the second period of analysis.

Table 25. Sortino ratio ranking

ETF	SO ratio ranking	σ downside
World	0,92	6,76%
Value	0,17	10,03%
Quality	-0,11	8,65%
Size	-0,46	9,45%
M.Volatility	-0,63	5,99%
Momentum	-0,69	9,01%

Source: *Personal*

If in the first period of analysis the results obtained for Sortino ratio values showed to have an inverse relationship with the values recorded by the downside deviation, in this case this does not seem to be the case, highlighting the singularity of the period analysed. Demonstrating this is the fact that higher downside deviation percentages are not matched by higher returns in this case. The ranking is confirmed to be the same as the previously analysed ratios, with the first position occupied by the benchmark (0.92) and the last occupied by the Momentum ETF (-0.69). Among the other ETFs, only the Value fund manages to achieve a positive Sortino ratio value (0.17).

As can be seen from Table 26, which summarizes the results obtained for the various ratios analysed for this second period, the traditional passive replication ETF proves dominant in most cases. This is followed by the Value and Quality funds, albeit at a considerable gap from the benchmark. In terms of standard deviation, it is once again the Minimum Volatility ETF that performs the best yet demonstrating an extremely low return (0.25 %). In contrast to the first period of analysis, the Momentum ETF ranks last for all ratios analysed during the period of crisis caused by the war. In essence, the second period of analysis seems to indicate, unlike the first, substantial efficiency of investment techniques based on traditional strategies.

Table 26. Key ratios summary

ETF	SR	TR	MM	Jensen's alpha	IR	SO ratio
World	0,58	0,09	-	-	-	0,92
Value	0,31	0,08	-4,02%	-0,39%	-0,34	0,17
Quality	0,10	0,02	-7,18%	-5,31%	-0,71	-0,11
Size	-0,12	-0,02	-10,40%	-8,52%	-0,88	-0,46
M. Volatility	-0,14	-0,03	-10,67%	-4,79%	-0,86	-0,63
Momentum	-0,26	-0,05	-12,55%	-9,73%	-1,14	-0,69

Source: *Personal*

CHAPTER 5. LIQUIDITY ANALYSIS

The liquidity analysis covered in this chapter will look closely at the same historical periods examined in the previous performance analysis. However, the focus will be on meticulously assessing the daily variation in bid-ask spreads and assets under management among the funds under study. By taking this approach, the goal is to identify any correlations between these fundamental liquidity indicators, shedding light on potential divergences and/or similarities during the specified time periods.

Specifically, for the purposes of this analysis, daily data will be used to capture the intricate nuances of liquidity dynamics. Through this exploration of liquidity, the goal is to unveil how liquidity fluctuations can affect fund performance and investor behaviour, ultimately contributing to a more holistic understanding of market dynamics.

5.1 LIQUIDITY RISKS (01/01/2015 - 31/12/2019)

5.1.1 BID-ASK SPREAD

The first indicator that will be used to determine what the risks arising from liquidity are for the two time periods under consideration is the bud-ask spread, which corresponds to the difference between the price at which a unit of a financial product can be bought and the price at which a unit of the same product can be sold in the market.

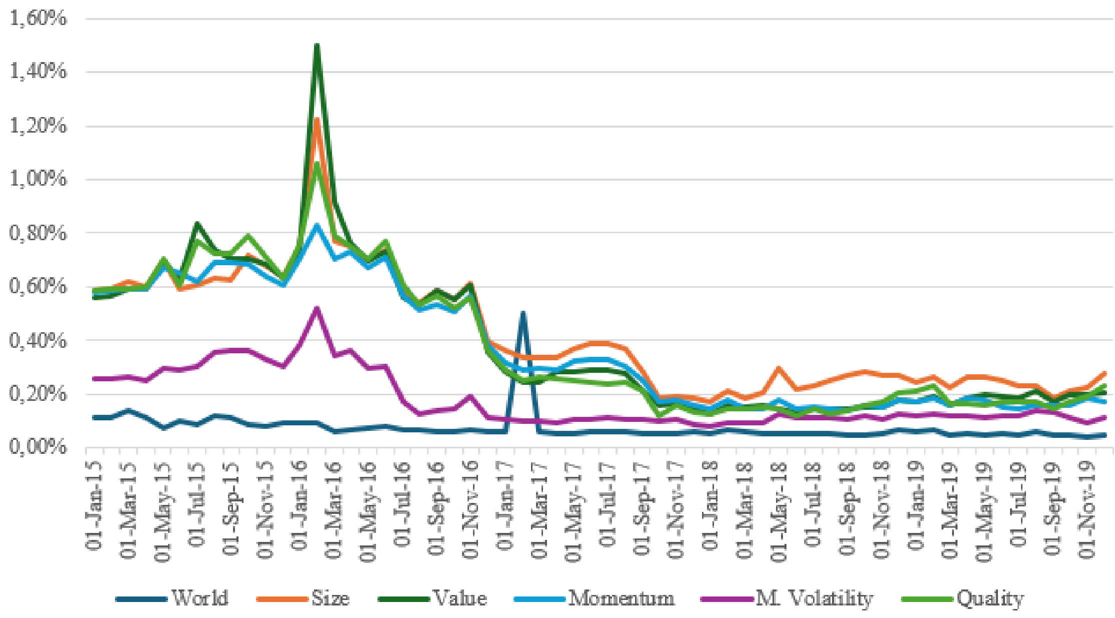
Usually, the value of this spread turns out to be small, however, under special circumstances, especially when the volume of activity turns out to be particularly high, its value can have extremely relevant consequences for investors. In order to make the results of the various funds comparable, the differences between the bid and ask prices have been normalized with respect to the mid-price, the average value between the two, to obtain results expressed as a percentage.

Figure 32 shows line graphs of the trends of normalized bid-ask spreads for the first period of analysis. It is evident that the values they assume are significantly higher during the first two years of analysis.

This phenomenon appears to be related to the periods of establishment of the funds taken into analysis.

In particular, four of the six funds examined were established at the end of 2014, and since managers have to bear the costs arising from the "birth" of these funds net of a still low amount of assets, they are forced to propose higher spreads. In fact, as can be seen, since the beginning of 2017, the spreads undergo a significant downward shift until they stabilize significantly below the 0.40% mark.

Figure 32. Normalized bid-ask spreads



Source: *www.borsaitaliana.com*

The decrease in spreads also coincides with the easing of uncertainty related to the Greek crisis and the Chinese recession, underscoring how, considering this analysis, there is a strong dependence between spreads and macroeconomic circumstances.

Table 27 shows the most salient spread data calculated for the first period for each ETF.

Table 27. Bid-ask spread highlights

ETF	Min Spread	Max spread	Average spread	Standard deviation
World	0,05%	0,50%	0,08%	0,06%
Size	0,17%	1,23%	0,42%	0,22%
Value	0,13%	1,50%	0,39%	0,28%
Momentum	0,14%	0,83%	0,37%	0,22%
M. Volatility	0,08%	0,52%	0,18%	0,10%
Quality	0,12%	1,06%	0,38%	0,25%

Source: *Personal*

As shown in Table 27, the lowest minimum spread is achieved by the traditionally replicated ETF with a value of 0.05%, followed at only 0.03 percentage points by the

Minimum Volatility ETF. The minimum values of the remaining ETFs appear to be higher, with values ranging from 0.12 % to 0.17 %.

In contrast, the maximum spread value is reached by the Value factor-based ETF, with a value of 1.5 %, followed by the Size and Quality ETFs with values of 1.23% and 1.06%, respectively.

In terms of maximum values, the traditional replication ETF also proves to be the least expensive, with a maximum spread of 0.5 %. Such cheapness is also demonstrated in terms of average values, where the traditional replication ETF shows an average value of only 0.08%. On average, the size ETF proves to be the most expensive, with an average value of 0.42%. Finally, even in terms of standard deviation, it is the World ETF that proves to be the least volatile, with a standard deviation of 0.06% over the time frame considered.

5.1.2 VARIATION OF ASSETS UNDER MANAGEMENT

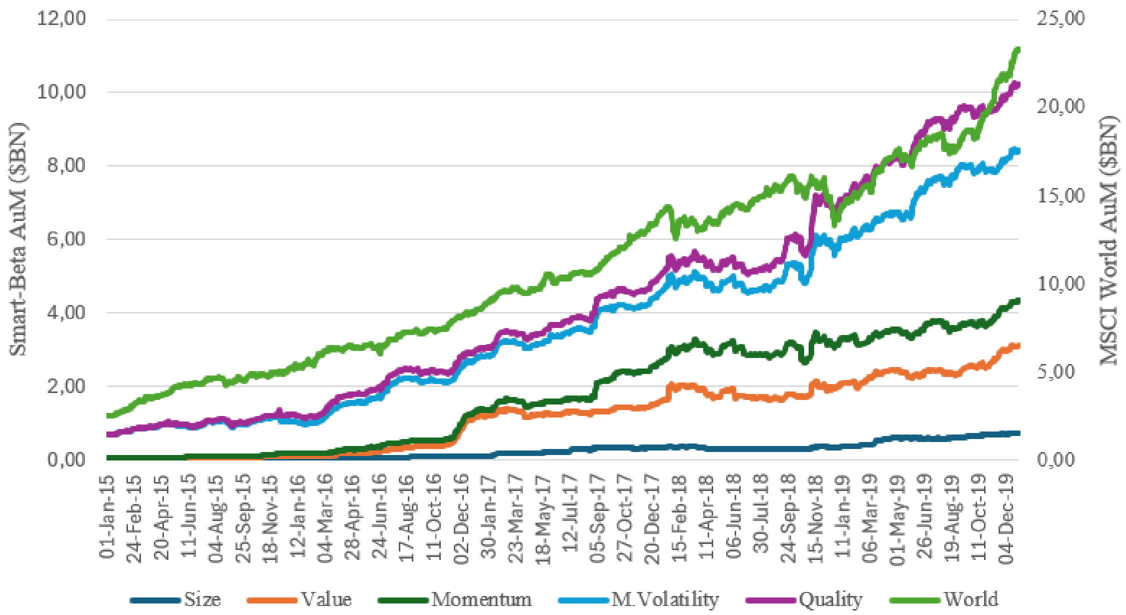
The second liquidity indicator examined corresponds to assets under management. Assets under management of ETFs is a key indicator of liquidity because it reflects the total amount of investments held by a fund. This value is a direct result of the supply and demand present in the ETF market, influencing the ease with which investors can buy or sell shares of the fund itself. In general, an ETF with a high AuM is considered more liquid because it offers a greater availability of funds for transactions, thus reducing the risk of slippage[66] and execution costs. In contrast, an ETF with a low AuM may be less liquid because it may be more difficult for investors to find willing buyers or sellers to trade the fund's shares.

Consequently, the AuM of ETFs provide an indication of their overall liquidity and their ability to handle transactions without significantly affecting market prices. This makes AuM an important factor considered by investors in assessing the liquidity and efficiency of an ETF. Over the years, the growth of AuM managed by Smart Beta ETFs has been exponential. Despite this, traditionally replicated ETFs still manage significantly higher flows of assets.

[66] Circumstance in which an order is executed at a price significantly greater or lower than the quoted price

This is highlighted by Figure 33, which shows the trend of assets under management for each of the funds analysed. To make the graphical comparison easier, two different scales were used to represent the AuM of the various funds. Specifically, a scale of 1 to 1 was used for the Smart Beta ETFs, while for the benchmark the scale is 1 to 5.

Figure 33. ETFs' AuM trend



Source: *www.blackrock.com*

As can be seen from Figure 33 and as previously mentioned, the amount of assets under management by the traditionally replicated ETF is significantly higher than the Smart Beta ETFs, with assets under management of about $23 billion at the end of the first period under consideration. As for the range of Smart Beta ETFs analysed, on the other hand, the Quality factor-based fund takes the top spot, with more than $10 billion in assets under management at the end of 2019.

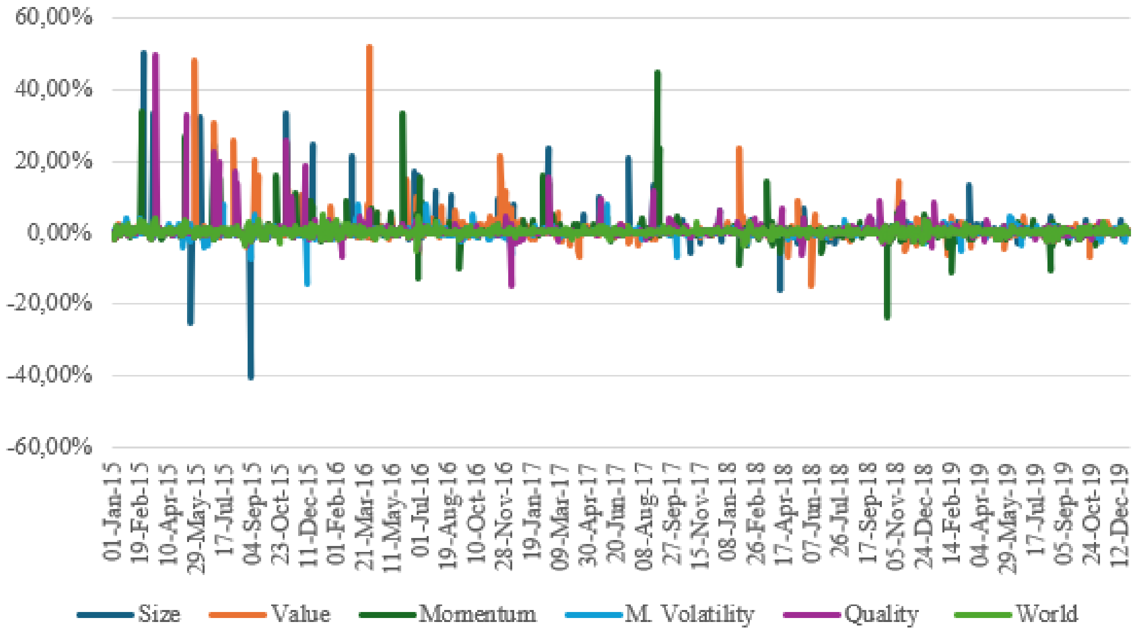
Next comes the Minimum Volatility ETF, which, over the time horizon considered sees the amount of assets under management increased from approximately $800 million in 2015 to more than $8 billion at the end of 2019.

Occupying the next two positions are the Momentum and Value factor-based ETFs, with assets under management, at the end of the time period considered, of approximately $4.2 and $3 billion. In these two cases, it is interesting to note that there was a sudden and steep increase in AuM in November 2016. Subsequently, the Momentum ETF experienced further significant and steep increases, such as the one recorded in July of the year 2017, probably related to the strong interest shown by active funds in this investment strategy. In contrast, on the other hand, the Value ETF recorded milder and more moderate increases.

The last position in the ranking is occupied by the Value ETF, which, at the end of 2019, fails to even break through the billion-dollar managed threshold, registering an AuM of about $750 million.

It is also interesting to analyse the percentage changes in AuM during the period of analysis. These variations are shown in Figure 34.

Figure 34. ETFs' percentage AuM variation



Source: *www.blackrock.com*

Figure 34 clearly shows the dynamics of the first juncture of the analysis period, which is distinguished by significant volatility in AuM. This volatility is inherently linked to the initial management of relatively fewer assets, which makes AuM more susceptible to the influence of eventual institutional investments.

It is evident that during the period spanning the years 2015 and 2016 extreme peaks occur, both positive, exceeding 50 %, and negative, reaching up to 40 %. These phenomena are partly attributable to the funds' start-up phase, during which institutional investment decisions can exert an amplified impact.

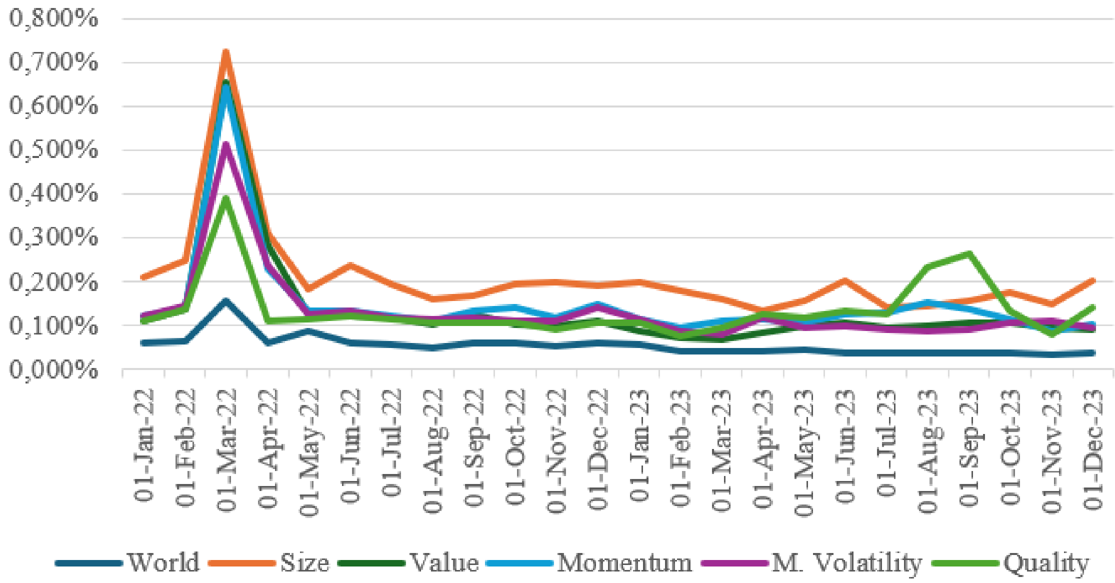
With the course of time, there is a marked attenuation of these volatility peaks. This phenomenon is particularly evident starting in 2017, a year that marks a phase of consolidation of Exchange-Traded Funds (ETFs) within the financial landscape, with increased investor adoption and understanding. This market maturation process results in a gradual reduction in AUM volatility until the end of the period under review.

5.2 LIQUIDITY RISKS (01/01/2022 - 31/12/2023)

5.2.1 BID-ASK SPREAD

Figure 35 shows line graphs of the trends of normalized bid-ask spreads for the second period of analysis.

Figure 35. Normalized bid-ask spreads



Source: *www.borsaitaliana.com*

Figure 35 illustrates a notable trend: the period between February and March registers the highest percentage change in spreads across the analysed ETFs. This underscores the critical nature of this timeframe, emphasizing its uniqueness and significance in the market dynamics.

The observed spread fluctuations not only underscore the sensitivity of liquidity to prevailing market conditions but also validate the correlation between the performance of the examined funds and broader market trends.

Notably, while all ETFs exhibit increased spreads during this period, the Value ETFs and the benchmark display comparatively smaller changes. Table 28 provides a detailed breakdown of the most significant spread data observed during the second period for each ETF, offering deeper insights into the liquidity dynamics and their implications for fund performance.

Table 28. Bid-ask spreads highlights

ETF	Min Spread	Max spread	Average spread	Standard deviation
World	0,04%	0,16%	0,05%	0,03%
Size	0,13%	0,72%	0,21%	0,12%
Value	0,07%	0,65%	0,13%	0,12%
Momentum	0,09%	0,64%	0,15%	0,11%
M. Volatility	0,08%	0,51%	0,15%	0,09%
Quality	0,08%	0,39%	0,14%	0,07%

Source: *Personal*

As can be seen from the values shown in Table 28, it is once again, for the second period analysed, the traditionally replicated ETF that has generally lower spreads, with a minimum value of 0.04 %, a maximum value of 0.16 %, an average value of 0.05 %, and an extremely low standard deviation of only 0.03 percentage points.

Table 29 provides a summary of the comparison data for the two time periods analysed.

Table 29. Average Bid-ask spread comparison

Period	World	Size	Value	Momentum	M. Volatility	Quality
Period 1	0,08%	0,42%	0,39%	0,37%	0,18%	0,38%
Period 2	0,05%	0,21%	0,13%	0,15%	0,15%	0,14%

Source: *Personal*

Table 29 presents findings that diverge from initial expectations, particularly considering the geopolitical crisis surrounding the outbreak of war in Ukraine. It would be reasonable to anticipate an increase in spreads during the second time given such circumstances. However, a contrary trend emerges, as all examined funds exhibit a decrease in spreads compared to the initial analysis period. Notably, the most evident decrease is observed in the Value ETF, reflecting a difference of 0.26 percentage points between the two periods. Similarly, the Size, Quality, and Momentum ETFs also demonstrate significant declines, registering decreases of 0.21, 0.24, and 0.22 percentage points, respectively.

In contrast, the Minimum Volatility ETFs and the benchmark maintain robust alignment across the two periods. These findings underscore the complexity of market dynamics and suggest that additional factors beyond geopolitical events may have influenced liquidity during the specified timeframe.

In particular, it would seem plausible that changes in assets under management could affect the size of spreads even more heavily than a geopolitical crisis of the size and significance of the war in question.

5.2.2 VARIATION OF ASSETS UNDER MANAGEMENT

Analysis of the change in assets under management during the period of the war in Ukraine can offer valuable perspectives on ETF market dynamics and investor attitudes toward this complex geopolitical environment.

This period of geopolitical crisis may influence investors' decisions and perceptions of risk, possibly affecting ETFs' investment strategies and liquidity. Examining how AuM have varied during this period can provide information about the degree of investor confidence in the market and investment strategies, as well as the resilience of ETFs to geopolitical turmoil. In addition, analysing such variations can contribute to a better understanding of capital flows and investor behaviour in response to global events, enabling market participants to adopt more informed and adaptive strategies.

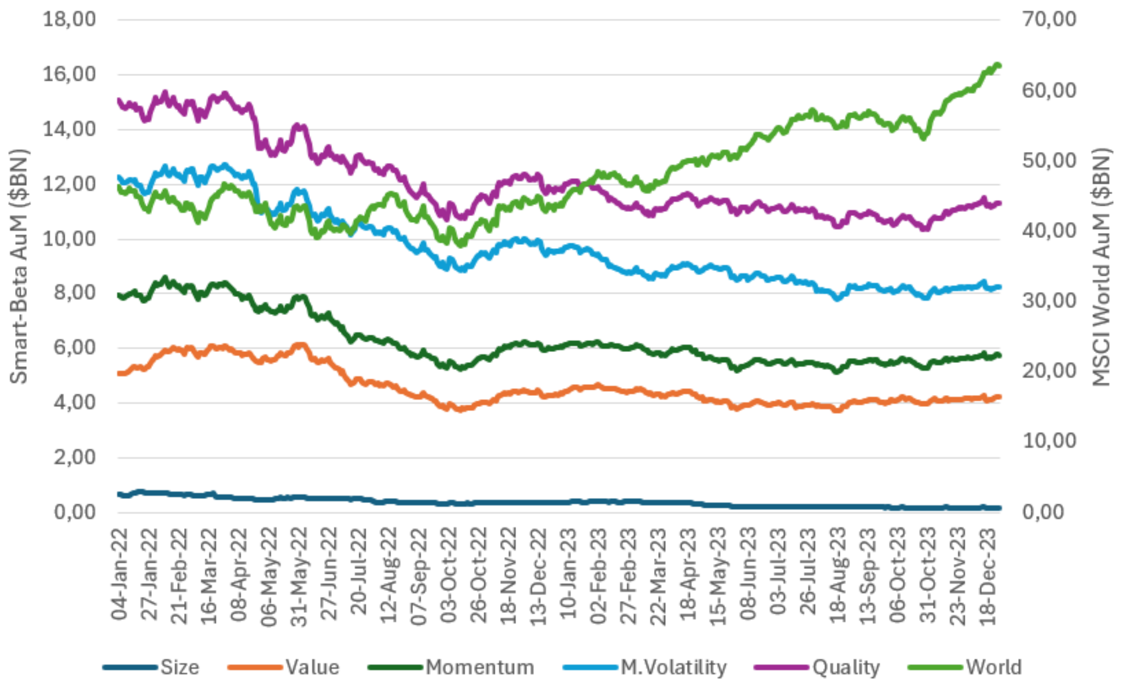
Figure 36 shows the performance of assets under management for the various funds considered in the second period of analysis, highlighting a significant increase in AuM compared to the first period of analysis.

However, looking only at the latter historical period, it can be seen that since February 2022 there has been a significant decline in assets under management by each of the ETFs considered. The only ETF to show a substantial recovery from this decline proves to be the traditional replicated ETF, which, starting in October 2022, reverses course from the momentary downward trend and then resumes its ascent in terms of assets under management, closing 2023 with $63 billion managed.

As can be seen from the chart, all other Smart Beta ETFs suffer the effects of the outbreak of war beginning in February and then stabilize at a value that will never return to par with that before the start of the conflict.

The Quality ETF goes from an initial value of approximately $15 billion AuM to a value at the end of the period of approximately $11.5 billion, placing it in first position among the Smart Beta ETFs. This is followed by the Minimum Volatility, Momentum, Value, and Size ETFs, which go from assets under management of approximately $12, $8, $5.6, and $1 billion to final assets under management of approximately $8, $6, $4, and $0.2 billion.

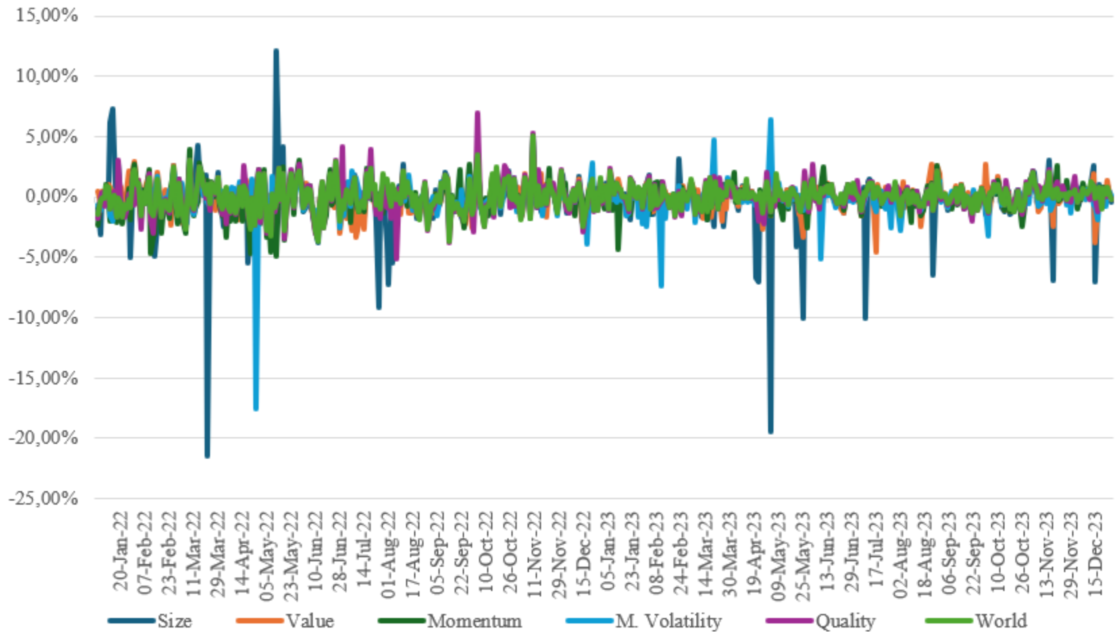
Figure 36. ETFs' AuM trend



Source: *www.blackrock.com*

Finally, the analysis turns to the percentage change in assets under management in the second period of analysis. This variation is depicted in Figure 37, which highlights the peculiarities of the period of February and March 2022, months circumscribing the outbreak of the conflict in Ukraine, with evident percentage changes in assets under management exceeding, in negative, the thresholds of -20% and -15% for ETFs based, respectively, on the Size and Minimum Volatility factors. This decline in assets under management due to strong pressure from the sell side was reflected in higher spreads during the corresponding period, causing further losses related to lower liquidity for sellers of ETFs shares.

Figure 37. ETFs' percentage AuM variation



Source: *www.blackrock.com*

CONCLUSIONS

The objective of this dissertation is to conduct a comparison of the performance of five Smart Beta ETFs with that of a traditional ETF belonging to the same category. The analysis aims to determine which factorial strategies have been most effective in two distinct historical contexts: a period of relative economic stability, from 01/01/2015 to 31/01/2019, and a period characterized by the geopolitical crisis resulting from the conflict in Ukraine, which runs from January 01/01/2022 to 31/12/2023.

The performance analysis for the first review period shows that the ETF based on the Minimum Volatility factor outperformed the other ETFs in almost all metrics considered. However, in terms of Information ratio, it was outperformed by the Momentum and Quality ETFs. The Minimum Volatility ETF achieved a remarkable risk-adjusted return, with an annual return of 11.40 % and a standard deviation of 10.16 %, significantly lower than all other ETFs. This result is in line with the theories advocated by Haugen and Heins in 1972 regarding the Risk-Return Paradox, according to which it is possible for an inverse relationship to occur between risk and return, as opposed to what traditional finance models predict. In second place for this analysis period is the Momentum factor-based ETF, a strategy based on the assumption that stocks that have recently performed well will continue to perform positively in the near future.

During this period, this ETF had the highest annualized return (13.76%) and a standard deviation of 12.92%. The excellent risk-adjusted performance of these two ETFs and their stochastic dominance over other ETFs is reflected in the composition of the efficient frontier, which is found to consist exclusively of these two ETFs. These results highlight the inefficiency of traditionally replicating ETFs for the period under study (Baker & Haugen, 2012). The worst results for this first period were obtained by the Value factor-based ETF, which recorded an annualized return of 8.00% and the highest standard deviation of 13.77%.

This result highlights the ineffectiveness of Value strategies (Israel, Laursen, & Richardson, 2020) during the period under review. This negative performance can be attributed to both the low inclusion of U.S. companies in the ETF and the concomitant outstanding performance of growth companies, predominantly in the technology sector.

In the second period of analysis, a general increase in volatility is observed for all ETFs considered. In terms of risk-adjusted return, the benchmark stands out with an annualized return of 10.20 % and a standard deviation of 14.86 %. In addition, the benchmark emerges as the ETF with the smallest variation from the previous period's performance. This result corroborates theories about the inefficiency of Smart Beta ETFs during some recessionary periods (Glushkov, 2015).

After analysing performance, the focus of the thesis shifts to liquidity risk, often considered a weakness of ETFs, especially Smart Beta ETFs. Changes in bid-ask spreads and assets under management of previously selected funds are studied, keeping the same time periods as in the performance analyses. The results indicate an increase in bid-ask spreads during the critical phases of the ETFs, with spikes that, in exceptional cases, reach 1.49% for the first analysis period and 0.72% during the second analysis period. In the case of the first period, this spike is related to the initial scarcity of AuM managed by the funds, as evidenced by the sharp decrease in spreads later on when AuM increases.

In the case of the second period, however, these changes appear to be related to reduced market liquidity resulting from downward pressure caused by investors' perceived greater risk. Indeed, in the outbreak period, there is a sharp reduction in the AuM of all ETFs and a consequent increase in bid-ask spreads.

In summary, Smart Beta ETFs continue to prove effective as diversification tools, offering the ability to tailor investment strategies in a customized manner while maintaining competitive costs. Large-scale adoption of such instruments is likely to increase over time, presenting investors with both new challenges and opportunities.

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