



SMART BETA

Discovering the world of smart beta

Final Degree Dissertation in Finance and Accounting

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Index

1. List of figures.....	I
2. Summary	II
3. Introduction	III
3.1. Advantages and disadvantages of Smart Beta.....	IV
3.2. Evolution of the Smart beta market in the US and Spain	V
4. Smart beta origin.....	VI
4.1. Markowitz model	VII
4.2. Fama and French model	IX
5. Types of smart beta	X
5.1. Volatility	XI
5.2. Momentum	XI
5.3. Size.....	XI
5.4. Quality.....	XI
5.5. Dividend.....	XII
5.6. Factor.....	XII
5.7. Equal weight	XII
6. Methodology	XIII
7. Comparison Smart beta VS index of reference USA	XV
7.1. Tracking error of the USA Smart betas.....	XVI
7.2. Excess of return of the Smart beta of the United States	XX
8. Comparison Smart beta VS index of reference Spain	XXIII
8.1. Excess of return of the Smart beta of Spain	XXV
8.2. Testing in the new Smart beta.....	XXIX
9. Conclusion	XXX
10. References	XXXI

1. List of figures

• Figure I: Efficient border of Markowitz.....	VIII
• Table I: Results of the United States smart beta.....	XVI
• Table II: Tracking error Smart beta of USA.....	XVIII
• Figure II: Excess return strategy of the United States dividend.....	XX
• Figure III: Excess return strategy of Momentum United States.....	XX
• Figure IV: Excess return small size strategy of the united states.....	XXI
• Figure V: Excess return strategy of lower volume of the United States.....	XXI
• Figure VI: Excess return strategy of equal weighting of the United States.....	XXII
• Figure VII: Excess return small business strategy of the United States.....	XXII
• Table III: Performance of the smart beta ETFs in Spain.....	XXV
• Figure VIII: Excess return Minimum active strategy of Spain.....	XXVI
• Figure IX: Excess return Minimum all strategy of Spain.....	XXVII
• Figure X: Excess return Equally-weighted strategy of Spain.....	XXVII
• Figure XI: Excess return Momentum active strategy of Spain.....	XXVIII
• Figure XII: Excess return Momentum all strategy of Spain.....	XXVIII
• Table IV: Results obtained from the investment in the Spanish Smart Betas.....	XXIX

2. Summary

The objective of this document is to conduct a study on the *Smart Beta*, a new investment strategy that aims to generate a higher return than the market index based on the analysis of the classical mean-variance theory of Markowitz. To demonstrate if the smart betas have generated better returns than their benchmarks, we will review the main academic models on which they are based and the evolution of the main smart betas available in the United States compared to its reference index. Finally, we also create our “homemade” portfolios of *Smart Beta* for the Spanish market for the period 2012-2017, all based on similar models that the ones used in the investment fund industry. After our analysis, we verify that most of the returns of smart beta strategies outperform the reference index, corroborating that the excitement about *Smart Beta* was justified.

3. Introduction

A stock portfolio is a set of assets that have been selected among the different financial markets to get the best performance for a certain level of risk or a lower risk for a certain level of return. The portfolio theory has been widely studied by economists creating several models to help investors with the decision on where to allocate their wealth. These studies conclude that the optimal portfolio is characterized as a mixture of different investments in order to obtain an optimal diversified portfolio.

From the fundamental concepts outlined in these studies, practitioners and the investment fund industry have adapted them into different asset management vehicles, such as Smart Beta. These new strategies combine passive strategies with active ones, in order to outperform the benchmark portfolio (usually stated as the market portfolio). Their purpose, in the end, is to obtain advantages that lead to more beneficial strategies than the vehicles of traditional management.

In recent years, the smart beta has become very popular in the market and most investment companies are offering more smart betas, new and more complex, in order to satisfy the increasing demand by investors. According to Luque (2017) the total number of Smart Beta funds traded at 2017 was 1320, with a total of 707 billion euros under management, and with an asset growth of 28.4% compared to the previous year.

After reviewing the existing research on the topic, we have carried our study and we have verified that new Smart Betas portfolios can be created based on a factor following a series of rules. After the creation of our own Smart Beta portfolios we have made a study of them and their results have been positive. All the new portfolios outperformed the benchmark index chosen. We also observed that the returns of the Smart Betas offered by industry exceed both the index and the rest of the portfolios.

One of the most successful innovations that have occurred in the financial market in recent years are the Exchange Trade Funds (ETF). It is a relatively young investment vehicle, born in the early 90s, which started with the SPDR S&P500 ETF, which has become the largest ETF in the world. It is a quoted investment fund that follows an index of the stock market. One of its main advantages are the low administration costs with the same properties as any other stock traded in the market. It is a hybrid between stocks and conventional investment funds, which also trades on a secondary market. The demand for these instruments by investors, both institutional and private, has grown steadily since its inception. With these vehicles, investors have easier to find an

investment that satisfies their risk-return preferences. In the end, these instrument are types of traded “*portfolios*” consisting of many assets which would be very difficult to replicate if the investors had to invest in all its constituents.

According to Funds People (2015), investment strategies were originally based on market capitalization. After the financial crisis, many institutions were not satisfied with their results and began to look for other ways to obtain higher risk-adjusted returns. To satisfy this new demand, the financial sector is constantly growing and evolving and, at the moment, the product that are increasingly employing a higher number of institutional investors for their investments is the Smart beta.

According to Blackrock (2016), Smart Beta is a process to create a portfolio based on rules that break the link between the price and the weight of the portfolio. It has an active and passive investment management, since it aims at a higher yield than an index that remains under the protection of specific risks. These strategies become a transparent and systematic method, which pursue diversification and liquidity.

The Smart Beta strategies are related to multifactor models of asset prices. The main idea is that the market model is an incomplete risk measure, since it does not have the additional risk factors to analyze them.

3.1. Advantages and disadvantages of Smart Beta

According to the blog Self bank (2017), there are many arguments in favor of the smart beta strategies, since once the fund is established, active management is not necessary. Also, they are strategies based on diversification, liquidity and transparency. As a result, the commissions charged are much less significant than those of any active management fund. So, they have a better price-quality ratio than conventional capitalization funds, with better returns adjusted for risk, which reduces the risks of the portfolio. The trading of these smart beta funds are very similar to those of individual stocks and they are very easy to buy/sell. It also allows leverage or short investments, giving speculation alternatives. Other tactical adjustments can also be made for the allocation of assets, such as access to the portfolio, specific sectors and the use of fiscal efficiency.

We can also find many arguments against smart beta, since these investments are based on a standard with academic evidence, so they can create a false alpha, since this is a reflection of the management capacity of the portfolio through a manager. Williams (2018) says that to create these portfolios, past data are used to build future

forecasts. Confidence in historical data to measure exposure to factors could give incorrect signals and underestimate risk. We can also make the investment at a time when the economic environment is uncertain to Smart Beta. The Smart beta has other trading problems because at this time is not well known, and it may require a lot of money to pursue a strategy.

In addition, each Smart beta contains a source of risk that is presented in two categories:

- Systematic risk:

They come from the fact that the new indexes may be more or less exposed to certain risk factors depending on the methodology of their construction.

- Specific risk:

It is the type of risk to which the investor is exposed when he uses a single point of reference for the construction of the smart beta version. Whatever the weighting system, it is only based on assumptions of modeling and parameter estimation, which has the disadvantage of lack of robustness out of the sample.

3.2. Evolution of the Smart beta market in US and Spain

The US Smart Beta market UU is the oldest and most mature market in the world, with more than 478 Smart Beta, 54% of the total Smart Beta in the world and approximately \$ 490 billion in assets under management. It all started in the year 2000, when they launched their first Smart Betas: iShares Russell 1000 Growth and iShares Russell 1000 Value. Since then, the Smart beta market in the United States has not stopped growing, reaching a market share in 2016 of 21% .

According to the research conducted by Clare et al (2015a), many Smart Beta strategies have been created in the form of investment funds and ETFs, which arrived a few years ago as a new investment vehicle that allowed replicate the behavior of an index more easily and efficiently and with lower costs. The first generation of these listed funds was reduced to replicating the most popular funds, such as the S&P 500 index or the Euro Stoxx 50 index, which are indexes weighted by the market capitalization. Therefore, instead of the traditional weighted index strategy, with the smart beta version you can increase performance or modify risk compared to these benchmarks.

Due to its flexibility, transparency and ease of implementation, Smart Beta has experienced great growth since 2013. In that same year, 29% of the net capital flows of the US industry UUUU corresponded to Smart Beta, accumulating more than 497 million dollars. Also, derivatives on these also products operated on stock exchanges.

In the European market, Smart Beta is relatively new. They started to be established in 2005. In 2016, they reached 268 Smart Beta with a value of 40 billion dollars in assets under management. These figures make Europe the second largest market of the world and with the second fastest growth rate of Smart beta strategies.

However, the Smart Beta industry had a difficult start in both Spain and the European market. Until 2007, they had a significant increase in market share, but after the crisis of 2008 they fell drastically. They were severely affected by the drop in the dividends paid by companies, which had a negative effect on the market. Since 2009, the Smart Beta had a steady growth thanks to new and innovative products and low volatility strategies, thus reaching 7.5% of the market share of the smart beta in Europe.

According to Alarcon (2017), both in Spain and Europe the Smart Beta began to be commercialized since 2011. At the beginning of this year, there were 27 ETFs of this type with approximately 250 million euros of assets under management available to the investors in Europe. In 2018, the figure has skyrocketed to 260 ETFs that accumulate managed assets of around 1.68 trillion euros.

The demand for this type of ETF, both by institutional and individual investors is increasing at times and it does not seem that the trend will stop in the upcoming years. However, although this industry is currently booming in Spain, most of the products do not follow the Spanish market but they follow directly a well-known index geographically established in the USA.

4. Smart beta origin

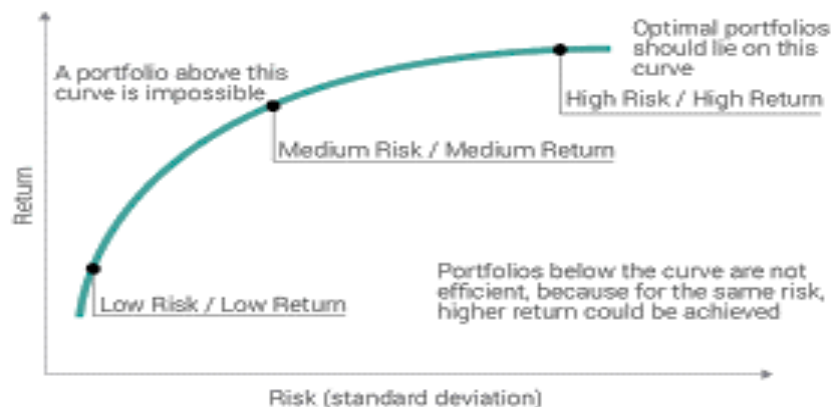
Currently, most modern theories of asset pricing are based on the idea that the excess return of an asset is directly related to the part of the total risk that cannot be diversified. However, the most important problem is the identification and measurement of the risk component that determines an asset excess return. Originally, this academic research was based on the idea of making a portfolio profitable. In this line of research, the risk factors that provide better risk-adjusted returns were searched.

4.1. Markowitz model

One of the first theories formulated with respect to asset pricing models was in 1960s by Sharpe (1964), in which he proposed a model that was a direct development of the mean-variance analysis of Markowitz (1952), in which a model is proposed where a rational investor wishes to maximize his return together with the minimization of the market risk. This model was derived from the concept of diversification and states that an adequate combination of the assets of a portfolio can lead to a reduction in risk without having to necessarily reduce its return. This pioneer model is known as the Capital Asset Pricing Model (CAPM).

According to Markowitz (1952), there is an efficient frontier, which is a set of combinations of assets that obtain the highest expected return for a certain level of risk. Currently, this frontier is known as Markowitz Efficient Frontier and, as can be seen in figure I, there are 3 possible investments located in the efficient frontier. The most profitable investment opportunities are represented for the different combinations of return-risk and there are no other combinations of this set of assets that can lead to a point above this curve. Depending on the profitability you expect to obtain, you will obtain a type of risk: low, medium or high, as well as the expected returns.

Figure I: Efficient frontier of Markowitz.



Source: Marín, Rubio, and Mas-Colell, (2001).

The CAPM is a financial theory that describes the relationship between expected returns and systematic risk (known as market risk or risk of diversifiable assets). This model says that the expected return on a portfolio is equal to the risk-free rate plus a risk premium. If the expected return exceeds the required performance, the investment

should not be made. With this model we can plot the different risks (beta) for the different expected returns.

$$r_i = r_f + \beta_i(r_M - r_f) + \varepsilon_i \quad (1)$$

Where r_i is the return of the asset i , r_f is the risk-free rate, β_i is the beta for the asset i , r_M is the return of the market factor and ε_i is the specific return of the asset i .

In studies such as Clare et al (2015a), researchers have found that smart beta has an active management component (alpha) and a passive management component (beta). In this model, beta is a measure of the covariance between returns in excess of the portfolio's risk-free rate and the markets return. That is, it measures the sensitivity level of the fund towards the market or its reference index over a period of time. There are two cases:

- Beta is greater than 1: the fund is more volatile than the market or benchmark.
- Beta is less than 1: the fund has a lower volatility than the market or benchmark.

In studies such as Clare et al (2015a), researchers have found that smart beta has an active management component (alpha) and a passive management component (beta). In this model, beta is a measure of the covariance between returns in excess of the portfolio's risk-free rate and the markets return. That is, it measures the sensitivity level of the fund towards the market or its reference index over a period of time. There are two cases:

Alpha represents the excess return over the market after taking into account the exposure of the strategy to this risk factor (beta). It is very difficult to say whether the alpha generated by the portfolio manager is due to the ability or simply luck. If the market is efficient and the CAPM is the appropriate model of expected return, the average alpha will be zero. The evidence that alpha is different from zero can be interpreted in two ways:

- Positive alpha: the investment manager has an added value to the portfolio.
- Negative Alpha: the investment manager is subtracting value from the portfolio.

The CAPM model offers the possibility of obtaining predictions about how to measure risk and the interaction with expected returns. It is one of the most used models for its simplicity and logic, but the utility of this model in empirical terms does not correspond

to the precision of their predictions, since this model assumes some assumptions that are controversial:

- There are only two types of assets.
- All investors have the same time horizon.
- Investors invest all their wealth in market assets.
- There are no barriers to entry.
- Investor preferences are of the risk-return type.
- Investors have homogeneous expectations.

Despite of its limitations, the CAPM model has become a reference model for the academic community. Thanks to this model, we have continued to investigate and experiment with different investment strategies based on rules that seemed to produce returns beyond what could be expected as a result of exposure for beta. These evidence indicated to investors the existence of other versions beta.

4.2. Fama and French model

Researchers Fama and French (1992) published their three-factor model for the valuation of assets through the average returns of stocks. It was the result of a comprehensive empirical analysis, where the various factors of the CAPM model and others tried to compete with each other in the empirical results to see which of these potential factors were the most powerful. Unlike the CAPM, it does not have a rigorous theoretical basis, but it seems to work.

The researchers argued that the returns on securities and portfolios are influenced by two additional factors, in addition to the market risk factor (that would be influenced by market capitalization) which are the size factor and the book to market ratio (which it refers to the value factor).

This model proposes that there are three sources of systematic risk, in which the exposure of an investment portfolio of these risk factors is what determines its performance over time.

- Excess market returns with respect to a certain risk-free asset.
- Difference in the performance of small capitalization shares with respect to those with greater capitalization.
- Difference in the performance of companies with a high book-to-market value compared to companies with a low book-to-market value.

$$r_i = r_f + \beta_i(r_M - r_f) + \beta_V SMB + \beta_V HML + \varepsilon_i \quad (2)$$

where r_i is the return of the asset i , r_f is the risk-free rate, β_i is the market beta for the asset i , r_M is the return of the market factor, β_s is the size beta for the asset i , SMB is the return of the size factor, β_v is the size beta for the asset i , HML is the return of the value factor and ε_i is the specific return of the asset i .

The model of Markowitz has been vastly studied over time and it has led to many other models, such as the Fama and French model. The Fama and French model proposed the extension of the CAPM model with additional risk factors besides market risk. However, it is still an incomplete and the interpretation of its new factors is limited. Nevertheless, these two academic models are the backbone of Smart Beta strategies.

5. Types of Smart beta

Originally, ETFs weighted their positions in each stock according to its capitalization. However, Smart Beta funds do not compensate the weight of each asset for its capitalization, but for other parameters.

After developing the CAPM theory, academics began to explore a series of investment strategies based on rules that seemed to produce higher than expected returns as a result of exposure to beta risk, along with research on the return-risk trade-off. These experiments indicated the existence of other beta versions to which investors could expose themselves to obtain higher returns.

According to the researchers Hsu, Kalesnik and Viswanathan (2015), it is possible to find more than 250 risk factors, where many of them can be noise, which in turn could affect the portfolio. In turn, many of these factors could offer a positive excess return in the future. Therefore, it is important to evaluate the strength of the factors.

Currently, there is no definitive list of these risk premiums, since in the academic world this topic continued to be the object of research and debate. According to Funds People (2016) there is only empirical evidence on 6 factors that support their ability to provide higher adjusted returns for risk in various markets. This type of investment is optimal for both institutions and individual investors, but tends to outperform at longer investment horizons. The evidence for the short-term is less conclusive.

5.1. Volatility

The low-volatility factor aims to reflect the superior performance of the stocks with volatility levels lower than the average, thus contradicting Markowitz (1952), who stated that a well-diversified portfolio with greater risk should expect higher returns. It is a verifiable hypothesis that Haugen and Heins (1972) came to the conclusion that there was a strong negative relationship between performance and volatility in both the stock and bond markets. That is, investment in low-volatility stocks can produce higher returns than investments in highly-volatile stocks.

5.2. Momentum

The Momentum factor seeks to capture the excess returns of the stocks that had the best performance in the past. To know which ones have been the best performing, price trends can be used. The main assumption here is that the stocks with the best results will continue to outperform the market, and that the stocks with the worst returns will tend to be lower than those of previous years.

Researchers Jegadeesh and Titman (1993) published an article in which they investigated this phenomenon. They showed that through the purchase of stocks that had obtained good results in the past and the sale of stocks that had obtained a bad performance, they had positive results in the following periods.

5.3. Size

In the CAPM model developed by Markowitz (1952), he explains that smaller capitalization stocks produce a higher return than large capitalization stocks. Therefore, small capitalization stocks had a higher beta than stocks of large capitalization. But after the investigation, Banz (1981) put this hypothesis to the test and found that small-cap stocks outperformed large-cap stocks and, on average, had a lower beta than large-cap stocks. Fama and French (1993) also reported convincing evidence that these small-cap stocks outperform consistently big-cap stocks.

5.4. Quality

The quality factor aims to benefit from the excess returns of companies that outperform the market, i.e. high-quality companies which must be profitable, competitive, transparent and able to finance their growth.

Rosenberg, Reid and Lanstein (1985) published an investigation on the relationship between the returns of the stocks and their book value. In this study, they found that when investing in stocks with a high book-to-market value, they generated a better performance than in companies with a lower book-to-market value. Fama and French (1993) also reported convincing evidence that these high book-to-market stocks outperform consistently high book-to-market stocks.

5.5. Dividend

The objective of the dividend yield factor is to take advantage of the higher returns offered by stocks with high dividends. Keim (1985) published a document in which he investigated the relationship between dividend yields and their performance as a portfolio. He says that focusing on high-yield dividend stocks produces higher returns than an equivalent strategy, focusing on investing in stocks with low dividend yields. These results imply that the highest yields can be obtained by adopting a lower systematic risk. This result would have been consistent with the CAPM if the high dividend that produces the stocks on average had a higher risk of beta.

5.6. Value Factor

The value factor seeks to take advantage of the excess returns, establishing as objective the stocks that are operated with a value lower than their fair value. Reasonable values are generally determined by calculating the price of a share with respect to the fundamental variables of the companies: sales, dividends, profits and book value.

Basu (1983) published an investigation that showed that investing in stocks of companies that are undervalued generates higher yields than companies that are overvalued at any given time. According to Banz (1981), this factor is closely related to the size factor, since companies that are undervalued tend to be small.

5.7. Equal weight

There are also indexation strategies based on risk, which focus on reducing or managing the overall risk of the portfolio, while maintaining a good level of performance. In this case, the one we have put into practice has been the equally-weighted strategy. They are a type of smart beta that focuses on creating a portfolio of values that have the same weight. Depending on the reference index, the number of

values will vary. However, the allocation of weights will not be affected by the number of assets, since in this Smart beta the same weight is given to all the selected values.

In addition to these factors, many investors create multifactor ETFs. That is, they use several risk factors to create a diversified ETF portfolio. From time to time, according to the rules of each fund, the positions of each company will be rebalanced to continue complying with the weighting parameters of this smart beta version.

6. Methodology

In order to get a first idea about the performance of the smart beta strategies, both the American and Spanish that we have chosen, we have done an analysis of the returns of the portfolio and an analysis of the risk factors. We explain our methodology in what follows next.

First, we will explain the case of the United States. We compared Smart Beta that have been created previously (and they are already available to investors), for a period of 5 years between 2013 and 2018. The data of the portfolios have been collected from the investment firm BlackRock website, which is one of the most important companies in the Smart beta sector.

We have chosen seven Smart Beta (representing smart beta strategies exposed to a wide range of risk factors) and the American reference index, in order to assess the outperformance of the Smart beta strategies over the market benchmark. Each Smart beta is oriented to a specific risk factor as mentioned in the previous sections. We have collected the daily closing prices of each Smart Beta and we have calculated the daily logarithmic returns per day, i.e. $r_t = \ln\left(\frac{P_t}{P_{t-1}}\right)$, where P_t is the closing price of the day t . From the times-series of daily returns, I computed the sample mean, the standard deviation and the Sharpe ratio. We also calculated the equivalent monthly metrics to get a clearer picture of the results. Finally, in the case of the United States, I have performed an analysis of variance, which is an analysis that allows determining if the portfolios show significant differences in their population averages. An analysis of variance was made for each Smart beta that will be developed in the next section.

The second part of the empirical analysis is about the Spanish case. I decided to create a Smart Beta based on our reference index, which is the IBEX 35. We have compiled from Google Finance, the daily closing prices of each one of the constituents that constitutes pf this market index, over a period of 5 years, since January 2012 until

December 2017. I have decided to collect data from this source, because it is one of the few updated databases that allows you to obtain the prices of each value in different periods of time. It also allows you to export the data to an Excel spreadsheet, what facilitates and speeds up the collection of data.

Once all the prices of the Spanish companies listed on the Ibex 35 were collected, the standard deviation, the mean and the Sharpe ratio were calculated. These metrics were also expressed into their monthly equivalents to see the differences between the smart beta versions. In the following sections, the results will be compared.

- Sharpe ratio

The Sharpe ratio is a measure of profitability adjusted for the level of risk. This ratio measures the excess return, with respect to the risk-free asset, for each unit of risk assumed in the investment. It is very useful to compare funds with homogeneous investments at risk. Although it has certain limitations that can generate erroneous results, for example, if the distribution of probability of the returns is not similar to the normal one and if it is compared in funds that make an active use of the derivatives to cover the risk. The higher the ratio, the greater the profitability of the fund.

$$Sharpe\ ratio_i = \frac{\mu_i - r_f}{\sigma_i} \quad (3)$$

where $\mu_i - r_f$ represents the average return of the smart beta strategy over there risk-free asset and σ_i is its standard deviation.

- Standard deviation

It is a measure of dispersion used in statistics that tells us how much the individual observations tend to move away from the average in a distribution of data.

$$\sigma = \sqrt{\frac{\sum(x_i)^2 f_i}{N} - (\bar{X})^2} \quad (4)$$

- Mean

It is the value that would correspond to each one of the data of the distribution if its total sum was distributed equally.

$$\bar{X} = \frac{\sum x_i f_i}{N} \quad (5)$$

Once we calculate these values for all funds, the historical weights of the 35 shares that make up the Ibox 35 were calculated through the Excel program, in order to create our portfolios according to the chosen risk factor. Next, it will be explained in more detail.

7. Comparison Smart beta VS index of reference USA

Currently there are many Smart Beta available for investors in the market, here we will focus on 7 Smart beta of the US market and its reference index, represented in the first column of Figure II, where they were evaluated and are related to the types of factors mentioned in the document. The performance of each one is derived from the same database described above, with a sample period covering from April 2013 to February 2018. Then, different indices have been calculated that facilitate the comparison of the different Smart Beta.

For comparison purposes, the evolution of the market index is also shown, taking as a reference the Standard & Poor's index (S & P 500). It is the most important index in the United States and it is considered the most representative of the current and real situation of the financial market. Based on the market capitalization of the 500 large companies listed on the NYSE or NASDAQ stock exchanges, this index captures approximately 80% of the market capitalisation of the United States. The annual average yield of the benchmark index during this period is 12.05%, with a Sharpe ratio of 0.98 and a standard deviation of 12.23%. For a stock to have a better performance, both the average and the Sharpe ratio must be higher than those of the benchmark. The only ones that outperform it were the Smart beta with small capitalization and Momentum, although this does not mean that, in any case, they give better returns than the reference index. This Figure also shows us the worst performance that Smart Beta can achieve, which in this case is the Smart Beta is directly related to the dividend factor, giving an average of 9.24%, a standard deviation of 11.43% and a Sharpe ratio of 0.8088. The rest of the results that we can observe in Figure II are quite homogeneous with each other, with an average return of 10% to 11% per year and a Sharpe ratio between 0.87 and 0.98.

Table I: Performance of the smart beta ETFs in the USA.

Smart beta	Average return	Standard deviation	Sharpe ratio
iShares Select Dividend ETF	9,24%	11,43%	0,8088
iShares Edge MSCI Min Vol USA ETF	10,14%	10,33%	0,9818
iShares Edge MSCI USA Momentum Factor ETF	16,79%	13,64%	1,2307
iShares Edge MSCI USA Size Factor ETF	11,15%	11,54%	0,9666
iShares MSCI USA Equal Weighted ETF	11,08%	12,72%	0,8713
iShares S&P 500 Value ETF	9,36%	12,39%	0,7557
MSCI EMU Small Cap	17,06%	14,72%	1,1590
S&P 500 Index	12,05%	12,23%	0,9854

Table I shows the average, standard deviation and Sharpe ratio of the seven Smart Betas chosen from the USA. UU and its benchmark S & P 500 Index

The average returns and the standard deviation are both expressed in annual terms. The values of the sharpe ratio are calculated with the appropriate values of annual return and volatility, where the risk-free rate is approximated by the 1-month Treasury bill. The performance statistics in Figure II show that only the Momentum and Small Cap strategies outperformed the benchmark in both the mean and the Sharpe ratio.

7.1 Tracking error of the USA Smart betas

According to Gallagher (2006), the tracking error is a risk indicator. It is used to evaluate the replication of the fund in relation to the benchmark. It is the measure of the difference in profitability between a certain portfolio or fund and its benchmark and it shows the volatility of the difference in profitability. The tracking error is measured as the difference between the performance of the fund and the returns of the underlying benchmark. In theory, ETFs are designed to replicate the index, so there should be no differences between them and the index. However, as mentioned above, there are synthetic repetitions that use derivatives instead of buying the assets that make up the index, so there is room for differences.

Colloquially, we know as 'management risk', the freedom that a manager takes to invest in assets outside the reference index, although it is also called 'specific risk'. The intervals for the interpretation of the tracking error are:

- Between 0% and 2% we would speak of a passive management.

- Between 2% and 5%, we would be facing a management with a little more risk, but controlled.
- A fund with a tracking error higher than 5% would indicate that we would be facing an active management.

We performed an analysis of variance for each Smart Beta, because although smart beta indexes seek to focus on exposures to specific factors, but many of them also seem to present unexpected exposures to other factors. The result obtained can be seen in Figure III. In this Figure we show the estimates of times-series regressions of equation (2), using the daily returns of our set of Smart Beta as the dependent variable. We collect the explanatory variables in equation (2) from the daily returns of the risk factors available in professor Kenneth French's website.

It is possible to assume that an ETF that follows the strategy of a factor will have a reasonably pure exposure to the intended factor, however after our analysis we can see that it shows unexpected results.

- iShares Select Dividend ETF.

This strategy pursues the Dividend factor, but as can be seen in Figure III, it is also subject to several secondary exposures. It suffers a high exposure to the market factor. This could be because the dividend factor follows the stock that in past years distributed more dividends, and most of them depend a lot on the market factor. Therefore, we can say that the dividend factor is related to the market factor.

- iShares Edge MSCI USA Momentum Factor ETF.

This strategy pursues the Momentum factor, but as can be seen in figure III, it is also subject to various secondary exposures. Suffers a high exposure to the market factor, this could be because the momentum factor follows an objective of following the actions that in past years had benefits, this depends a lot on the market factor. Therefore, we can say that the momentum factor is related to the market factor.

- iShares Edge MSCI USA Size Factor ETF.

This strategy pursues the size factor, as you can see this factor is negatively related to its exposure factor, and is subject to the market factor. It is possible to assume that it follows the market factor and that the market is composed of big companies, and therefore has a high correlation.

Table II: tracking error Smart beta of USA.

ETF	Intercep	P-value	MKT	P-value	SMB	P-value	HML	P-value	MOM	P-value	R2
iShares Select Dividend ETF	-0,0001	0,4153	0,8074	0,0000	-0,0639	0,0019	0,1609	0,0000	-0,0148	0,3177	0,7727
iShares Edge MSCI USA Momentum Factor ETF	0,0000	0,8087	1,0096	0,0000	-0,1410	0,0000	-0,2800	0,0000	0,2447	0,0000	0,9292
iShares Edge MSCI USA Size Factor ETF	-0,0001	0,0934	0,9076	0,0000	-0,0647	0,0000	0,0252	0,0219	-0,0162	0,0257	0,9462
iShares Edge MSCI Min Vol USA ETF	-0,0001	0,4487	0,7777	0,0000	-0,2265	0,0000	-0,1350	0,0000	0,0568	0,0000	0,8571
iShares MSCI USA Equal Weighted ETF	-0,0001	0,0002	1,0068	0,0000	-0,0249	0,0011	0,0047	0,5737	-0,0913	0,0000	0,9746
MSCI EMU Small Cap	0,0003	0,2321	0,6792	0,0000	-0,0505	0,2777	0,0816	0,1081	-0,0513	0,1254	0,3177
S&P 500 Index	-0,0001	0,0357	0,9691	0,0000	-0,1467	0,0000	-0,0382	0,0002	-0,0236	0,0005	0,9574
iShares S&P 500 Value ETF	-0,0001	0,0000	0,9711	0,0000	-0,1171	0,0000	0,2415	0,0000	-0,0731	0,0000	0,9725

Table II shows the tracking error of the seven Smart Betas chosen from the USA and their reference index S & P 500 Index

- iShares Edge MSCI Min Vol USA Factor ETF.

This strategy, which can be seen in Figure III, deals with the companies with the least volatility of the market, it can be seen that the risk factor to which is more exposed is the market risk factor.

- iShares Edge MSCI USA Equal Weighted ETF.

In the equal weighting strategy found in figure III, this strategy does not have any reference factor on this occasion, since it weighs all the shares equally, regardless of their stock market capitalization. But it can be seen that the risk factor that is most exposed is the market factor.

- MSCI EMU Small Cap.

This strategy pursues the risk factor of small capitalization companies, since it can see that this factor is positively related to the market factor. It can be assumed that it also follows the market factor and that it is composed of companies that have a small capitalization and, therefore, has a high correlation.

- iShares S&P 500 Value ETF.

This ETF pursues to replicate the benchmark index, so its relationship coefficient should be 100%, in this case it is approached with 97.25%. Therefore we can say that it replicates our reference index almost perfectly.

- S&P 500 Index.

This is the reference index therefore its ratio should be 100%, in this case it is not but it is close, being 95.74%.

After seeing this figure III, and see how Smart beta behaved with its risk factor, we can say that all the ETFs that have been analyzed follow the Market factor to a large extent. This can be explained as the fundamental risk when try to invest is the market risk, and that is why it affects all our Smart betas chosen for this analysis.

7.2 Excess of return of the Smart beta of the United States

In the following Figures we can see the excess returns of the strategies chosen in the US over its reference index, from April 2013 to January 2018, where the weights were determined annually.

Figure II: Excess return dividend strategy of the United States.

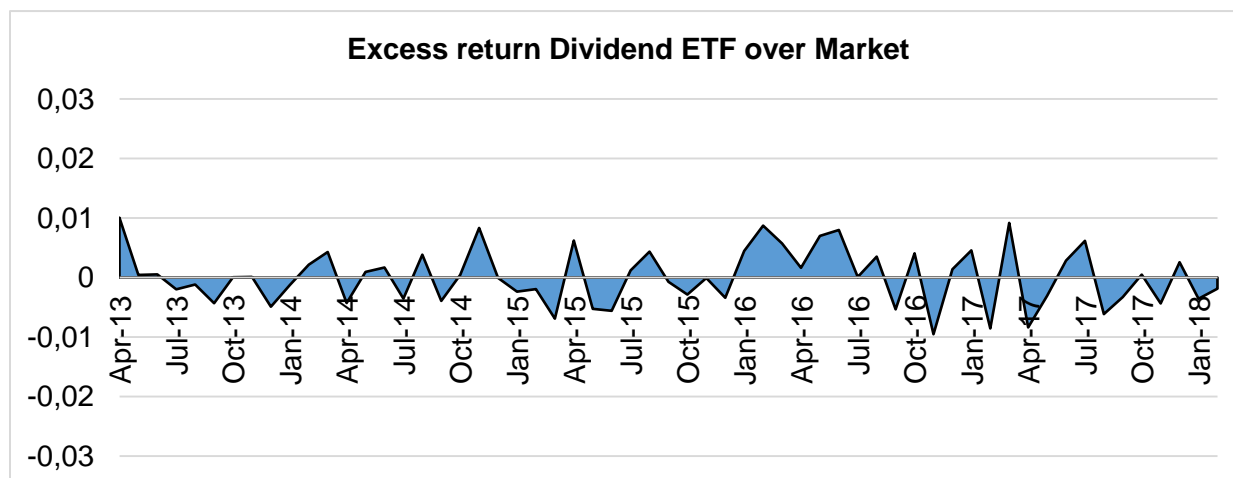


Figure II shows the excess return of the Smart beta of Dividends over the market of US.

The strategy of the previous figure is based on investing more in the companies that obtain more returns for dividends. As you can see their returns are not constant, they fluctuate between 0.01 and -0.01. At first glance we see more negative than positive returns.

Figure III: Excess return Momentum strategy of United States.

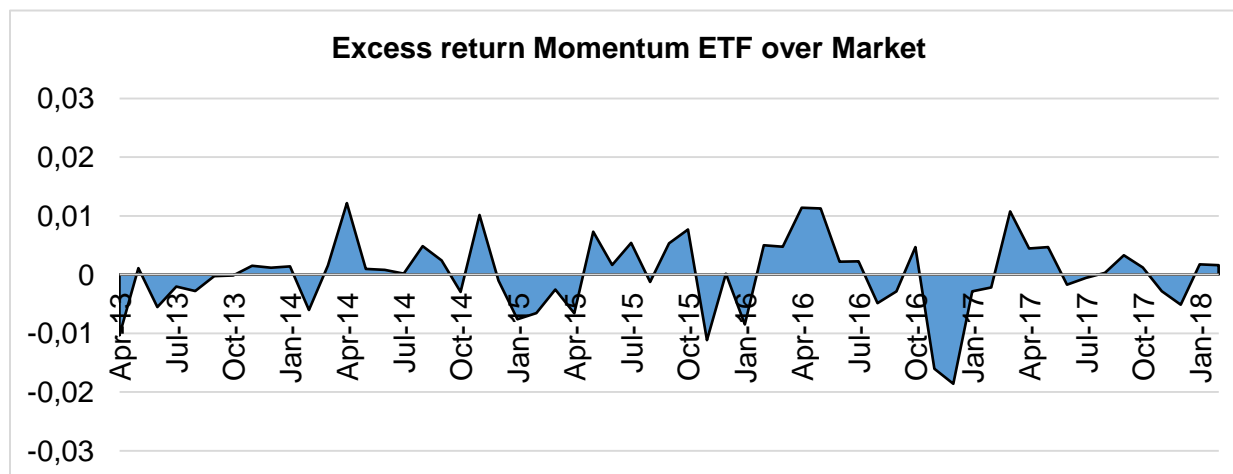


Figure III shows the excess return of the Smart beta of Momentum over the market of US.

Figure IV: Excess return low volatility strategy of the United States

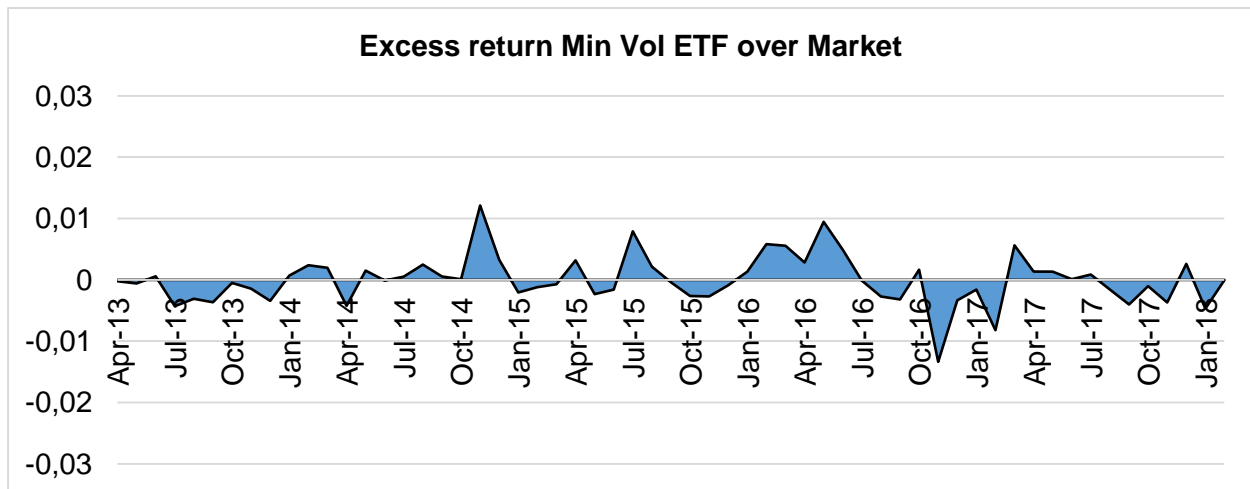


Figure IV shows the excess return of the Smart beta of Low volatility over the market of US.

The previous figure deals with the momentum strategy, which invests in companies that in previous years have had positive returns. It can be seen that from October 2016 to January 2017, their returns were negative, reaching a maximum loss of 2%, with their worst results during the period. We can see that there are more positive than negative returns, therefore it can be said that if we invest in this strategy it will give us benefits, although it seems more risky.

Figure V: Excess return small size strategy of the United States.

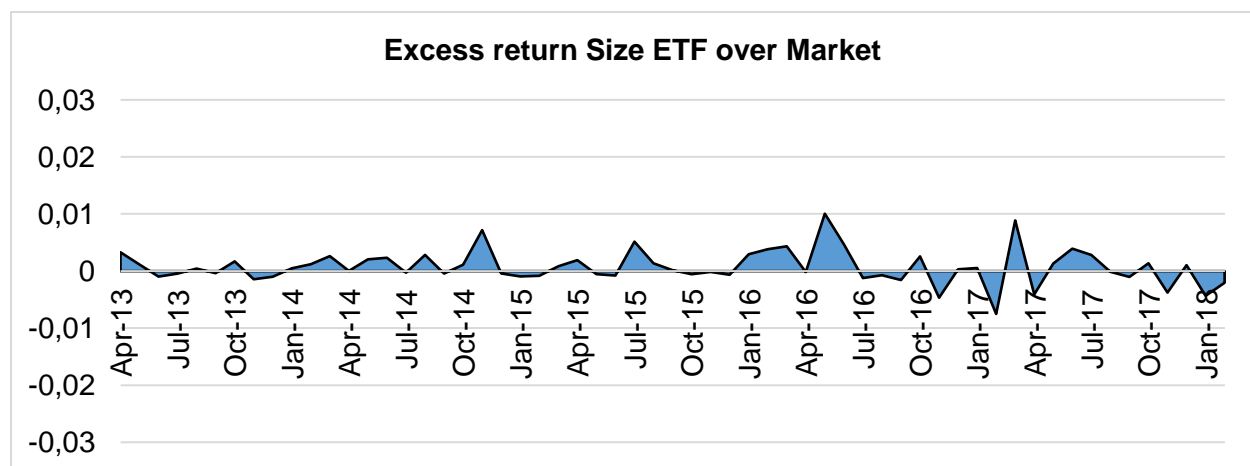


Figure V shows the excess return of the Smart beta of Small size over the market of US.

In the previous figure, the excess returns of the strategy pursued by the smaller size factor are represented. Its results during most of the period were positive until July 2016, which was where it began to have negative results that did not reach the monthly 1%.

Figure VII shows the excess return of the Smart beta of Low volatility over the market of US.

The previous figure deals with the risk factor of minimum volatility on the market. It includes the companies that currently weight less in the reference index. It can be observed that it seems to have more negative than positive results. During the period, its positive results are few in number during and not very significant.

Figure VI: Excess return of Equally-weighted strategy of the United States.

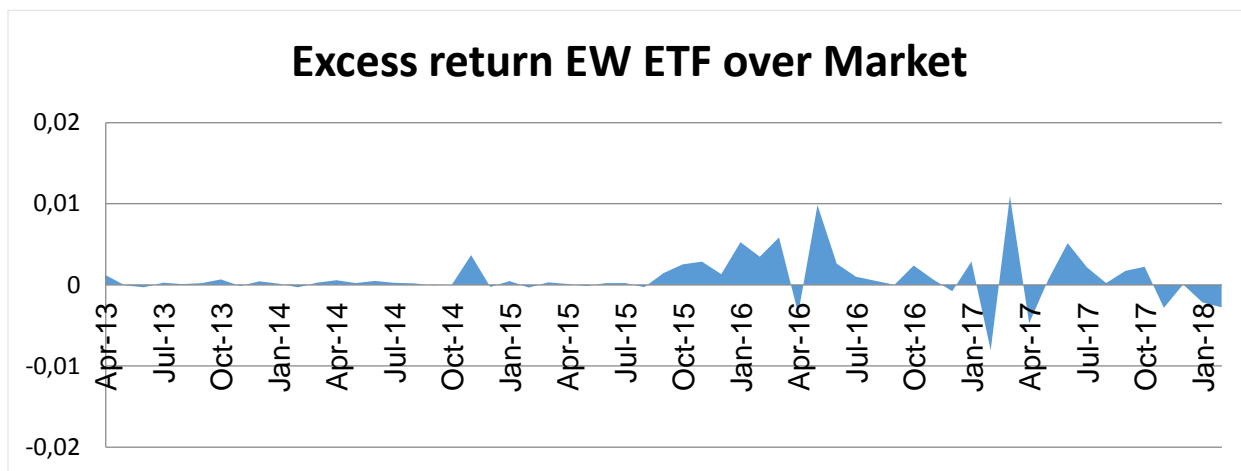


Figure VI shows the excess return of the Smart beta of Equality weighted over the market of US.

In the previous figure, it is about the strategy that weights equally each stock. It is observed that all results are positive until April 2016. It is seen that there are only negative yields in specific periods. We can say that investing in this strategy will give us higher returns.

Figure VII: Excess return small business strategy of the United States.

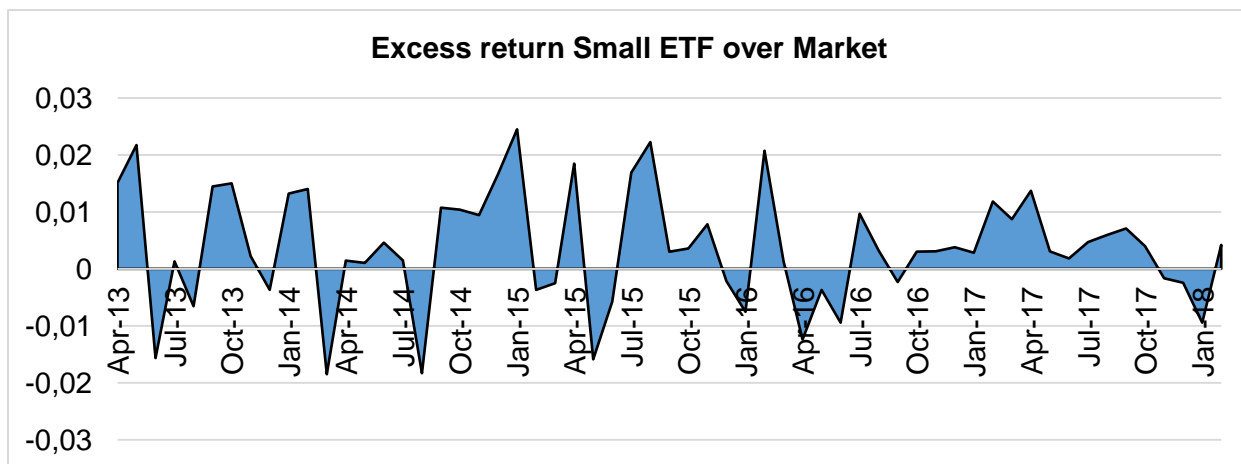


Figure VII shows the excess return of the Smart beta of Small business over the market of US.

In the previous figure we can see that it has many spikes during the period, but most of the returns are positive. Its returns range between 0.025 and -0.02. But, it can be seen as one of the most risky options available.

8 Comparison Smart beta vs market index in Spain

Currently, in Spain we only have two Smart Beta of our reference index for investors in the market, which are the Ibex Top Dividend and the Ibex Small Cap. For this project, I have formed five Smart Beta from our Spanish reference index, which is the Ibex 35. It is the main reference index of the Spanish stock market, prepared by Bolsas y Mercados Españoles (BME¹). It is formed by 35 companies contained in the System. of the Electronic Securities Intercommission (SIBE²). Similar to the S&P500 index, it also weights its constituent by market capitalization.

To create the new Smart beta, first, using the methods and risk factors mentioned above, I have collected the daily closing prices for the period from 2012 to 2017 of the thirty-five values that constitute the Ibex 35 index. I have also collected the daily closing prices of the two Smart Betas that we already have in Spain (IBEX35 and IBEX35 Top Dividend).

The five Smart Betas that I have created are divided into three types of risk factors, which are the following:

- Equally-weighted: in our case the thirty-five shares that are in the Ibex 35, will weight equally within our Smart beta regardless of its capitalization.
- Momentum only assets: with the closing prices and the logarithmic returns, we compute the annual returns of each stock. We consider in our portfolio only those stocks that give us positive returns. We weights these stocks proportionally to the returned offered during last year, so the stocks that offer higher return will have a higher weight in our portfolio.
- Momentum all: with the closing prices and the logarithmic returns, we compute the annual returns of each stock. In this case, we will take all the stocks and weighted them

¹ Grupo Bolsas Mercados Españoles (BME) is the operator of all the securities markets and financial systems of our country

² The Spanish Stock Exchange Interconnection System (SIBE) is an electronic system that allows the trading of equity securities admitted to trading on the national stock exchanges and offering information in real time on the activity and trend of each security.

according to their performance, except for the stock that gives the worst performance during the last year (which will weight zero). Similarly to the previous case, we weight the reminding stocks proportionally to the returned offered during last year, so the stocks that offer higher return will have a higher weight in our portfolio.

- Volatility only assets: with the closing prices and the logarithmic returns, we will solve a simple minimum variance allocation problem. We will compute a covariance and an inverse matrix of the same, then the inverse matrix will be multiplied by the vector of ones. With the solution to this problem, we will weight our portfolio of stocks. In this case, only the stocks with positive weights will be included in the portfolio so we re-scale our original weights accordingly.
- Volatility all: with the closing prices and the logarithmic returns, we will solve a simple minimum variance allocation problem. We will compute a covariance and an inverse matrix of the same, then the inverse matrix will be multiplied by the vector of ones. With the solution to this problem, we will weight our portfolio of stocks. In this case, we will take all the stocks available and we will consider the maximum negative weight as our new minimum weight. Then, we re-scale the obtained weights according so they add up 1.

We have also analyzed two Smart Beta that are currently available to investors in the Spanish market and have been used in this project, which are:

- Ibex Top Dividend: it is an index designed to collect the behavior of companies that offer a higher dividend yield in the Spanish market. It incorporates the 25 companies with the highest dividend yield and the values will be weighted in this index based on their returns adjusted by dividend yield, by the company's free float (number of outstanding shares – number of restricted shares) and with a liquidity ratio based. The maximum weight allowed for each individual stock is 10%.
- Ibex Small Cap: It is an index that is made up of the 30 securities of the Spanish stock market whose capitalization values are less traded in the Spanish stock market. It is a price index weighted by stock market capitalization adjusted by floating capital. The maximum weight allowed for each individual stock is 20%.

The performance statistics for each Smart Beta are shown in the first column of Figure IV. The performance of each one is derived from the same database described above, with a sample period from January 2012 to December 2017. .

For comparison purposes, the evolution of the market is also shown, taking as benchmark the IBEX 35. The average annualized return of the reference index during this period is of 3.48% with a relation with the Sharpe index of 0.1748 and a standard deviation of 19.91%. In this case, according to the analysis, all the smart beta, both created and existing, exceed the reference index, so we can say that the Figure shows that these strategies will obtain the maximum performance that the risk factor allows them.

Table III: Performance of the smart beta ETFs in Spain.

Smart beta	Annual average return	Standard deviation	Sharpe ratio
EQUALITY	7,69%	19,16%	0,4014
IBEX 35	3,48%	19,91%	0,1748
IBEX SMALL CAP	13,83%	16,92%	0,8174
IBEX TOP DIVIDEND	8,27%	18,72%	0,4419
MINIMUM ACTIVE	6,26%	15,56%	0,4023
MINIMUM ALL	7,69%	18,03%	0,4267
MOMENTUM ACTIVE	5,86%	17,87%	0,3278
MOMENTUM ALL	6,00%	17,41%	0,3443

Figure X shows the average, typical deviation and the Sharpe ratio of the seven Smart betas chosen from Spain and their reference index Ibex 35.

The average returns and the standard deviation are both annual figures. The values of the Sharpe ratio are calculated with the appropriate values of annual return and volatility, where the risk-free rate is approximated by the 1-month T-bill. The performance statistics in Figure IV show us that all the strategies adopted exceeded the benchmark in both the mean and the Sharpe ratio.

8.1 Excess of return of the Smart beta of Spain

In the following Figures, we can see the returns of the new smart beta strategies created for Spain together with their reference index, from January 2013 to October 2017, where the weights were determined annually according to the factor chosen for each of the strategies. The analysis conducted was out-of-sample, creating the risk factor using the data from the previous year and applying the corresponding date for the following year. The weights for each strategy were rebalanced at annual frequency. All the strategies had very high positive returns until April 2014. After this, the returns of all the strategies decreased. Each graph will be explained in more detail now.

Figure VIII: Excess return Minimum active strategy of Spain.

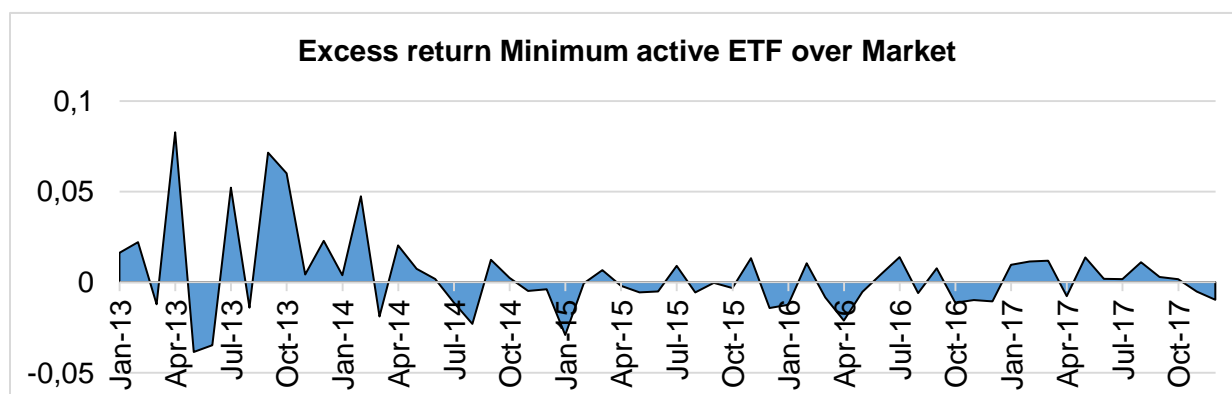


Figure VIII shows the excess return of the Smart beta of Minimum active over the market of Spain.

According to the previous graph, which represents the excess returns over the market index of the strategy pursued by the minimum volatility factor (in the case we only use stocks with positive weights), it can be seen that until April 2014 it had a fairly high profitability, less in May 2013 where it had negative returns that reached -4%. As of 2015, their returns were not constant, suffering more negative than positive returns.

Figure IX: Excess return Minimum all strategy of Spain.

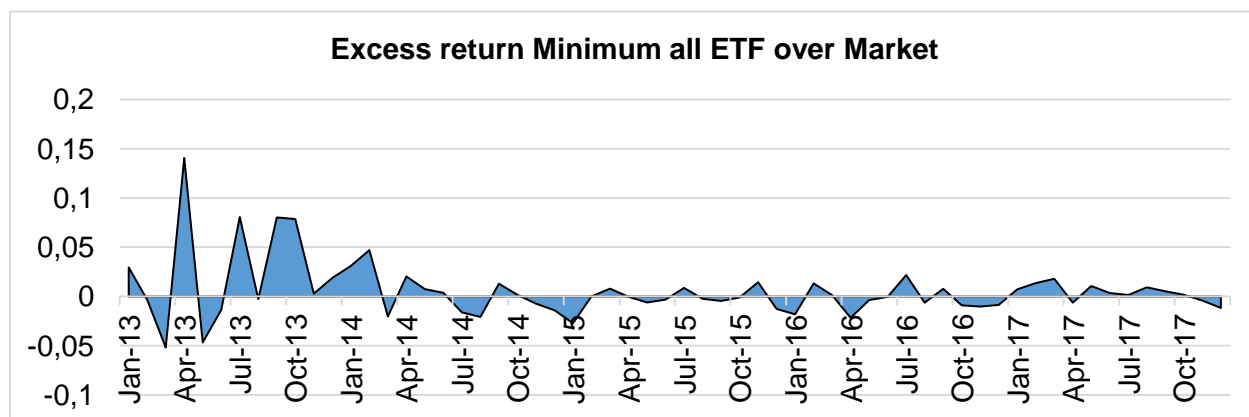


Figure IX shows the excess return of the Smart beta of Minimum all over the market of Spain.

According to the previous graph, which represents the excess returns over the market index of the strategy pursued by the minimum volatility factor using all assets, it can be seen that until June 2014 it had a fairly high profitability, less in February and May 2013 where it had negative returns that arrived at -5%. As of 2015, their returns were not constant, but it could be concluded that they had more positive than negative returns until the end of the period.

Figure X: Excess return Equally-weighted strategy of Spain.

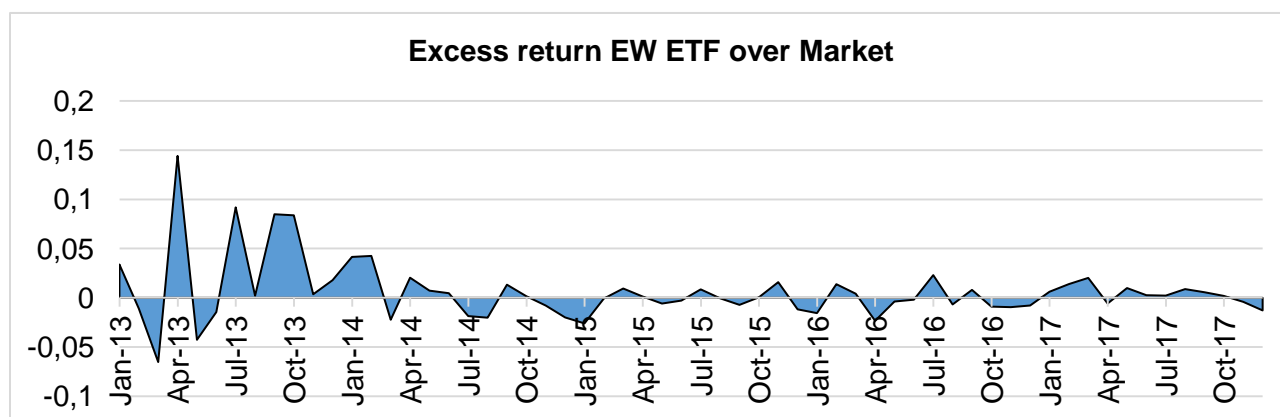


Figure X shows the excess return of the Smart beta of Equality Weighted over the market of Spain.

According to the previous graph that talks about the excess returns of the strategy that equally weights each share, it can be seen that until February 2014 it had a quite high profitability, less in February and May of 2013 where it had negative returns that arrived exceeded -0.5%. As of March 2014, their returns were not constant, but it could be concluded that they had more positive than negative returns. Since 2017, all their returns were only positive.

Figure XI: Excess return Momentum active strategy of Spain.

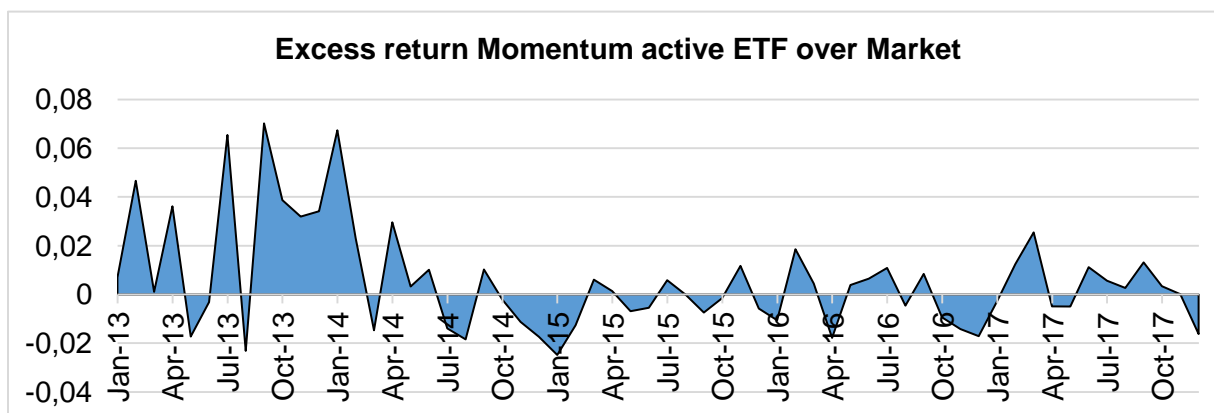


Figure XI shows the excess return of the Smart beta of Momentum active over the market of Spain.

According to the previous graph that talks about the excess returns of strategy pursued by the momentum factor (where only we included the stocks that had past positive returns), it can be seen that until June 2014 it had a fairly high profitability, less in May and August 2013 where it had negative returns that were not very significant. As of July 2014, their returns began to be negative for several months, always without exceeding -3%. As of February 2015, their returns were not constant but it could be concluded that they had more positive than negative returns until the end of the period.

Figure XII: Excess return Momentum all strategy of Spain.

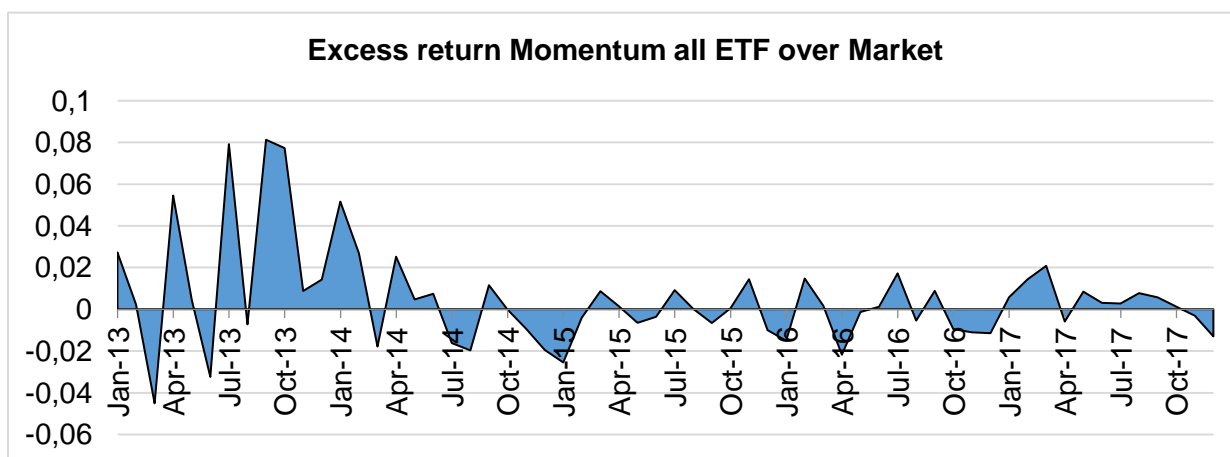


Figure XII shows the excess return of the Smart beta of Momentum all over the market of Spain.

According to the previous graph which shows us the excess of returns of the strategy pursued by the momentum factor where we consider all stocks regardless of their performance, it can be

seen that until February 2014 had a fairly high profitability, less in March and June 2013 where had negative yields that came down to -4%. In 2014, the returns have not been constant, but it could be concluded that they had more positive than negative returns until the end of the period.

As we have seen in all the previous graphs, most of the strategies are very similar. This is because all smart betas use the same constituents but weight them differently in order to create the portfolio. It can also be said that in all of them they outperform the returns of the benchmark index. Possibly the low performance of the market benchmark could be explained by the fact that our financial market has just emerged from a global financial crisis, and at the moment it is still expanding. This crisis produced an increase in unemployment which in turn affected the financial market, causing the banking crisis, and these effects are still shown in the market.

8.2 Simulating investment with the new Smart beta

After completing the creation of the new Spanish Smart Beta, they were tested by fictitiously investing € 30,000 in each one, including the reference index. Therefore, it is possible to better observe which of the Smart Beta offers more benefits with a sampling period of 5 years. This will help us conclude if it is advisable to invest in our alternatives of the Smart Beta or, on the other hand, would not be an attractive investment.

Table IV: Results obtained from the investment in the Spanish Smart Betas

Smart beta	01/01/2013	01/01/2014	01/01/2015	01/01/2016	01/01/2017	29/12/2017
Equality	30.000,00 €	40.596,39 €	40.416,20 €	40.509,93 €	37.559,88 €	39.933,49 €
Ibex 35	30.000,00 €	34.059,77 €	34.269,08 €	31.198,14 €	30.481,28 €	32.234,98 €
Ibex Small Cap	30.000,00 €	41.787,40 €	36.982,48 €	37.415,66 €	41.883,00 €	53.728,14 €
Ibex Top Dividend	30.000,00 €	38.989,30 €	42.132,85 €	35.781,92 €	37.535,87 €	41.025,77 €
Minimum Active	30.000,00 €	37.380,95 €	40.021,75 €	40.973,54 €	35.399,81 €	38.350,45 €
Minimum All	30.000,00 €	40.090,04 €	41.016,70 €	41.359,24 €	37.549,72 €	40.203,88 €
Momentum Active	30.000,00 €	39.595,09 €	41.042,07 €	40.985,56 €	36.128,74 €	36.887,51 €
Momentum All	30.000,00 €	38.494,29 €	38.691,19 €	39.629,15 €	35.396,03 €	37.282,23 €

Table IV shows the results obtained from the investments made in the Spanish Smart Betas, showing both the products that have been created and those already existing, during the period between January 2013 and December 2017, with an initial investment of € 30,000.

As you can see in the first column, the initial investment of all the portfolios is € 30,000. Over the years, which it has obtained the worst results was the Ibex 35 index, which was obtained a return after 5 years of € 2234.98. All our betas strategies are investing in the same constituents than the Ibex 35 index, but instead of weighting them according to the market cap, we used the criteria outlined in section 16.

The Smart beta with more accumulated profit after 5 years would have been the small capitalization with a profit of € 23,728.14 after 5 years. We can say that this beta is currently in our market. Coincidentally the two Smart Beta that obtained more benefits in our simulation are the two Smart Beta that are currently available to investors in our Spanish financial market. This shows that with these products we can obtain better returns than with the benchmark index. Since they are already available in the market, it can be assumed that they will have carried out studies to know if they are efficient and would exceed the index and, therefore, they are available to investors. We should ask ourselves why the Smart Betas we have created are not available in the market, since they also exceed the benchmark.

From our set of Smart Betas that we created with the aforementioned risk factors, the one which obtained more profit after 5 years is the Smart Beta that pursues the low volatility factor with all the shares, with a total profit of € 10,203.88 after 5 years. It must be remembered that this option chose the stocks that had low volatility levels during the previous year. The strategy followed by the Momentum asset risk factor is the one with the worst returns, with only € 6,887.51 in profits after 5 years. It should be remembered that this factor pursued the stocks of companies that had previously worked well, but taking only those that had past positive returns.

With these results, we can confirm that all Smart Beta have outperformed our Ibex 35 reference index, and therefore, when investing in portfolios, it will be more convenient to make profits to invest in a Smart Beta than in the Spanish reference index.

9. Conclusion

In this paper on the investment of Smart beta, I have reviewed the academic theories underlying to these investment strategies. There are already different investors that have created investment strategies that pursue the risk factors stated in these academic theories. Using these models, I have managed to create new smart beta portfolios and analyze their results, which we have proven to outperform the Spanish reference index.

This bachelor's dissertation has been very difficult to carry out because of the few studies that are on the Smart beta, since the professionals who are dedicated to this exclusively do not share their models so they are not replicated by competitors. These strategies are becoming a popular vehicle in our market and they are increasingly making their way into the most powerful investment companies. Being such a novel product, it does not yet have great confidence among investors, but seeing its results, it would be a highly recommended practice.

After analyzing all the results I have concluded that the Smart Beta are a novel, little known and highly recommended for investing. Their returns in some cases are not outstanding, but in all of them the reference index has been exceeded. All this is possible from rules long established in the academic world. As a word of warning, you need to have confidence in the proposed model and review it periodically.

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