SMART BETA ETF'S PERFORMANCE: A EUROPE-DOMICILED SAMPLE

Mª Elena Monserrat Tolós

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Tutor: Dr. Miguel Ángel Martínez Sedano

Universidad Complutense de Madrid

Universidad del País Vasco

Universidad de Valencia

Universidad de Castilla-La Mancha

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Mª Elena Monserrat Tolós

Supervisor:
Dr. Miguel Ángel Martínez Sedano[a]

[a] University of the Basque Country, Avda. Lehendakari Aguirre, 83, 48015 Bilbao, Spain

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University of Castilla la Mancha

Complutense University of Madrid

University of the Basque Country

University of Valencia

ABSTRACT

Exchange Traded Funds (ETFs) have increased their relevance in markets as a new product accessible for all kind of investors. Recently a kind of ETFs has appeared as a great innovation to outperform capitalization-weighted strategies. They are Smart Beta ETFs, which take its name from Smart Beta (SB) strategies. They are active strategies that use simple, rules-based, transparent approaches to build portfolios that deliver static exposures (relative to cap-weighted benchmarks) to characteristics traditionally associated with excess risk-adjusted returns.

Do Smart Beta ETFs keep their promise of outsmarting traditional cap-weighted indexes? In a context of European markets, the main objective of the paper is to evaluate SB ETFs compared to traditional ETFs, in relation to their ability to provide the intended exposure and their potential to deliver improved raw and risk-adjusted returns as a result of this exposure. As well as empirically assessing the efficiency of SB funds in capturing documented factor risk-premiums by means of static and dynamic factor allocation.

Similar questions about Smart Beta ETFs have been analysed in previous papers. We observe that, in general, Smart Beta ETFs performance is better than those non-SB, based on performance indicators, and this kind of ETFs are able to replicate fairly the benchmarked index. The main argument that professional asset managers have for using equity Smart Beta is to gain exposure to rewarded risk factors with the purpose of achieving an efficient risk-adjusted return with ease of implementation. In addition, at the same time they are aware of being exposed to a risk of unintended consequences of undesired risks.

Keywords: Exchange-Traded Fund, Smart Beta Strategy, Benchmark replication, Performance/Risk measures.

CONTENT

1. Introduction

Exchange Traded Funds (ETFs) have increased their relevance in markets as a new product accessible for all kind of investors. Recently a kind of ETFs has appeared as a great innovation to outperform capitalization-weighted strategies. They are called Smart Beta ETFs, which take its name of Smart Beta (SB) from strategies that follows other approaches than weighting assets by capitalization, for example, by value, dividends or momentum, among others. ETFs and SB strategies are going to be explained later in more detail to completely understand SB ETFs, the key instrument in this paper.

The principal aim of this paper is to assess the efficiency of ETFs in European markets as substitutes of investment in a particular market index. This study of efficiency will be done comparing Smart Beta ETFs and traditional ETFs whose benchmark is capitalization-weighted. Do Smart Beta ETFs keep their promise of outsmarting traditional cap-weighted indexes? That is, the main objective of this paper is to evaluate the SB ETFs compared to traditional ETFs, in relation to their ability to provide the intended exposure and their potential to deliver improved raw and risk-adjusted returns as a result of this exposure. As well as empirically assessing the efficiency of SB funds in capturing documented factor risk-premiums by means of static and dynamic factor allocation (Hsu (2014), Plyakha et al. (2014), Steward (2014), West and Larson (2014)).

Glushkov (2015) analyses similar questions about Smart Beta ETFs. Comparing SB ETFs to traditional ETFs, this author concludes that there is no conclusive empirical evidence to support the hypothesis that SB ETFs outperform their risk-adjusted benchmarks over the studied period in that paper. This author takes a sample of 164 equity US-domiciled ETFs during May 2003 until December 2014 and roughly 60% of SB ETF categories outperformed their declared benchmarks on a total return basis. In addition, only Value category offers benchmark-adjusted returns meaningfully different from zero. According to the evidence of his paper, the best relative performer (by the end of 2014) was Buyback Yield strategy that selects and/or weights their constituents based on some measure of cash (dividends, share repurchases, or debt retirement) returned to shareholders over a specified period. Value ETFs are in the second place generating excess annualized return of 1.83%, since the inception of the first Value-based SB ETF in March 2005, and beating their benchmarks by just 0.27% per year during last 5 years and underperformed by -1.56% during the last 12 months ending in December 2014. Also he finds proof for the hypothesis that static factor exposure is the main driver of SB ETFs performance, rather than systematic rule-based rebalancing, that is, the dynamic factor. He finds that most SB portfolios generally load positively on Size factor, suggesting that many SB ETFs tend to commove with smaller stocks after controlling for the corresponding benchmark because most alternative non-price-linked weighting schemes are likely to result in exposure to smaller stocks. In addition, he finds that most SB funds do not appear to commove significantly with value factor, although he expected that Dividend Weighted, Equal Weighted and Value categories would provide robust value exposure.

This paper tries to increase the analysis done until now and adding some contribution to this literature. Due to the fact that there are so much research about US-domiciled ETFs, we consider significant doing this research about Europe-domiciled ETFs, to broaden the investigation to other particular SB ETFs. In addition, Glushkov (2015) makes a comparison of the different categories of ETFs comparing ratios calculated from a portfolio of such ETFs, but in this paper we want to carry out another methodology. We calculate ratios and regressions for every ETF and make weighted averages for each ETF category with funds sizes as weights, looking for diversifying the methods of analysis to provide robustness to conclusions.

In relation to the efficiency of ETFs, we conclude that SB ETFs perform better according to risk-adjusted performance indicators. In addition, they are less risky if we consider risk indicators and they get excess returns over the benchmark index. Therefore, in general SB ETFs outsmart traditional ETFs, although conclusions do not consider the comparison of fund with similar features, so they cannot be taken for individually decisions without a specific analysis of the corresponding fund.

Regarding the replication aim of ETFs, we show that in general they track the declared benchmark with an average beta coefficient of over 0.90, without additional return. This unique factor is able to collect the whole return of the ETF, although adding factors the explanatory power increases. The most significant factors, apart from the benchmark, are Size and Investment. Analysing SB and non-SB ETFs, we can conclude that there are not significant difference in replication, even if, in general, SB ETFs have a higher beta than non-SB ETFs and tracking error for non-SB ETFs is almost twice the tracking error for SB ETFs. That is, the risk of replication is higher for non-SB ETFs than for SB ETFs. Therefore, we can conclude that SB ETFs behave better in relation to replicate its benchmark.

The paper is structured as it follows. Next section contains the definitions of the key instruments in this paper and specific information to understand them. In section 3 the sample and methodology are explained. Section 4 presents our empirical results and discusses their interpretation. We end with a brief conclusion in section 5 regarding the issues intended to study.

2. ETFs and Smart Beta strategies

Since the development of Modern Portfolio Theory (MPT), or mean-variance analysis, by Markowitz (1952) investors have been looking for efficient ways to diversify their portfolio in order to eliminate idiosyncratic risk and obtain efficient portfolios that maximize return minimizing risk. The most direct way to do this is replicating indices by buying all stocks of the index or, at least, a representative sample of them (Bernabeu (2014)). However, this strategy is not available for retail investors, who would have high transaction costs. Because of these problems, this kind of investors started demanding equity funds, so that they could buy stocks in large quantities resulting in lower transaction costs. This caused the appearance of the first passive mutual funds (index mutual funds). These funds are planned to replicate indices charging fewer fees to their customers than active mutual funds, which look to outperform a market index.

Active mutual funds follow active strategies based on the knowledge of professional managers to rebalance the position of the fund, paying higher fees in exchange. Investors give capital to the fund and it follows different strategies in order to obtain abnormal returns compared with an index reference, known as benchmark. In order to get so, active funds usually pursue investment strategies that focus in finding α stocks, which offer more (less) returns given their market risk β, that is, stocks offer higher (lower) returns that companies with the same risk (following CAPM[1]). Therefore, it can be a productive investment if active funds are able to find them.

Both indexed and managed funds have their positive aspects. The former is seen compelling to invest for the following reasons: simplicity, management quality, low portfolio turnover, low operational expenses, asset bloat and performance. They have made it very easy and relatively cheap to get broad market exposure for retail investors. But they have limitations in terms of liquidity and pricing efficiency.

The percentage of overall mutual fund assets linked to index-based products has increased from 9.5% in 2000 to 18.4% in 2013, according to the Investment Company Institute. The main reason for this rise is that buying an index fund guarantees that you will outperform the majority of other investors. Because a total market index fund captures the average return of all investors, before costs, and due to the lower costs of owning an index fund than any other strategy, after costs, an index fund will outperform the majority of investors (ETF.com (2005)).

Mutual funds are structured in two different ways: open-end and closed-end funds. On the one hand, open-end funds have important liquidity problems as their shares do not trade in organized markets. They can only be bought or sold back to the fund at the end of trading sessions for the Net Asset Value (NAV). This fact is not optimal as it increases transaction costs and reduces the ability of investors to liquid their investment. In addition, they also charge fees when buying or selling the fund's shares, decreasing even more liquidity and increasing transaction costs. This liquidity problem is an important concern for short term investors, as they need to make multiple transactions and to recover their money soon and with as low as possible

[1] Capital Asset Pricing Model, Sharpe (1964) and Lintner (1965).

transaction costs. Whereas for long term investors liquidity does not mean such a great problem because they plan to keep the money invested in the fund for a long period of time. Although the increasing costs and higher probability of default due to less liquid funds make them consider these restrictions before investing. On the other hand, closed-end funds are exchanged between individuals in organized markets, that is, they are traded like shares. But once the fund has issued shares, they cannot be redeem back, namely, that shares can only be purchased or sold in the market and not back to the fund. The price is not guaranteed to reflect the real value of the underlying assets, so these shares are at risk for significant price deviations between their market price and the value of the assets held by the fund. These deviations usually appear as a discounted price relative to the fund's NAV, showing that investors value the fund's shares less than the assets that back them. However, unlike the other kind of funds, there is not a mechanism through which investors can use arbitrage and eliminate deviations.

Given the rise of empirical research that showed that, in general, active funds underperform their index benchmark, as it can be seen in Malkiel (1995), and the acceptance that low-cost passive strategies can provide superior results than traditional actively managed funds, investors began seeking low-cost methods of replicating indices. At first, they demanded funds that could be easily tradable and not prone to substantial discounts from the NAV.

The increasing demands lead to appear the first generation of Exchange-Traded Funds (ETFs), known as Spiders and introduced in 1990 in Canada. They were hybrid funds between open-end and closed-end funds. They were passively traded portfolios of securities (similar to passive mutual funds), they were listed on exchanges like individual stocks (analogous to closed-end index mutual funds) so that they could be traded continuously throughout the trading session and they could be redeemed back to the fund provider for the NAV (like open-end index mutual funds). These products were created to avoid price deviations while continuous trading was allowed.

The advantages of ETFs made them to expand quickly to the rest of the world. Moreover, a new variety of products with similar structures were born next to ETFs. They are known as Exchange Traded Products (ETPs) and include Exchanged Traded Notes (ETNs), Exchanged Traded Commodities (ETCs), alternative ETFs, currency ETFs, active ETFs, inverse ETFs and leveraged ETFs.

In the year 2000, there were 106 ETPs with asset value of 79 billion US dollars. By the end of 2015, there were investments with asset value of 2,962 billion US dollars. Last available data about the number of ETPs was 4,759 with asset value of 1,944 billion US dollars at the end of 2012. This exponential growth can be seen in Figures I.1 and I.2 in appendix I. It shows how important these products have become in financial markets at present.

The five main advantages that investing in an ETF has are diversification, liquidity, transparency, flexibility and cost efficiency. ETFs give access to an index with a just subscription order, covering multitude of assets: stocks, bonds, commodities; or sectors: health, energy, gold. They offer high liquidity because they are listed on major exchanges and can be traded at any time during the trading session. In addition, liquidity is given to the underlying assets with the creation and redemption process. Usually, they focus on the most liquid segments of a particular asset class. ETFs are transparent because the underlying values are published daily and total fees of the vehicle are known. It is flexible because it allows investors to express their strategic and tactical asset allocation. They allow rebalancing the portfolio easily and quickly. Furthermore, they have efficient costs for allocation in a diversified portfolio. This fact has attracted pension funds, insurance companies and individuals.

ETFs are more efficient and more attractive than mutual funds due to the following characteristics: creation-redemption process, cost advantage, transparency, avoidance of principal-agent problem and tax efficiency. They are described next.

- The creation-redemption process (Ramaswamy (2011)) guarantees that prices do not vary much from the NAV, that is, it is a way that ETFs have engineered to avoid price deviations. The process assurances that the ETF market price does not differ much from its NAV as if mismatch occurs Authorized Participants (APs) will intervene exchanging ETF shares for underlying shares using arbitrage until market price and NAV are equal. An AP can be a market maker, a specialist or any other large financial institution with buying power. The system works as it follows. When an ETF provider wants to create new shares of its fund he contacts an AP, who buys all the shares that compose the benchmark index (or a representative sample) that the ETF replicates and exchanges them with the ETF provider for the ETF's equally valued own shares at their NAV. This process is only done for large blocks of shares, typically 50,000 or more. The exchange takes place in a fair value basis as the block of underlying shares and the ETF shares are equally valued at the NAV. The ETF provider gets the stocks that he needs to track the index and the AP gets ETF shares to resell for profit, so both participants benefit from the transaction. The process in reverse means that an AP can buy large blocks of the ETF shares and exchange them for the underlying benchmark shares at the NAV.
- ETFs have cost advantage opposite to mutual funds (Harper et al. (2006)). The majority of ETFs are passive investment products that usually try to track the performance of a market index. Therefore their turnover is low, because share transactions only occur for rebalancing aims. In addition, the passive approach does not require expensive fund's managers neither complex market analysis, therefore ETFs have lower costs. This cost advantage is shown in lower expense ratios that make them more attractive to investors,

who generally consider fees as one of the key determinants when choosing among analogous funds. Gastineau (2001) discusses the low expense ratios of ETFs and how ETFs manage to avoid significant capital gains contributions.

- Transparency is a principal feature of ETFs due to its nature. ETFs are usually listed in market exchanges and trade like shares. This fact forces them to comply with the exchange transparency and transmission of information rules, which includes the following ones. They are obliged to publish their financial statements and prospectus in order to inform investors of all relevant changes in the fund's policy and to disclosure the components of the fund, their weights and the NAV of their shares daily. All this allow investors to be aware of the fund's actions and conduct.
- In ETFs, as managers are specifically instructed to replicate a market index, they assume the same risk than the benchmark. In this way, these kind of funds avoid the principal-agent problem, well documented in many research papers like Grossman and Hart (1983) and Haubrich (1994). This problem happens when the manager of the fund makes decisions on behalf of investors (the owners of the fund), acting in his own interest instead of operating in the investors' interest. In addition, when salary of managers in active mutual funds is based in bonus or a stock-based compensation when they beat the market, they are incentivized to pursue riskier strategies to get higher expected returns.[2]
- There is tax efficiency in ETF. Taxes are minimized for the holder of the ETF because of its structure and, in addition, the last tax bill (when the ETF is sold and investors pay taxes for capital gains) is less than in a similarly structured mutual fund. ETFs administrate inflows and outflows by creating or redeeming blocks of ETF shares that are exchanged for an equally valued amount of benchmark stock, not creating any capital gains in the process. Dellva (2001) finds that transaction costs limit ETF attractiveness for small investors, but that creation-redemption processes provide the ETFs with significant tax efficiencies. In contrast, a mutual fund constantly rebalance by selling securities to accommodate shareholder redemptions or to reallocate assets. This fact creates capital gains for shareholder that are subject to taxes.

The increasing interest of investors for ETP made that investment banks started to enter the market offering different new characteristics and new replication methods appeared, therefore the market became more complex.

There are different types of replication methods, which made ETFs more dissimilar to others and to comparable investment products. Investors have to differentiate between physical and synthetic (swap-based) replication strategies (Ramaswamy (2011)).

[2] Nevertheless, a kind of ETFs called active ETFs try to outperform their benchmarks by pursuing active (alpha) strategies. These products are usually cheaper than equivalent active mutual funds, but suffer from the same disadvantages when trying to outperform market benchmarks (Malkiel (1995)).

- Physical replication strategy consists in physically holding all of the underlying index's constituents with the same weights than the target benchmark (see Figure I.3 in appendix I). Creation-redemption process (explained previously) describes the ETF investment process in more detail. This method entails higher transaction costs as a consequence of buying and rebalancing more stocks, however the risk of tracking error is lower.
  Similarly to physical replication strategy, sampling replication entails holding only a representative sample of the benchmark that is supposed to give nearly the same returns than it. This technique involves lower transactions costs because the fund needs to operate with less stocks, but it increases tracking errors.
- Synthetic replication tries to replicate an index benchmark using different derivatives, like swaps. ETFs invest (or may be directed to invest by the swap counterparty) in securities that may be unrelated to the benchmark index and also enter into a swap agreement with one or more counterparties who agree to pay the return on the benchmark to the fund (Dickson et al. (2013)). Even though there are two synthetic ETF structures (an unfunded and a funded swap structure), in both cases the swap counterparties are responsible for providing the index's return to the ETF investors. On the one hand, the unfunded swap structure makes use of total-return swaps (see Figure I.4 in appendix I). The ETF issues newly created shares to an AP in exchange for cash, which is used to acquire the substitute basket of securities from the swap counterparty while also entering into a total-return swap with the swap counterparty. So the fund owns the assets in the substitute basket. In the swap, the return generated by the substitute basket is paid to the counterparty, whereas the counterparty pays the ETF the return of the benchmark index. On the other hand, in the funded swap structure (see Figure I.5 in appendix I) the creation mechanism is similar to that of the unfunded model, although a swap-type payment is technically made in only one direction. The ETF delivers the cash to the counterparty, who posts a collateral basket into a segregated account with an independent custodian. In return for receipt of the cash, the counterparty is then responsible for paying the return on the benchmark index to the ETF. This system have lower costs (the need to rebalance is eliminated since they do not physically track the index) and more favourable tax treatment (in some countries, like U.K.) than the previous ways of replication explained. Another potential advantage of this method of replication over the other ones is that of relatively lower tracking error. Nevertheless, it has other risks like counterparty risk and lack of transparency.

This surge in demand has led to significant innovation in ETF offerings, including the introduction and widespread adoption of synthetic ETFs, especially in Europe. Even though there may be some benefits of investing in these products, there are important differences between traditional, physically based ETFs and synthetic ETFs that investors should be aware of before making any investment decisions.

According to Dickson et al. (2013), Vanguard's research and experience indicate that physically based ETF structures can provide the diversification, transparency, and liquidity that ETF investors seek. Nevertheless, synthetic ETFs may have sense in certain instances, such as when investors wish to gain exposure to markets that are hard to access or strategies that are not easily implemented. Even so, these funds have more counterparty risk than physical ETFs do, therefore investors should be compensated accordingly through lower tracking error or lower costs (the latter of which can lead to higher expected excess return). In Table I.1 in appendix I it is shown a summary comparison of physical versus synthetic ETF structures and in Table I.2 there are the distinguishing features of the two synthetic ETF structures.

Comparing physical versus synthetic ETFs, are investors in synthetic ETFs compensated for taking on the counterparty risk associated with a swap-based approach, through either lower total costs (and therefore the potential for enhanced excess returns) or lower tracking error? Generally, physically based ETFs have demonstrated a strong ability to deliver low-cost access with low tracking error to many broad-based indexes, suggesting that investors often may not need to take on the increased counterparty risk of synthetic ETFs. In some instances when costs and tracking error may be substantially higher, like for harder-to-access markets, difficult-to-implement strategies, or less-liquid benchmarks, synthetic ETFs may provide a competitive offering to access these markets.

According to Glushkov (2015), one of the fastest growing segments of ETF market that has been attracting a lot of attention in recent years are the so called Smart Beta ETFs. Now, Smart Beta (SB) strategies are going to be explained.

Nowadays, there is much research dedicated to try to beat the market. From that core of research, the idea of smart beta was first publicized by Arnott et al. (2005). The paper compares the returns of market-cap-weighted indexes with indexes that weighted securities based on a number of different "fundamental characteristics": book value, cash flow, revenues, sales, dividends and even the total number of employees at each company. The authors wanted to test whether indexes weighted by "Main Street" characteristics would outperform indexes weighted by the "Wall Street" characteristic of market capitalization. Market-cap-weighted indexes link the weight of a stock in the index with its market value. They noted that market-cap-weighted indexes have a systemic failure: they systematically overweight the most overvalued securities and underweight the most undervalued securities. The main advantage of market-cap-weighted index funds over actively managed strategies comes down to costs. As said by ETF.com (2005), index funds are low cost for management fees, low turnover, low trading spreads and high investment capacity. Firstly, index funds are index based, so they do not need many high-priced analysts and portfolio managers to run them. Secondly, index funds only rebalance when companies move into or out of the index or merge with other companies, so they don't have to trade a lot. Thirdly, index funds put the highest weights into the largest stocks, which tend to be the most liquid, so trading should be relatively cheap to execute. Lastly, index funds have very high investment capacity, that is to say that people can put a lot of money into index funds without impacting the market. The authors argue that well-designed fundamental indexing strategies should be able to capture these core features of traditional indexes.

In ETF.com (2015), Smart Beta is defined as a catchall term for rules-based, quantitative strategies that aim to deliver better risk-adjusted returns than traditional market indexes (market-cap-weighted indexes). It is known by many different names, such as Strategic Beta, Fundamental Indexing, Factor Investing and others. Practically, a Smart Beta strategy is any index-based strategy that either chooses securities or weights securities for an intentional reason other than their market capitalization, geography or sector classification. So Smart Beta is a broad term who breaks down into five major categories: Capped Weighting Strategies, Equal-Weight Strategies, Single-Factor Strategies, Multifactor Strategies and Proprietary or Idiosyncratic Strategies. Capped Weighting Strategies includes GDP[3]-Weighted Strategies as the most popular one, which remain somewhat popular with government bond investors. Equal-Weight Strategies assign an equal weight to every stock in an index. Proponents of this kind of strategies suggest that they have some advantages, such as avoiding the problem of overweighting overvalued securities by default, because of breaking the link between price and weight, and creating a positive rebalancing benefit due to buying low and selling high in their rebalance (typically on a quarterly basis). Single-Factor Strategies focus on isolating one or more market factors (stock characteristics) that research shows are long-term drivers of return. These factors include things like size, style, momentum or minimum volatility. Multifactor Strategies combine multiple factors together in an attempt to capture value from each. Proprietary or Idiosyncratic Strategies includes a wide variety of quant strategies. Perhaps the best known of these (and typical for the type) are the "AlphaDex" index strategies that form the basis of a series of ETFs from First Trust.

According to Kahn and Lemmon (2016), Smart Beta strategies are active strategies with some of the characteristics of passive ones. They are active strategies because they require periodic rebalancing in order to maintain the desired exposures, but they use simple, rules-based, transparent approaches to build portfolios that deliver justly static exposures (relative to cap-weighted benchmarks) to characteristics traditionally associated with excess risk-adjusted returns. Like any active strategy, they can underperform their cap-weighted benchmark.

There are obvious potential flaws because you could take on specific risks against the market, although there are two major issues that investors could consider. The biggest risk with

[3] Gross Domestic Product of a country.

Smart Beta investments is behavioral risk, that is, the potential for behavioral error when investing, because Smart Beta Strategies will deliver long term outperformance. Another concern is the so-called observation effect, which suggest that the primary drivers of long term outperformance for certain factors are behavioral. The listless movements of low volatility stocks make them unattractive to professional portfolio manager searching for short term outperformance, that is, these managers simply overlook them.

According to Morningstar (2014), the common thread among SB ETFs is that they seek to either enhance returns or minimize risk relative to a traditional market-capitalization-weighted benchmark by using alterative weighting methodology to get exposure to a number of factors such as size, value, volatility and others.

Institutional investor surveys suggest that most investors are assessing SB funds with the determination of purchasing exposure to a compensated factor, rather as a tool to earn "alpha". Investors are rather looking for factor exposure to afford an efficient risk-adjusted return with ease of implementation (Amenc et al. (2015)). Specifically, the main reason investors have for using smart beta strategies is to gain compensated factor exposure with the following explicit objectives: (1) to improve diversification relative to cap-weighted benchmarks, (2) to potentially lower risk compared with cap-weighted indices and (3) to potentially earn higher returns than cap-weighted indices (Glushkov (2015)).

3. Data and methodology

3.1. Sample

We employ the Morningstar Direct database in order to obtain the sample for the analysis. It contains a total of 14,082 ETFs. We establish some criteria search in order to do it representative for this study. This paper deal with European ETFs, so the sample is reduced to 2,897 Europe-domiciled ETFs and in primary share (424 of them classified as SB by Morningstar Inc). After excluding commodity, fixed-income and blended multi-asset SB categories, the sample is further reduced to 1,297 equity Europe-domiciled ETFs following both foreign and domestic indexes (252 of them are SB ETFs). Therefore, our focus is on the Europe equity market. They are retained only those ETFs for which data are available and it is possible to assign an individual benchmark either using ETF prospectus or Morningstar "Analyst Assigned Benchmark" whichever is available. If both are present, the self-declared benchmark from the ETF factsheet is chosen. In this way, the sample results in 980 equity Europe-domiciled ETFs (107 of them are SB ETFs). In addition, we remove from the sample those ETFs that have an inception date posterior to May 2015 or have less than 12 data of monthly return, because their short histories may lead us to inconsistent conclusions. So finally, we work with a sample of 848 equity Europe-domiciled ETFs and 76 of them are SB ETFs. As we can see in the reduction of number of ETFs in the sample by removing the short-history ETFs, the emergence of SB has appeared in the lately 12 months, as almost a third part of the SB are removed of the sample because of this reason.

The sample is classified in SB and non-SB ETFs according to the classification established by Morningstar and SB ETFs are classified in 19 categories, produced by Morningstar and based on the ETF's targeted factor characteristics such as dividend weighted, equal-weighted, low volatility, and others. See appendix II for more detailed breakdown between SB categories. Among these categories, the sample does not deal with everyone, but only with 13 due to the reduction of the sample as it was explained above.

A possible drawback of this sample is that it is not survivorship-bias free, because it includes only ETFs that were still active at 16th May 2015. Although Morningstar sample contains active and dead ETFs, we thought more appropriate to consider only the survivor ETFs.[4]

We select data from inception date of the funds. The oldest one appeared during October 1999, therefore the period data is from 1st October 1999 until 30th April 2016. All data variables are selected in monthly frequency.

The needed variables of each ETF for the analysis have been: Daily Price, Monthly Return, Inception Date, Primary Prospectus Benchmark, Strategic Beta, Strategic Beta Group, Strategic Beta Attributes and Fund Size. Their meaning is explained in Appendix II. We use Daily Price to check the Monthly Return variable, by deleting daily prices except for the last data in each month. Using this new series of month-end prices, we calculate the standard monthly return (by dividing the difference between month-end price at a month and the previous month over month-end price at the previous month). There are some differences in February and August due to the adjustments done by Morningstar in monthly return variable, so we decided to take this variable in our calculations. In addition, we take monthly returns of the declared benchmark of each ETF. In order to classify ETFs, we use the variable Strategic Beta, which provides yes if the referred ETF is considered Smart Beta. In this category, we classify SB ETFs according to Strategic Beta Attributes variable. We take Fund Size variable to weigh ETFs indicators and to provide results grouped by categories. We have checked weighted results of categories using the average ETF fund size of the used sample period and also its last data. Results are similar in both cases, therefore we decided to use average ETF fund size because we think is the most reasonable way.

Once we have the series of ETF monthly return, ETF declared benchmark monthly return and ETF fund size, we adequate the two first series so that they start at the same time and we have

[4] The primary reason for ETF providers to close their funds is that these funds failed to attract enough flows due to the lack of investor interest and/or poor fund performance (Glushkov (2015)).

equal length series. After that, we make data imputation for blank gaps of data in the three series using the average value of the previous and next data of the missing return. Imputed percentage for the series are 0.05% for ETF monthly return and ETF benchmark monthly return and 6.64% for ETF fund size. Although we need to make data imputation, imputed data in the series are few.

In addition, we take factors data from the Fama and French data webpage[5]. The used factors in this paper are Size, Value, Operating Profitability, Investment and Momentum. They are in US-dollars, so we take the exchange rate Euro per US-dollars from Thomson Reuters Eikon database.

3-months German government bond is utilized as risk-free asset because we have a European sample. We download the risk-free rate from Datastream database.

3.1.1. Descriptive statistics

In order to analyse the trends in the fund size into this segment of the ETF market we use the sample of 848 equity Europe-domiciled ETFs (76 of them classified as SB ETFs). Figure III.1 shows that the selected sample also illustrates the general pattern of growth of Smart Beta segment of ETF. We can see that during the period of 2007 and 2008 this kind of products become over 8% of the total ETF market. This fact can be attributed to the financial crisis and the tendency of investors to search innovative market segments. We can also see the steady growth in the aggregate fund size of ETF market increasing its share from nearly 10,000 € millions at the end of 2006 to over 400,000 € millions at the end of 2016. In panel B, there is a detailed exhibition of the growth of fund size by ETFs categories. As we can see, Dividend Weighted category has a significant relevancy in the weight of SB ETFs. In Table III.1 we observe that this category is the most numerous of the 13 categories (panel A) and it also represents more than 65% of the total weight of SB ETFs during the whole period (panel B), confirming the dominance of dividend-oriented funds in the entire sample of equity Europe-domiciled ETFs. The number of ETFs belonging to each category is increasing, showing again the growth of SB segment of ETF. As we said that Dividend Weighted is the most relevant category, it is followed by Low Volatility, which appeared in 2009 and in 2016 has reached 19% of the total fund size of SB.

Table III.2 presents the top 20 largest SB equity European-domiciled ETFs of the sample by fund size by the beginning of 2016 along with the declared or assigned benchmark as well as Morningstar type and category, Global Investment Fund Sector and inception date. We have to highlight two main takeaways from this list. First, it is dominated by funds from dividend-related category as 14 out of largest 20 listed belong to Dividend Weighted category, commanding more than 70% of the entire fund size of top 20 group. Second, not all of the largest SB ETFs use

[5] See link http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

weighting methodology unrelated to stock price, but some of the largest SB funds weigh their constituents by modified market capitalization.

3.2. Methodology

In this section we explain the different performance and risk measures used in this paper in order to analyse the performance and risks of SB ETFs. It is going to be made a comparison of SB ETFs and traditional ETFs performance in terms of return and risk with several different ratios. Unlike Glushkov (2015), as we said above, we calculate ratios and regressions for every ETF and make weighted averages for each ETF category with funds size as weights. It is expected that all ETFs track their benchmark index almost perfectly.

According to ERI Scientific Beta (2015), evaluating the performance of a SB ETF requires not only considering its average return, but also assessing the accompanying risk using suitable indicators. Risk-adjusted performance measures are also essential to assess whether the risk of a strategy is sufficiently rewarded, as well as to compare the performance of strategies with different levels of risk. 12 performance and risk indicators (Annualised Return, Annualised Volatility, Sharpe Ratio, Downside Deviation, Sortino Ratio, Relative Return and Extreme Relative Return, Tracking Error and Extreme Tracking Error, Information Ratio, Beta and Treynor Ratio) are used in this paper in order to analyse SB and non-SB ETFs. All measures are calculated based on monthly total returns (with dividends reinvested) with rolling windows of 12 months, except for extreme indicators that are calculated using rolling windows of 36 months, considering the strategy since inception for SB ETFs and since April 2006 for non-SB ETFs whose inception date is earlier than that date. Therefore, we obtain series of ratios.

The performance and risk indicators are presented in an absolute and in a relative form. The former considers the ETF on its own and the latter uses the prospectus benchmark as reference. These indicators, both in the absolute and relative form, are explained in Table 3.1.

Table 3.1 Performance and Risk Indicators

Indicator	Definition
Absolute Analysis	
Annualised Return	Annualised Return is defined as the return of the ETF converted into a yearly rate. Average return computations provide basic performance evaluation on time periods. It is calculated by compounding the monthly ETF NAV returns over a 12-months investment horizon and annualised. $$Rm_{ETF,t} = \frac{NAV_{ETF,t} - NAV_{ETF,t-1}}{NAV_{ETF,t-1}}$$ $$Annualised\ Return, R_{ETF,t} = \left(\prod_{i=t-11}^{t} (1 + Rm_{ETF,i})\right) - 1$$ Where $NAV_{ETF,t}$ is the monthly ETF NAV in the moment t and $Rm_{ETF,t}$ denotes the monthly ETF NAV return in the moment t.

Indicator	Definition
Annualised Volatility	Annualised Volatility is defined as the annualised standard deviation of the ETF returns. Volatility, defined as the standard deviation of returns, measures the dispersion of strategy returns around their mean. It is calculated as the standard deviation of monthly returns over a 12-months investment horizon and annualised (that is, multiplied by square root of 12). $$Annualised\ Volatility, \sigma_{ETF,t} = \sqrt{12}\sqrt{\frac{\sum_{i=t-11}^{t}\left(Rm_{ETF,i} - \overline{Rm}_{ETF,t}\right)^2}{11}}$$ Where $Rm_{ETF,t}$ denotes the monthly ETF NAV return in the moment t and $\overline{Rm}_{ETF,t}$ is the average monthly ETF NAV return during the time period considered (from t-11 to t).
Sharpe Ratio	Sharpe Ratio, henceforth SR, is a risk-adjusted performance measure calculated by using the standard deviation of ETF returns and its excess return over the risk-free rate to determine the return per unit of risk. That is, it evaluates the excess return of an ETF over the risk-free rate relative to the volatility of the ETF. Investors are usually risk averse, therefore they prefer the ETF with less risk given the same return. This ratio, developed by Sharpe (1966, 1994), allows for the evaluation of ETFs with different returns and different levels of risks, as it presents the return per unit of risk. It has become one of the most referenced risk-adjusted performance measures used in finance. The higher the SR, the better the risk-adjusted performance. Annualised Sharpe Ratio is computed by using the difference between the geometrically annualised return of the ETF in t $\left(R_{ETF,t}\right)$ and the geometrically annualised risk-free return in t (RF_t) (calculated as explained above for annualised return of the ETF in t, but using monthly risk-free returns during the time period considered, that is, from t-11 to t) over the annualised volatility of the ETF in t $\left(\sigma_{ETF,t}\right)$. $$SR_{ETF,t} = \frac{R_{ETF,t} - RF_t}{\sigma_{ETF,t}}$$
Annualised Downside Deviation	Downside Deviation, henceforth DD, measures only deviations below a specified benchmark, in our case we take the risk-free rate. It is computed from monthly data and annualised (that is, multiplied by square root of 12). $$DD_{ETF,t} = \sqrt{12}\sqrt{\frac{\sum_{i=t-11}^{t} d_{ETF,i}^2}{11}} \quad where \quad d_{ETF,t} = min\left[\left(Rm_{ETF,t} - RFm_t\right), 0\right]$$ Where $Rm_{ETF,t}$ denotes the monthly ETF NAV return in the moment t and RFm_t is the monthly risk-free return in t.
Sortino Ratio	Sortino Ratio, henceforth SoR, presented by Sortino and Van Der Meer (1991), Sortino and Price (1994), Sortino and Forsey (1996)), is a measure of the reward of an ETF adjusted by its downside risk. It is the ratio of the return of an ETF in excess of a minimum acceptable return (that is, the return below which the investor does not wish to drop) compared to the standard deviation of the returns that are below this minimum acceptable return. In our case the risk-free rate is chosen as the minimum acceptable return (MAR). A large SoR indicates there is a low probability of a large loss. Since upside variability is not necessarily a bad thing, SoR is sometimes more preferable than SR. SoR is better than SR when highly volatile portfolios are analysed. The returns and the semi-deviation are computed from monthly data and annualised. $$SoR_{ETF,t} = \frac{R_{ETF,t} - RF_t}{DD_{ETF,t}}$$ Where $R_{ETF,t}$ is the annualised return of the ETF in t, RF_t is the annualised risk-free rate in t and DD_t is the annualised downside deviation in t.
Relative Analysis	
Relative Return (Outperformance)	Relative return, henceforth RR, is defined as the ETF return in excess of the return of the declared benchmark. It is calculated as the difference between the annualised return of the ETF in t and the annualised return of its declared benchmark in t, computed from monthly returns. $$RR_{ETF,t} = \left(\prod_{i=t-11}^{t}\left(1 + Rm_{ETF,i}\right)\right) - \left(\prod_{i=t-11}^{t}\left(1 + RBm_{ETF,i}\right)\right)$$ Where $Rm_{ETF,t}$ denotes the monthly ETF NAV return in the moment t and $RBm_{ETF,t}$ is the monthly ETF benchmark return in the moment t.

Indicator	Definition
Extreme Relative Return (5%)	Extreme Relative Return (5%), henceforth ERR, measures the maximum expected amount of the relative annual loss that the ETF can suffer at a 95% confidence level. It is computed as the 5th percentile of the three year rolling relative returns. It means that there is only a 5% chance that the ETF will experience a relative loss that is greater than the indicated extreme relative return value over the rolling window period. It is calculated as it is explained next. The rolling window analysis is conducted using a window size of 3 years (36 months). Taking the RR series calculated for this period of 36 months (from t-35 to t), the 5th percentile of the trailing RR series is the Extreme Relative Return (5%) in the moment t $\left(ERR_{ETF,t}\right)$.
Tracking Error	Tracking Error, henceforth TE, is defined as the difference in return between the ETF and its declared benchmark. It is a measure of how closely an ETF follows the index to which it is benchmarked, that is, the separation of ETF returns from benchmark returns. It is known as well as residual risk. While excess return measures the extent to which an index product return differs from that of its benchmark index, tracking error indicates how much variability exists among the individual data points that make up the ETF average excess return (Vanguard (2009)). In theory, there should not be significant differences as ETFs are created in order to replicate an index. Tracking error analysis will determine if buying an ETF is the same to buying an equivalent part of an index in terms of risk and return. It is computed as the annualised standard deviation of the series of differences in monthly returns between the strategy (ETF) and the declared benchmark. $$TE_{ETF,t} = \sqrt{12}\sqrt{\frac{1}{11}\sum_{i=t-11}^{t}\left[\left(Rm_{ETF,i} - RBm_{ETF,i}\right) - \overline{\left(Rm_{ETF,t} - RBm_{ETF,t}\right)}\right]^2}$$ Where $Rm_{ETF,t}$ denotes the monthly ETF NAV return in the moment t, $RBm_{ETF,t}$ is the monthly ETF benchmark return in the moment t and the overbar of $\left(Rm_{ETF,t} - RBm_{ETF,t}\right)$ denotes the mean of the relative returns during the time period considered (from t-11 to t).
Extreme Tracking Error (95%)	Extreme Tracking Error (95%), henceforth ERR, measures the maximum amount of the tracking error that the ETF can experience at a 95% confidence level. It is computed as the 95th percentile of the three year rolling tracking error. The tracking error distribution is built using a 12 months rolling window analysis and determines the Extreme Tracking Error for a 95% level of confidence, which means that there is only a 5% chance that the ETF will experience a tracking error that is greater than the indicated extreme tracking error value over the 3 year rolling window period. It is calculated as it is explained next. The rolling window analysis is conducted using a window size of 3 years (36 months). Taking the TE series calculated for this period of 36 months (from t-35 to t), the 95th percentile of the trailing TE series is the Extreme Tracking Error (95%) in the moment t $\left(ETE_{ETF,t}\right)$.
Information Ratio	Information Ratio, henceforth IR, presented by Sharpe (1994), compares the residual return of an ETF (that is, the difference between the return of the ETF and the return of its declared benchmark) to its residual risk (i.e. the tracking error). By computing risk on a relative return basis, the Information Ratio effectively eliminates market risk, showing only risk taken from active management. Therefore, in one simple number, the IR shows how a manager has performed per unit of active risk taken. Good performance efficiency is measured by a high ratio. This ratio addresses an issue of SR, related to active management, because as SR centres on the use of a risk free rate, it places all managers on a level playing field regardless of style. It is computed as excess return of an ETF over its declared benchmark $\left(R_{ETF,t} - RB_{ETF,t}\right)$ adjusted by its tracking error $\left(TE_{ETF,t}\right)$, where $R_{ETF,t}$ and $RB_{ETF,t}$ are the annualised returns (computed from monthly data) of respectively the ETF and the benchmark in the moment t. $$IR_{ETF,t} = \frac{R_{ETF,t} - RB_{ETF,t}}{TE_{ETF,t}}$$

Indicator	Definition
Beta	Beta is a measure of systematic risk with respect to a benchmark. Systematic risk is the tendency of the value of the ETF and the value of benchmark to move together. Beta measures the sensitivity of the ETF's excess return (total return minus the risk-free return) with respect to the benchmark's excess return that results from their systematic co-movement. It is the ratio of what the excess return of the ETF would be to the excess return of the benchmark if there were no ETF-specific sources of return. If beta is greater than one, movements in value of the ETF that are associated with movements in the value of the benchmark tend to be amplified, while if beta is one, they tend to be the same, and if beta is less than one, they tend to be dampened. If such movements tend to be in opposite directions, beta is negative. Beta is measured as the slope of the regression of the excess return on the ETF as the dependent variable and the excess return on the benchmark as the independent variable. Beta is calculated by comparing ETF's excess return over risk-free rate to the benchmark's excess return over risk-free rate, that is, as in CAPM analysis. Taking a 12-month window (from t-11 to t), we estimate the coefficients of the regression below using OLS (Ordinary Least Squares) method for the period from t-11 to t and assign the coefficients value to the moment t. $$Rm_{ETF,i} - RFm_i = \alpha_{ETF,t} + \beta_{ETF,t}\left(RBm_{ETF,i} - RFm_i\right) + \varepsilon_{ETF,i}\,, \quad i = t-11, \dots, t$$ Where $Rm_{ETF,t}$ denotes the monthly ETF NAV return in the moment t, RFm_t is the monthly risk-free return in the moment t, $RBm_{ETF,t}$ is the monthly ETF benchmark return in the moment t, $\alpha_{ETF,t}$ and $\beta_{ETF,t}$ are the estimated coefficients of the regression in the moment t that represents the market risk-adjusted return and the beta with respect to the benchmark, respectively, and $\varepsilon_{ETF,t}$ is a white noise. A beta of 1.10 shows that the ETF has performed 10% better than its benchmark in up markets and 10% worse in down markets, assuming all other factors remain constant. Conversely, a beta of 0.85 indicates that the ETF's excess return is expected to perform 15% worse than the benchmark's excess return during up markets and 15% better during down markets.
Treynor Ratio	Treynor Ratio, henceforth TR, presented by Treynor (1965), evaluates the excess returns of an ETF over the risk-free rate relative to the "market" risk (beta) of the ETF. Good performance efficiency is measured by a high ratio. It is computed using the difference between the geometrically annualised return of the ETF (from monthly returns) and the geometrically annualised risk-free return in the period t. The market beta is estimated as explained above. $$TR_{ETF,t} = \frac{R_{ETF,t} - RF_t}{\beta_{ETF,t}}$$

This table summarizes the indicators displayed in performance and risk analysis, both in the absolute and relative perspective.

In order to verify the differences between SB ETFs and non-SB ETFs, we carry out a test about the difference of means of each pair of ratios series and we also test if the means of ratios series are significantly different from zero. The first test, a two-sample t-test, is a parametric test that compares the location parameter of two independent data samples and the test statistic is the following:

$$t = \frac{\bar{x} - \bar{y}}{\sqrt{\frac{s_x^2}{n} + \frac{s_y^2}{m}}}$$

where $\bar{x}$ and $\bar{y}$ are the sample means, s_x and s_y are the sample standard deviations, and n and m are the sample sizes. Given that it is not assumed that the two samples are from populations with equal variance, the test statistic under the null hypothesis has an approximate Student's t distribution with a number of degrees of freedom given by Satterthwaite's approximation. The second test, a one-sample t-test, is a parametric test of the location parameter when the population standard deviation is unknown and the test statistic is the following:

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

where $\bar{x}$ is the sample mean, μ is the hypothesized population mean, s is the sample standard deviation, and n is the sample size. Under the null hypothesis, the test statistic has Student's t distribution with n-1 degrees of freedom.

According to ERI Scientific Beta (2015), risk factors are often implicit results of portfolio construction and investors would want to know how exposed they are to certain factors. Many studies have underlined the importance of factor risk exposures in explaining part of the outperformance of SB strategies over their references (Amenc et al. (2009), Blitz and Swinkels (2008), Jun and Malkiel (2007), Kaplan (2008)).

In order to assess the efficiency of ETFs, we use the CAPM to find out if the returns of ETFs achieve perfect replication and we derivate from it the Jensen's Alpha (Jensen (1968)), a risk-adjusted measure of portfolio performance that estimates how much a manager's forecasting ability contributes to the fund's returns. This method to test the performance of ETFs has previously been used in other papers like Harper et al. (2006) and to check the performance of SB ETFs in Glushkov (2015).

As the consensus in academic finance and among practitioners suggests that the simple single market factor used in the CAPM model (Sharpe (1964) and Lintner (1965)) does not fully capture the cross sectional variation of expected stock returns, there has been a development of multi-factor models that account for a range of priced risk factors. Fama and French (1993) have highlighted two important factors: a size factor associated with a company's market capitalisation and a value factor associated with the book-to-market ratio. The Fama-French three-factor model has been extended by Carhart (1997) to include the momentum factor. In addition, Fama and French (2014) have proposed a Five-Factor Asset Pricing Model including operating profitability and investment patterns as new factors.

Therefore, in this paper, in addition to the ETF benchmark, the four European factors of Fama and French (value, size, operating profitability and investment) and the European momentum factor of Carhart are going to be used. These used factors are described next.

According to Fama-French webpage, the Fama-French 5 factors are constructed using the 6 value-weight portfolios formed on size and book-to-market, the 6 value-weight portfolios formed on size and operating profitability and the 6 value-weight portfolios formed on size and investment. To construct the SMB (Small Minus Big), HML (High Minus Low), RMW (Robust Minus Weak) and CMA (Conservative Minus Aggressive) factors, stocks are sorted into two market cap and three respective book-to-market equity (B/M), operating profitability (OP) and investment (INV) groups at the end of each June. Big stocks are those in the top 90% of June market cap and small stocks are those in the bottom 10%. The B/M, OP and INV breakpoints are the 30th and 70th percentiles of respective ratios for the big stocks.

- Size factor (SMB) is the average return on the nine small stock portfolios minus the average return on the nine big stock portfolios ,

$$SMB_{(B/M)} = \frac{1}{3}(Small\ Value + Small\ Neutral + Small\ Growth) - \frac{1}{3}(Big\ Value + Big\ Neutral + Big\ Growth)$$

$$SMB_{(OP)} = \frac{1}{3}(Small\ Robust + Small\ Neutral + Small\ Weak) - \frac{1}{3}(Big\ Robust + Big\ Neutral + Big\ Weak)$$

$$SMB_{(INV)} = \frac{1}{3}(Small\ Conservative + Small\ Neutral + Small\ Aggresive) - \frac{1}{3}(Big\ Conservative + Big\ Neutral + Big\ Aggresive)$$

$$SMB_t = \frac{1}{3}\left(SMB_{(B/M)} + SMB_{(OP)} + SMB_{(INV)}\right)$$

- Value factor (HML) is the average return on the two value portfolios minus the average return on the two growth portfolios,

$$HML_t = \frac{1}{2}(Small\ Value + Big\ Value) - \frac{1}{2}(Small\ Growth + Big\ Growth)$$

- Operating Profitability factor (RMW) is the average return on the two robust operating profitability portfolios minus the average return on the two weak operating profitability portfolios,

$$RMW_t = \frac{1}{2}(Small\ Robust + Big\ Robust) - \frac{1}{2}(Small\ Weak + Big\ Weak)$$

- Investment factor (CMA) is the average return on the two conservative investment portfolios minus the average return on the two aggressive investment portfolios,

$$CMA_t = \frac{1}{2}(Small\ Conservative + Big\ Conservative) - \frac{1}{2}(Small\ Aggresive + Big\ Aggresive)$$

To construct the WML factor (Winner Minus Loser), the 2x3 sorts on size and lagged momentum are formed monthly. The momentum breakpoints are the 30th and 70th percentiles of the lagged momentum of the big stocks. The independent 2x3 sorts on size and momentum produce six value-weight portfolios, SL, SN, SW, BL, BN, and BW, where S and B indicate small and big and L, N and W indicate losers, neutral and winners (bottom 30%, middle 40% and top 30%).

- Momentum factor (WML) is the equal-weight average of the returns for the two winner portfolios minus the average of the returns for the two loser portfolios,

$$WML_t = \frac{1}{2}(Small\ High + Big\ High) - \frac{1}{2}(Small\ Low + Big\ Low)$$

The proposed models are described next and several regressions will be done. First, a one-factor model using only the corresponding benchmark; second, a three-factor model with this factor and value and size ones; third, a five-factor model adding the profitability and investment factors; and finally, four-factor and six-factor models adding the momentum factor to the three-factor model and to the five-factor model.

- One-factor model:

$$Rm_{ETF,t} - RF_t = \alpha_{ETF} + \beta_{1,ETF}(RBm_{ETF,t} - RF_t) + \varepsilon_{ETF,t}$$

Where $Rm_{ETF,t}$ denotes the monthly ETF NAV return in the moment t, RFm_t is the monthly risk-free return in the moment t and $RBm_{ETF,t}$ is the monthly ETF benchmark return in the moment t.

The expected results for this regression are the following. A value for β of 1, as ETFs track benchmark indices so their sensitivity should be approximately equal to the market, and α should not be significantly different from 0, as ETFs are not constructed to obtain any extra return than the market. Given that ETFs charge an expense ratio for their services, the value of α is expected to be negative and close to the average monthly expense ratio.

In a similar way, the following regressions are considered.

- Three-factor model:

$$Rm_{ETF,t} - RF_t = \alpha_{ETF} + \beta_{1,ETF}(RBm_{ETF,t} - RF_t) + \beta_{2,ETF}SMB_t + \beta_{3,ETF}HML_t + \eta_{ETF,t}$$

- Four-factor model:

$$Rm_{ETF,t} - RF_t = \alpha_{ETF} + \beta_{1,ETF}(RBm_{ETF,t} - RF_t) + \beta_{2,ETF}SMB_t + \beta_{3,ETF}HML_t + \beta_{6,ETF}WML_t + \xi_{ETF,t}$$

- Five-factor model:

$$Rm_{ETF,t} - RF_t = \alpha_{ETF} + \beta_{1,ETF}(RBm_{ETF,t} - RF_t) + \beta_{2,ETF}SMB_t + \beta_{3,ETF}HML_t + \beta_{4,ETF}RMW_t + \beta_{5,ETF}CMA_t + \nu_{ETF,t}$$

- Six-factor model:

$$Rm_{ETF,t} - RF_t = \alpha_{ETF} + \beta_{1,ETF}(RBm_{ETF,t} - RF_t) + \beta_{2,ETF}SMB_t + \beta_{3,ETF}HML_t + \beta_{4,ETF}RMW_t + \beta_{5,ETF}CMA_t + \beta_{6,ETF}WML_t + \epsilon_{ETF,t}$$

In addition, tests of individual significance are carried out for beta parameters in regressions over each ETF (as we explained above, the one-sample t-test in order to test if the parameter is significantly different from zero). Calculating for each factor, the percentage of ETFs over the total number of ETFs belonging to the category that has a beta significantly different from zero. Because a factor beta significantly different from zero means that this factor influences the excess return of the ETF over the risk-free rate.

Regression analyses conducted with those specified models enable the exposures of an ETF to well-known systematic factors to be measured, but they do not provide insights as to how each factor managed during the selected time period and how each factor's performance has impacted the ETF performance. According to ERI Scientific Beta (2015), decomposing the ETF performance over the selected time period into separate terms attributable to each factor risk premia is key to going beyond the raw measure of performance and to understanding the sources of outperformance of an ETF. This is the concept of Factor Performance Attribution. This methodology breaks down the total excess returns of an ETF (over the risk-free rate) into several components related to the performance of systematic risk factors of a regression analysis. Factor Performance Attribution remains as a question for further research.

4. Empirical results

This paper provides an evaluation of equity European-domiciled Smart Beta ETFs. It aims to provide empirical evidence on the efficiency of ETFs in European markets as substitutes of inversion in a particular market index, as well as empirically assessing the efficiency of SB ETFs in capturing documented factor risk-premiums by means of static and dynamic factor allocation. Empirical results of this analysis are going to be showed next.

4.1. Performance and risk indicators

We can observe in Figure III.2 and Table III.3 that the average annualised return is higher for SB ETFs than for non-SB ETFs (0.0657 versus 0.0627) and in 57.41% of times the former series is over the latter. Therefore, we could say that SB ETF have higher return, but it is also more variable (standard deviation of 0.2285 versus 0.1843). In fact, as we see in the figure in the periods when extreme returns happen (from February 2008 to October 2009 with negative returns and from November 2009 to August 2011 with positive returns), the annualised return for SB ETFs is more extreme than for non-SB. That is, in the period that returns are negatives, they are more negative for SB ETFs than for non-SB ETFs and in the period that returns are positives, SB ETFs returns are more positive. Testing the difference of mean between SB ETFs and non-SB ETFs annualised return series, we see that the difference between the two series is not statistically significant al 5% level of significance. That is, although SB ETFs and non-SB ETFs have different average annualised return (both medias are statistically different from zero), they are statistically equal. We can observe in both figures (panel A and B) that annualised return series follow the same path in general. Looking at SB categories in panel B, we have to remark that the category with the highest average return is Size (0.1449) followed by Equal Weighted (0.1295), Risk-Weighted (0.1215), Low Volatility (0.1181), Fundamentals Weighted (0.1129) and Quality (0.1124). In addition, the categories that are most part of time over others are Fundamentals Weighted (25.93%), Growth (22.22%) and Low Volatility (19.44%). Therefore, we could say that Fundamentals Weighted is, according to annualised return, the most profitable category in SB ETFs, which are more profitable than non-SB ETFs. Other remarkable fact in the behaviour of series is that we see negative annualised returns at the beginning of the financial crisis (from February 2008 to October 2009), reaching annualised returns of -0.40 by non-SB ETFs and -0.50 by SB ETFs. At the end of 2009, the returns increase and become positive with a peak in May

2010 and descending again. In 2012 there are again negative returns because of the instability of the market and the continuing crisis, recovering soon the positive returns until beginning of 2016, when returns change to negative again.

At the same time as we look at the annualised returns, we have to observe the annualised volatility series in Figure III.3 and Table III.4. We can observe that the time periods mentioned above like negative returns periods are the stages when there is higher volatility. During the first period cited, the volatility for SB ETFs is higher than for non-SB ETFs, but in the other two non-SB ETFs volatility series is above non-SB ETFs one. The average annualised volatility is similar for both type of ETFs (0.1551 for SB and 0.1543 for non-SB, they are statistically different from zero), although the difference of means is statistically significant at a 5% level of significance. In fact, the standard deviation is higher for SB ETFs (0.0761 versus 0.0519). In addition, in 53.70% of times, non-SB ETFs volatility is higher than SB ETFs one. Therefore, SB ETFs have higher standard deviation than non-SB ETFs and the difference is significant. Respect to SB categories, those with the highest average annualised volatility are Buyback Yield (0.1902), Value (0.1773) and Momentum (0.1715), furthermore Value is the category that is over the others in 40.74% of times (more than any other). We can observe that the periods with low annualised return are also the periods with high annualised volatility (considered as standard deviation), so the usually association of high (low) return with high (low) risk is shown with this indicators.

Figure III.4 and Table III.5 provide an analysis of Sharpe Ratio (SR) of SB ETF versus non-SB ETF and SR of SB ETF categories. In panel A, we can observe that the mean of both series are positive (0.8410 for SB ETFs and 0.7278 for non-SB ETFs, both means statistically signficant), so that it indicates that ETFs generate a positive excess return over the risk-free rate per unit of risk, and it is higher for SB ETFs in mean. In fact, the difference of means is statistically significant at a 5% significance level, so that verifies that SR is higher for SB ETFs than for non-SB ETFs. Standard deviation, maximum and minimum of the series are also greater for SB ETFs and in general the SR for non-SB ETFs is under the SR for SB ETFs. As we can see in the Figure, during the period from February 2008 until October 2009, coinciding with the time of the financial crisis, the SR of both categories were negative and the SR of SB ETFs is more negative than the SR of non-SB ETFs. Therefore, it was not profitable to invest in ETFs, even less in Smart Beta ones, given the risk taken when investing in them instead of the risk-free asset. It happens similarly in a short period between September 2011 and June 2012, but in this time SB ETFs hardly have a negative SR and it is always over the SR of non-SB ETFs. Looking in detail at SB ETFs, panel B provides the previous analysis of SB ETFs categories. In general, as it happens between SB and non-SB ETFs, the SR series of SB ETFs categories follow a similar path and during the crisis period almost all the categories have a negative SR. We can observe that the SB category with the highest SR mean is Size (2.0836), followed by Risk-Weighted (1.7106), but they have also the greatest standard deviation (1.6644 and 1.5647, respectively). The most noteworthy fact is that Fundamentals Weighted and Growth SB ETFs are those which have higher SR in more periods of time, 23.15% and 21.30%, respectively; followed by Low Volatility with 14.81 % and Dividend Weighted with 13.89%. This results are consistent with Annualised Returns, Fundamentals Weighted and Growth are over the other categories in more periods of time looking at both indicators. In addition, Fundamentals Weighted is the one with highest Annualised Return.

Before analysing the results of Sortino Ratio, we observe the Annualised Downside Deviation series and their descriptive statistics in Figure III.5 and Table III.6 in order to take them into consideration for the posterior analysis. As we saw in the ratio explanation, downside deviation measures only deviation below the risk-free rate, that is, deviations of negative excess returns (over the risk-free rate). We can observe a similar behaviour than for annualised volatility, high downside deviation is shown in high volatility periods. As analysing Annualised Volatility series, Buyback Yield and Value are the categories with the highest average Annualised Downside Deviation (0.1399 and 0.1222, respectively). A remarkable fact of these series are the low average minimum values of SB and non-SB ETFs (0.0025 and 0.0259, respectively, but significantly different from zero), which are significantly different from each other at a 5% significance level. This low Downside Deviation (zero for some periods for several ETFs) will lead to infinite values of Sortino Ratio, as we are going to see following.

The information regarding in Figure III.6 and Table III.7 show an analysis of Sortino Ratio (SoR) of SB ETF versus non-SB ETF and SoR of SB ETF categories. In panel A, we can observe that the median of both series are positive (2.3506 for SB ETFs and 2.4890 for non-SB ETFs, significantly different from zero at a 5% significance level), so that it shows that ETFs generate a positive excess return over the risk-free rate per unit of risk calculated by the standard deviation of the returns that are below the risk-free rate, but the median of non-SB ETFs is higher than the other and also the minimum. Although the difference of medians is not statistically significant at a 5% significance level, so medians are statistically equal. So given its downside risk, the excess return obtained over the risk-free rate is similar. Standard deviation and maximum of the series tend to an infinite value[6], therefore they are not comparable by that value. It is shown that peaks to infinite are more numerous for non-SB ETFs, that is in several times the probability of a large loss for non-SB ETFs is low, but in general this probability is higher for SB ones as it is shown in the Figure. In fact, SoR for SB ETFs is over the SoR for non-SB ETFs in 54.63% times of the period. Similar to SR series, in the periods from February 2008 to September 2009 and from September 2011 and May 2012 (at the end of financial crisis), a period with negative SoR is seen but the series recovered soon their positive value. As it happens between SB and non-

[6] Infinite values in the series correspond to windows where all returns are positive.

SB ETFs, in general, in panel B we can see that the SoR series of SB ETFs categories follow a similar behaviour. In this case, there are peaks to infinitive in most of categories, except for Buyback Yield, Earnings Weighted, Momentum and Quality. We can observe that the SB category with the highest SoR median is Size (5.1400), followed by Risk-Weighted (3.6315) and Fundamentals Weighted (3.4779). The most remarkable fact is that Fundamentals Weighted, Dividend Weighted and Growth SB ETFs are those which have higher SoR in more periods of time, 25.93%, 21.30% and 17.59%, respectively; followed by Low Volatility with 12.96% and Size with 10.19%. Fundamentals Weighted and Growth categories coincide in this ranking in Sharpe Ratio. As it was said previously in the explanation of performance indicator, SoR is better than SR when highly volatile portfolios are analysed. In this case, we have series with annualised volatility between 5% and 30% for non-SB ETFs and between 5% and 40% for SB ETFs, so that it is preferable to use SoR in the comparison. It can be checked that, even though the two ratios measure different things, there are not significant changes.

The calculations about the analysis of Relative Return (RR) are shown in Figure III.7 and Table III.8. The RR is the excess return of an ETF over its benchmark and we can observe in panel A that SB ETFs have in mean a positive RR (0.0021) while non-SB ETFs have in mean a negative RR (-0.0035). Testing the difference of means, we observe that it is not statistically significant at a 5% significance level, so means are not statistically different. In fact, they are practically equal to zero (although tests of significance carried out show that SB ETF mean is statistically different from zero at a 5% significance level), that is, there is not return over the benchmark so the ETF replicates it well. In addition, it is shown that SB ETFs have low standard deviation (0.0068) while non-SB ETFs have approximately five times that standard deviation (0.0312). It exhibits that RR of non-SB ETFs is a series more variable, so SB ETFs provide in general a superior return than its benchmark, although in certain periods they do not. Analysing non-SB ETFs, this kind have time periods when the strategy has a great return over its benchmark, but also a high one below it, therefore non-SB ETFs are riskier. Relative Return for SB ETFs is over the RR for non-SB ETFs in 56.48% times of the period. In panel B we can see that few categories have a positive RR average: Value, Dividend Weighted and Quality (0.0066, 0.0016 and 0.0006, respectively). In fact, several categories have negative RR during all the sample. In general, most of RR series of SB ETFs categories are almost invariable, with low standard deviation (less than 0.02), except for Value, Low Volatility and Size (0.0959, 0.0500 and 0.0332, respectively). The most notable fact is that Dividend Weighted, Value and Growth SB ETFs are those which have higher RR in more periods of time, 31.48%, 25.93% and 16.67%, respectively.

For a complete analysis of this ratio, Figure III.8 and Table III.9 exhibit an analysis of Extreme Relative Return (ERR) of SB ETF versus non-SB ETF in panel A and SB ETFs categories in panel B. It is not surprising that ERR of SB ETFs is over ERR of non-SB ETFs during the total period, as we said previously that the latter is a series very variable. In addition, averages of Extreme Relative Return series are statistically different at a 5% significance level (-0.0123 for SB and -0.0307 for non-SB, statistically different from zero at the same significance level). Related to SB categories, we can remark that Value is the category with the lowest minimum (-0.2322), although 16.44% of times is over the rest of categories (the period before August 2011).[7]

Figure III.9 and Table III.10 provide an analysis of Tracking Error (TE) of SB ETF versus non-SB ETF and TE of SB ETF categories. In Panel A, we can observe that the mean of the TE series of SB ETFs is lower than for non-SB ETFs (0.0111 compared to 0.0254, both statistically different from zero at a 5% significance level) and they are statistically different at the same significance level, so that it indicates that SB ETFs excess return (over the declared benchmark) has less variability. In 91.67% of times, the TE of non-SB ETFs is over the TE of the other category, therefore we can say that spread of non-SB ETFs return over benchmark return is higher than for SB ETFs. In Panel B we can observe that SB categories with the highest TE mean are Value (0.0738) and Low Volatility (0.0683) and they have also the greatest standard deviation (0.0644 and 0.0665, respectively). These categories are those which have higher TE in more periods of time, 42.59% and 26.85%, respectively. Therefore investing in these categories is riskier than in others (understanding risk as the separation from benchmark), even the average series of non-SB ETFs, because their Tracking Error is over 0.15 in several times, while non-SB does not reach 0.05 of TE in any time.

For a complete analysis of this ratio, Figure III.10 and Table III.11 show an analysis of Extreme Tracking Error (ETE) of SB ETF versus non-SB ETF in panel A and SB ETFs categories in panel B. ETE of non-SB ETFs is over ETE of SB ETFs during almost all period (83.56%). As we said previously, SB ETFs have less variable Relative Return and almost always positive, so Tracking Error must be lower than for non-SB ETFs and therefore Extreme Tracking Error will also be. In addition, ETE of SB ETFs is in average statistically different from ETF of non-SB ETFs at a 5% significance level. Related to SB categories, we can remark that Value is the category with the highest maximum (0.1948), it has an average value (0.1067) that is more than 5 times the mean of SB ETFs series (0.0189) and this category is over the rest of categories in 78.08% of times, followed by Low Volatility and Fundamentals Weighted (maximums are 0.0661 and 0.0615, respectively). ETE analysis reinforces the results obtained previously with TE.[8]

The information regarding in Figure III.11 and Table III.12 show an analysis of Information Ratio (IR) of SB ETF versus non-SB ETF and IR of SB ETF categories. According

[7] Categories Buyback Yield, Momentum and Size have not Extreme Relative Return series, because the Relative Return series is shorter than 36 months (size of the used window in the calculations of ERR).
[8] Categories Buyback Yield, Momentum and Size have not Extreme Tracking Error series, because the Tracking Error series is shorter than 36 months (size of the used window in the calculations of ETE).

to the definition, in panel A we observe that the mean of both series are negative due to the low strategy return compared to the benchmark return and relative to its residual risk (-0.9297 for SB ETFs and -3.8856 for non-SB ETFs, statistically different from zero at a 5% significance level) and statistically different at the same significance level. Mostly during all period the IR series of SB ETFs is over the IR series of non-SB ETFs. In fact, the former series is positive during the period between August 2007 and September 2009, but the latter is negative during the whole period of the sample. In Panel B we can observe that there are only two SB categories with a positive mean of the IR series: Quality (0.1567) and Value (0.1509). These categories and Dividend Weighted are the series that are over others during more periods (25.00%, 37.04% and 23.15%, respectively). Buyback Yield is the category with the most negative mean of IR (-33.3921) with a low standard deviation (0.4665). It is followed by Risk-Weighted, Size and Growth with also negative mean of IR (-18.1077, -15.1873 and -11.9671, respectively) and the series are negative during the whole period. Therefore, we can say that SB ETFs have higher excess return per unit of residual risk than non-SB ETFs, although the IR for SB ETFs is not high in general, so they do not provide high excess return over its benchmark per unit of residual risk.

Before analysing the results of Treynor Ratio, we observe the Beta series and their relevant descriptive statistics in Figure III.12 and Table III.13 in order to take them into consideration for the posterior analysis. Looking at the series in the Figure, we can observe that SB ETFs are better replicators of the benchmark, as they have a series of betas nearer the value 1.00, in fact, the average beta is 0.9410 for SB ETFs and 0.8722 for non-SB ETFs (difference of means statistically significant at a 5% significance level and means statistically different from zero at the same significance level). In addition, in 88.89% of times SB ETFs series is over non-SB ETFs series. Looking in detail at the SB categories, we see that Earnings Weighted (in fact, a unique ETF) replicates the benchmark perfectly in average (mean value of beta is 1.0000). Low Volatility and Momentum categories over-replicate the benchmark, that is, they have mean value of beta over 1.0000 (1.0020 and 1.0032, respectively). We have to remark the valleys in the series of betas, as they might explain high values of Treynor Ratio (in absolute value) together with high excess returns (over the risk-free rate).

Figure III.13 and Table III.14 provide an analysis of Treynor Ratio (TR) of SB ETF versus non-SB ETF and TR of SB ETF categories. In panel A, we observe that the mean of SB ETFs TR series is positive due to, in general, the high strategy return compared to the benchmark return and relative to market risk (0.0831). While for non-SB ETFs TR series have a negative mean (-0.1181) with higher standard deviation (1.1161), but also higher maximum value (2.0719). In addition, testing the difference in means, it is not statistically significant at a 5% significance level. This result does not agree with results of testing significance of the means (SB ETF TR mean is statistically significant at a 5% significance level, while non-SB ETF TR mean is not).

So we could think that SB ETFs have higher TR than non-SB ETFs, besides the fact that non-SB ETFs TR mean is not statistically different from zero. As we can see in the figure, during the period from January 2008 until September 2009, coinciding with the time of the financial crisis and with SR and SoR negative periods, the TR of both categories were negative, demonstrating the low return of these strategies compared to the risk-free rate. In general, SB ETFs series is over non-SB ETFs series (in 62.04% of times). With this calculations and looking at the figure we can see that the non-SB ETFs series have many peaks and valleys, while the other series is less variable. Note that this measure consists in dividing by beta and not by standard deviation, as Sharpe Ratio does. Panel B provides the calculations of previous analysis for SB ETFs categories. We can also see the negative value of the series for all categories during the same period as indicated below for SB and non-SB ETF TR series. We can observe that most of categories series follow the same path except for Value, with a standard deviation of 1.4022, almost 10 times the value of that statistic for others categories, and the highest minimum and maximum value among the 13 categories (-2.6459 and 8.3001, respectively). The series of this category and Fundamentals Weighted series are the ones that are more time over the others (27.78% and 28.70%, respectively). Note that in Value category TR series there are also several peaks and valleys due to the beta of the series.

Annualised return difference between SB and non-SB ETFs is statistically equal (and both means are statistically different from zero). But SB ETFs have higher standard deviation than non-SB ETFs and the difference is significant. We can observe that the periods with low annualised return are also the periods with high annualised volatility (considered as standard deviation), so the usually association of high (low) return with high (low) risk is shown with this indicators. According to the mean-variance criteria and given that SB ETFs are riskier as they provide an equal average return, we could say that non-SB ETFs are better investment instruments.

Relative return for SB and non-SB are not statistically different and are practically equal to zero, so there is not return over the benchmark so the ETF replicates it well. Although relative return for non-SB is very variable and in several periods there are high difference between ETF return and benchmark ETF return.

In general, ETFs generate a positive excess return over the risk-free rate per unit of risk (Sharpe Ratio). This indicator is significantly higher for SB ETFs than for non-SB ETFs Sortino Ratio median is statistically equal for both series of SB and non-SB ETFs. So, given its downside risk, the excess return obtained over the risk-free is similar. Although SB Sortino Ratio is over the other in more periods. Generally, SB ETFs Tracking Error is lower (and statistically different) than for non-SB ETFs, so that SB ETFs excess return (over the declared benchmark) has less variability. The mean of Information Ratio series for SB and non-SB are negative due to the low strategy return compared to the benchmark return and relative to its residual risk. In addition, SB ETFs have higher Information Ratio and Treynor Ratio than non-SB ETFs.

In time of crisis, Sharpe Ratio and Sortino Ratio and Treynor Ratio series are negative so it was not profitable to invest in ETFs, even less in Smart Beta ones, given the risk taken when investing in them instead of the risk-free asset. Demonstrating the low return of these strategies compared to the risk-free rate.

The categories which behaves the best according to those analysed indicators compared to the risk-free rate are Fundamental Weighted, Growth and Dividend Weighted and compared to the declared benchmark are Value and also Dividend Weighted and Growth. With respect to the benchmark, Value category is the one that behaves the best, as Glushkov (2015) concluded. That is, Return-Oriented Strategies perform better than others. In addition, we observe a pattern of behaviour among the different SB categories, even non-SB ETFs, due to economic and financial cycles that are reflected in stocks returns.

4.2. Factor exposures

Proponents of Smart Beta argue that the main appeal of smart beta concept from investors' point of view is that SB ETFs are designed to return factor premiums (above and beyond the market premium) in an efficient and cost-effective way (Hsu (2014), West and Larson (2014)). In this section, we empirically evaluate the factor exposures of ETFs to assess the degree to which these ETFs are providing exposure to the intended factors.

As we explained in the methodology section, we have carried out several regressions of excess returns of ETF on excess returns of declared benchmarks and other five factors (explained in that section).

Table III.15 reports descriptive statistics of factor portfolios along with pairwise correlations over the entire period. Momentum factor provide the best relative risk/return trade-off, because of his nature of reflecting the positive or negative trend in returns based in past results, but has the highest standard deviation. It is followed by Operating Profitability factors, which is based on the average return on the two robust operating profitability portfolios minus the average return on the two weak operating profitability portfolios. Size factor is the worst performing. All factors have high standard deviation (between 1.9082 and 5.3681). This evidence is consistent with the idea that factor premiums are highly time-varying. Size factor is negative correlated with the other factors except for Momentum factor. Value factor is also negative correlated with Operating Profitability and Momentum factors and Operating Profitability also with Investment factor.

For the one-factor regression, the results are shown in Table III.16. We can see that in average both SB and non-SB ETFs are able to replicate its benchmark, as we observe that $\beta_{benchmark}$ is near 1 (0.9265 and 0.9267, respectively). It also happens for SB categories, except for Value (0.7126). Categories Low Volatility and Momentum have $\beta_{benchmark}$ superior to 1 (1.0143 and 1.0030, respectively), what means that they over-replicate the benchmark, that is, they "overperform" what the benchmark does. In addition, in more of 93% of SB and non-SB ETFs and SB categories, the beta respect to excess return of benchmark is significantly different from zero at a 5% significance level, except for the mentioned category Value (only in 75% of the ETFs). This fact makes more trustworthy the affirmation of good benchmark replication. As we observe, there is a positive but low α for SB and non-SB ETF, but particularly for each SB category we find both positive and negative α, but also low. It means that in average the ETF obtains more market risk-adjusted return (the Jensen's alpha), exactly 0.0001 and 0.0002 for SB and non-SB ETFs, respectively. A noteworthy case is Risk-Weighted, that obtains 0.0031 less market risk-adjusted return. We have to remark that Value category, in addition have a low determination coefficient and low percentage of significant coefficients for the ETF of the category. In addition, in these tables we can observe that there is a high explanatory power in all regressions. The average determination coefficient of the regressions for SB ETFs is 90.44% and for non-SB ETFs is 93.91%. In all the SB categories, this measure is higher than 80% (99.99% in case of Momentum category, composed of only one ETF), except for Value and Size categories, whose determination coefficient are just 67.67% and 78.30%, respectively. Therefore, the explanatory power in the regressions is high in general.

The information regarding the six-factor regression is shown in Table III.17.[9] In general, the coefficient associated to the excess return of benchmark is near 1 and significantly different from zero at a 5% significance level, showing that ETFs are near perfect replicators of its benchmark index, except for Value category (coefficient associated to benchmark is 0.6827). Related to other considered factors, in average none of the five factors are significantly different from zero to SB and non-SB ETFs for a relevant number of ETFs. Going into detail in SB categories, size factor is significantly different from zero at a 5% significance level for Earnings Weighted category and the coefficient is negative, so this category (in fact, a unique ETF) is related to that factor in an opposite way. The factor that in most of cases is significantly different of zero for several categories is Momentum (Size, Risk-Weighted, Growth and Low Volatility with 100%, 66.67%, 50% and 37.50% of ETFs significantly different to zero at a 5% significance level, respectively). We have to remark that Value factor is significant for Value category in 25% of ETFs and Size factor in 33.33%, Size factor is also significant for Growth category in 33.33%

[9] We have calculated all regressions explained in the methodology section, but results for the different models with less factors are similar to six-factor regression results.

of ETFs and the four Fama-French factors are significant for Fundamentals Weighted category in 37.50%, 25%, 12.50% and 25%, respectively. In relation to the explanatory power, in all regressions the average determination coefficient improves compared to the one-factor regression. It means that adding more factors allows to explain ETFs returns, but the explanatory power increment is not so relevant in general to accept adding several factors, except for Value and Size categories, whose determination coefficients grow over 80% with the addition of factors. With this six-factor model, Momentum category remains with 100% explanatory power and Buyback Yield category gets the same percentage (it has 99.99% in the one-factor regression).

Due to the length of the sample and the years included in it, we split in two subsamples from May 2007 to December 2011 and from January 2012 to April 2016. We have followed the same procedure as for the whole sample. There are not significant changes in average estimated coefficients, although in the first subsample the percentage of ETFs with significant coefficients is lower than with the whole one. It must be considered that the number of ETFs in the first subsample is lower because we have deleted from the sample those ETFs whose returns were less than 12 in order to results robustness.

The main argument professional asset managers have for using equity Smart Beta is to gain exposure to rewarded risk factors with the purpose of achieving an efficient risk-adjusted return with ease of implementation and the fact that they are, at the same time, concerned about being exposed to a risk of unintended consequences of undesired risks (Amenc et al. (2015)). Therefore, as it was expected, ETFs provide a return that replicate the benchmarked index and the excess return over it is very low, although significantly different from zero. This fact agree with the objective of this kind of assets explained above, to replicate the benchmark, because ETFs aim to offer an alternative way to invest in the benchmarked index.

In contrast to Glushkov (2015), we find no conclusive evidence about the significance of the factors sensibility of ETFs, because the sensibilities to factors except for the benchmark are not significantly different from zero and the estimated value is practically zero for every SB category and also for non-SB ETFs. We can conclude that the benchmark return collect the whole return of the ETF, as the sensibilities are nearly one as we expected.

In summary, most categories did not display expected co-movement with their intended factors once the exposure to other well-documented factors is accounted for.

5. Concluding remarks

According to performance ratios, we conclude that SB and non-SB ETFs have similar return, not statistically different. But SB ETFs perform better than the benchmark index, getting a positive relative return mean, so the replication aim is achieved. Relative to risk ratios, in general, non-SB ETFs are riskier than SB ETFs since non-SB ETFs Tracking Error mean is twice the SB ETFs Tracking Error mean, although volatility mean of the return series is similar for both categories. Showing that SB ETFs are better investment instruments given the return that they achieve. We can also see beta as a risk measure (non-diversifiable risk), in this way we could see that SB ETFs are riskier because of having higher beta mean (in relation to the benchmarked index), but it is also a measure of how well the ETF replicates its benchmark, the aim of this investment. In relation to risk-adjusted performance ratios, SB ETFs get significantly better results than non-SB ETFs. But it cannot be conclusive, because it depends on the period considered and economic situation. Although Sharpe Ratio (in excess return to risk-free rate) and Information Ratio (in excess return to the benchmark return) are higher for SB in most of time periods. We can conclude that SB ETFs are better strategies to invest than non-SB ETFs because they perform better considering both return and risk.

According to performance and risk-adjusted performance ratios, Size and Fundamentals Weighted are the categories that perform the best, but Dividend Weighted and Value taking into consideration the benchmark return. Relative to risk ratios, Buyback Yield and Value are the riskiest ones. Therefore we can conclude that Return-Oriented Strategies perform better than others.

In general, as advocates of smart beta strategies say, SB ETFs perform better than non-SB ETFs, as we can deduce from analysed performance indicators. Although this is a general analysis that can lead us to conclusive evidence, we have to consider that we are comparing funds of different features among the diverse categories.

We find evidence about the fact that ETFs replicate the benchmarked index and in some cases they provide an excess return not significantly different from zero. In fact it is as we expected, because it is the difference between the ETF and the benchmarked index and if the ETF replicate the benchmark, it must have an equal return. Actually, it should be negative and equal to the fund commissions. But we find no conclusive evidence about the significance of the factors sensibilities of ETFs because they are estimated as practically zero. Therefore, we can conclude that the benchmark return collect the whole return of the ETF, as the sensibilities to the declared benchmark are nearly one as we expected.

In summary, comparing SB ETFs versus non-SB ETFs, the former have higher return and similar risk, therefore SB ETFs have better risk-adjusted return. The lower risk in relation to the benchmark replication reinforces this affirmation and we can conclude that investing in SB ETFs is better than in non-SB ETFs.

Related to the analysis carried out about comparison of SB ETFs and non-SB ETFs performance, a pending issue is a matching study for ever SB ETFs. That is, for every SB ETF we should find two or three non-SB ETFs with similar characteristics based on fund size, commissions and other relevant variables. In this way, we would be able to make a thorough analysis and find conclusive evidence about SB ETFs performance.

A pending issue that we have left for further research during this paper is Factor Performance Attribution. As we explained in methodology section, this concept allows to show how each factor managed during the selected time period and how each factor's performance has impacted the ETF performance. This is a significant question that we would do in a possible extension of this work.

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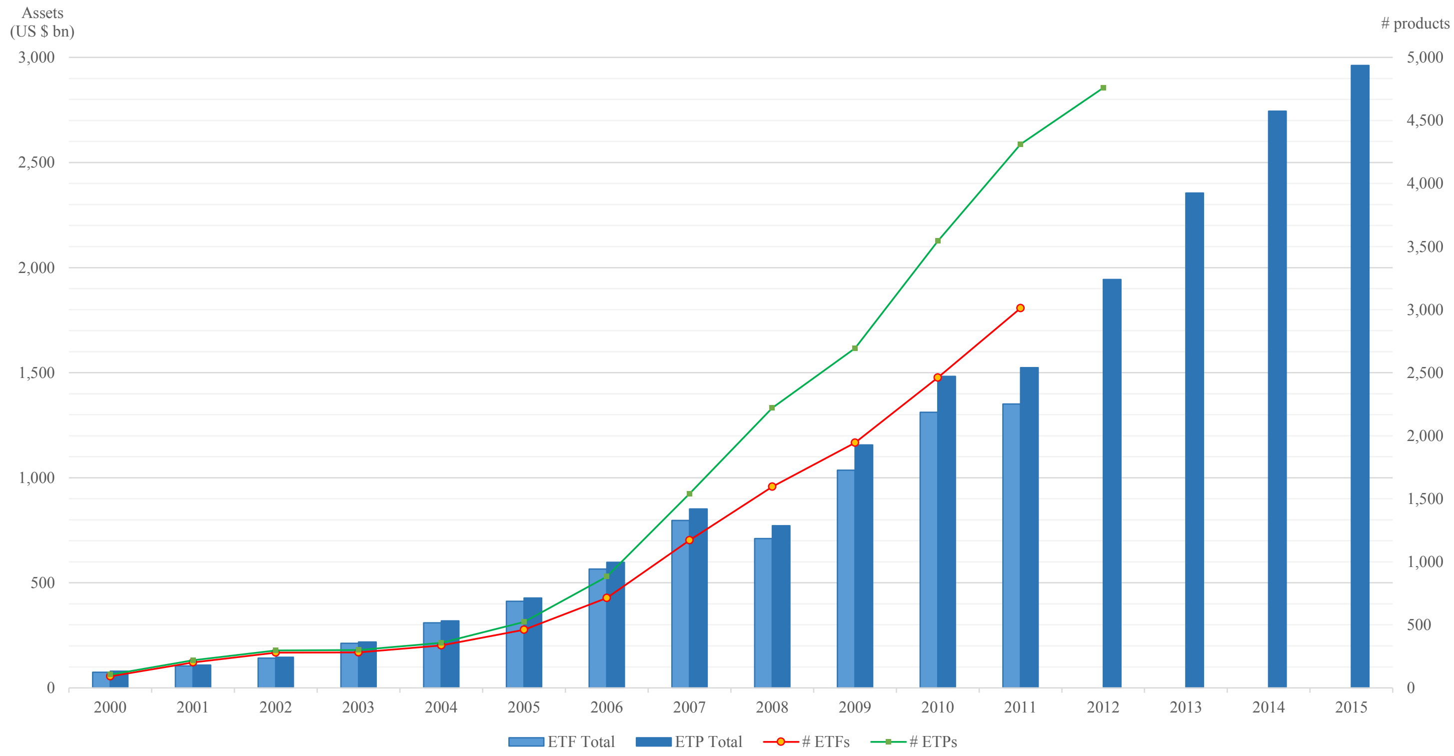
Appendix I.

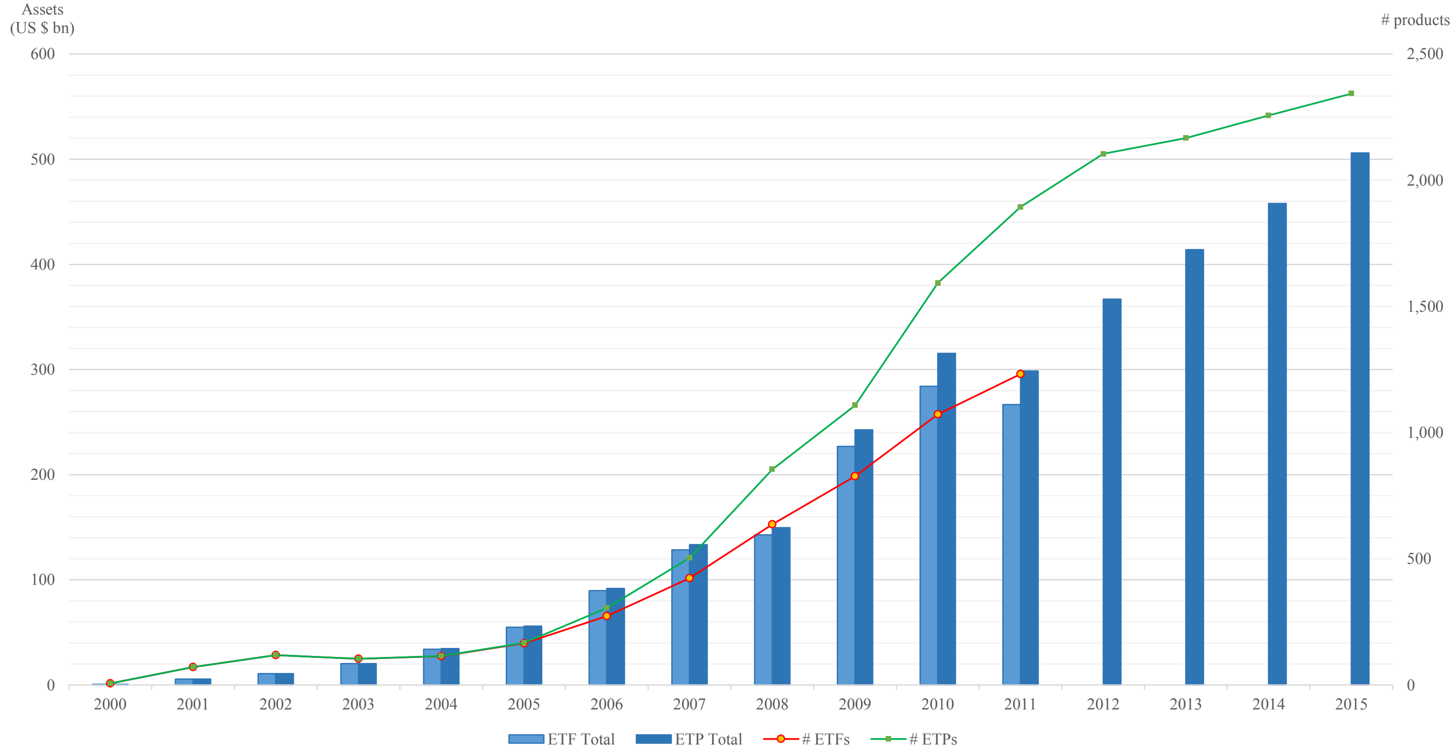
Figure I.1. Global ETP Multi-Year Asset Growth



Assets (US $ Bn)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
ETF Total	74	105	142	212	310	412	566	797	711	1,036	1,311	1,351				
Other ETP Total	5	4	4	6	9	16	33	55	61	120	171	174				
ETP Total	79	109	146	218	319	428	598	851	772	1,156	1,483	1,524	1,944	2,355	2,744	2,962
# ETFs	92	202	280	282	336	461	713	1,170	1,595	1,944	2,460	3,011				
# Other ETPs	14	17	17	18	21	63	170	371	625	750	1,083	1,300				
# ETPs	106	219	297	300	357	524	883	1,541	2,220	2,694	3,543	4,311	4,759			

This figure shows the evolution of Global ETP assets under management since 2000 until 2015. Source: Blackrock (2012, 2013, 2016).

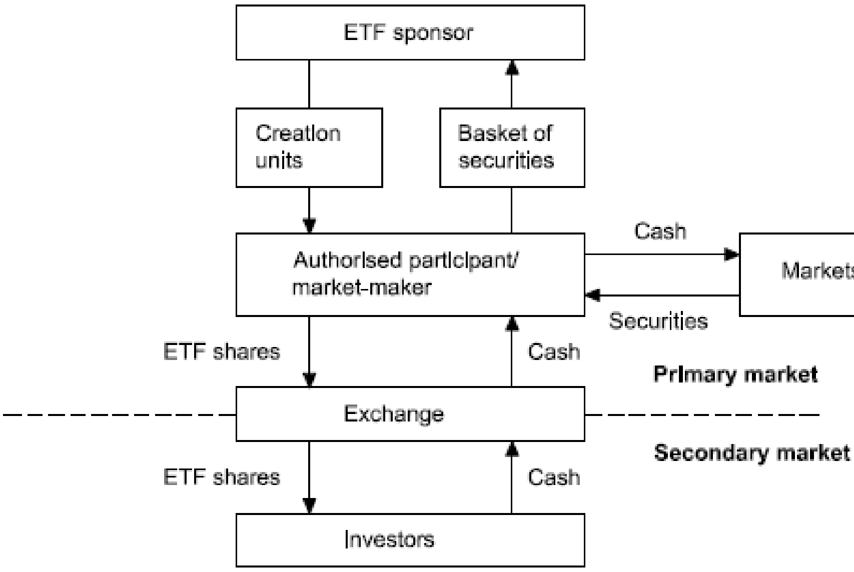
Figure I.2. European ETP Multi-Year Asset Growth



Assets (US $ Bn)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
ETF Total	1	6	11	20	34	55	90	129	143	227	284	267				
Other ETP Total	-	-	-	-	1	1	2	5	7	16	31	32				
ETP Total	1	6	11	20	35	56	92	133	150	243	315	299	367	414	458	506
# ETFs	6	71	118	104	114	165	273	423	636	827	1,072	1,232				
# Other ETPs	-	-	-	-	1	2	32	80	218	281	521	662				
# ETPs	6	71	118	104	115	167	305	503	854	1,108	1,593	1,894	2,105	2,167	2,257	2,343

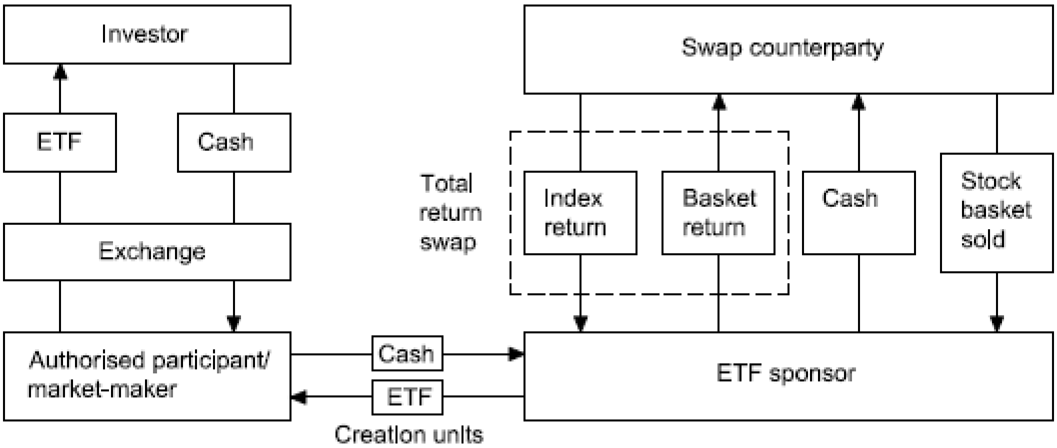
This figure shows the evolution of European ETP assets under management since 2000 until 2015. Source: Blackrock (2012, 2013, 2016).

Figure I.3. Phsical ETF structure



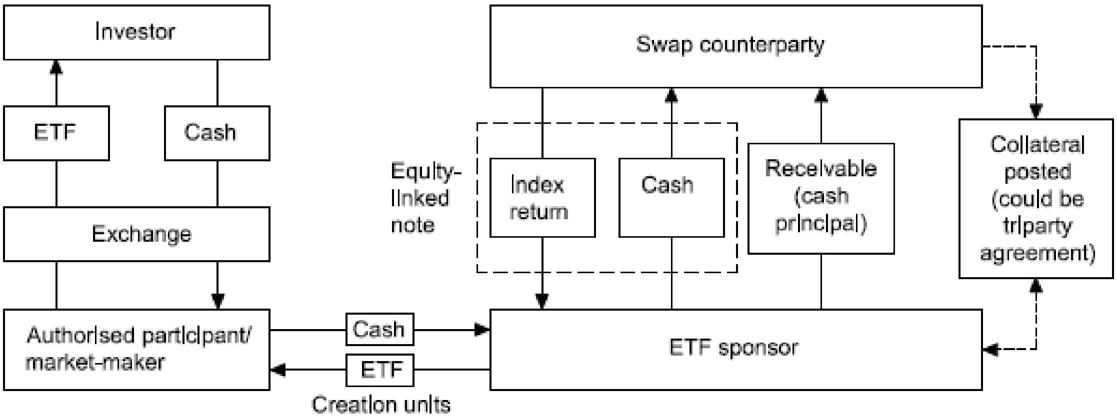
This figure shows the physical ETF structure. Source: Ramaswamy (2011).

Figure I.4. Unfunded-swap ETF structure



This figure shows the unfunded-swap ETF structure. Source: Ramaswamy (2011).

Figure I.5. Funded-swap ETF structure



This figure shows the funded-swap ETF structure. Source: Ramaswamy (2011).

Table I.1. Comparing physical and synthetic ETF structures

	Physical ETFs	Synthetic ETFs
Underlying holdings	Index-constituent securities.	Collateral and swaps.
Transparency of holdings	Yes.	Historically limited; recently improving.
Counterparty risk	Limited.	Yes.
Sources of costs	Management fee. Transactions costs.	Management fee. Swap costs.
Sources of tracking error	Level of portfolio optimization. Dividend treatment.	Resetting of swap contract terms.

This table shows the distinguishing features of physical and synthetic ETF structures. Source: Vanguard (2009).

Table I.2. Comparing unfunded-swap and funded-swap ETF structures

	Unfunded-swap structure	Funded-swap structure
Type of transaction	Total return swap.	Credit- or equity-linked note.
Counterparty risk	Mitigated through ownership of collateral assets effected through true sale.	Mitigated through the pledge of collateral assets through tripartiy agreement.
Overcollateralization	Typically small, if any.	Typically up to 120% of the ETF's net asset value.
Haircuts on collateral assets	Usually none, but under UCITS some jurisdictions can impose haircuts for certain assets.	Usually none, but under UCITS some jurisdictions can impose haircuts for certain assets.
Composition of collateral assets	Can change daily.	Can change daily.
Balance sheet implication for swap counterparty	True sale of collateral assets can alter risk-weighted capital charges.	Pledge of collateral assets unlikely to alter risk-weighted capital charges.

This table shows the distinguishing features of the two synthetic ETF structures: unfunded-swap ETF structures and funded-swap ETF structures. Source: Ramaswamy (2011).

Appendix II. Morningstar variables

The relevant variables in this paper are explained using Morningstar Direct definition in Table II.1.

Table II.1. Morningstar Direct variables

Variable	Morningstar Direct definition
Daily Price	The NAV price for the fund as of the performance date.
Fund Size	The total amount of money managed as a standalone portfolio across share classes/subaccounts. Fund Size is useful in gauging a product's size, agility and popularity. This can be greater than or equal to the share class/subaccount net assets. (They will be equal if only one share class is offered or the fund only appears in one policy). Fund Size (Surveyed-Monthly) is used in this paper.
Inception date	Date on which the security is first offered.
NAV (Net Asset Value)	The most-recent net asset value, which is the fund's share price. Funds compute this value daily by dividing the total net assets by the total number of shares. NAV updates offer a way of tracking the value of an investment. Changes in NAV can reveal capital appreciation (increase) or depreciation (decrease). The NAV will fall any time a fund makes a distribution, regardless of the distribution amount. If your fund's NAV has dropped considerably, determine if a distribution payout was made, and check the fund's most recent total-return and NAV-change figures. Because NAVs fluctuate daily with the market, mutual funds rely upon total return and not just share-price change, to gauge fund performance. Funds compute this value by dividing the total net assets by the total number of shares. NAV (Mo-End) is used in this paper.
Primary Prospectus Benchmark	The investment product's primary benchmark. For funds & VA/L subaccounts, the primary benchmark is stated in the fund's prospectus.
Primary Share	This indicates via yes or no which shareclass is the primary class. It is used for shareclasses that are listed in multiple currencies only one of which is designated as the primary class.
Strategic Beta	Yes or no.
Strategic Beta Attributes	Buyback/Shareholder Yield: Buyback/Shareholder yield strategies will select and/or weight their constituents of some measure of cash returned to shareholders (typically any one or some combination of the following: dividends, share repurchases and debt retirement) over a specified period. Dividend Screened/Weighted: Dividend screened and/or weighted strategies seek to deliver equity income by employing a number of dividend-oriented screening and/or weighting criteria. These include screening a universe of stocks for dividend paying firms, weighting stocks on the basis of dividend payments, screening on the basis of dividend growth, isolating firms based on metrics that would indicate dividend stability, and other dividend-related criteria. It is important to note that some of these strategies will weigh the results of their screening criteria by market capitalization. Earnings Weighted: Earnings screened and/or weighted strategies seek to deliver excess returns by employing a number of earnings-oriented screening and/or weighting criteria. Equal-Weighted: Equal-weighted strategies assign an equal weight to their constituent securities. Expected Returns: These equity strategies will select their constituents based on one or more measures of expected returns or relative performance (e.g. quantitative rankings, broker recommendations, etc.) and weight them in a variety of ways. Fundamentally weighted: Fundamentally weighted refers exclusively to Research Affiliates' RAFI Fundamental index equity strategies which select and weight their constituents based on fundamental measures such as sales, adjusted sales, cash flow, dividends, dividends plus share buybacks, book value, and retained cash flow. Growth: Growth strategies will screen a segment of the stock market looking to identify those stocks that display "growth" characteristics. These characteristics will differ across index providers. Common "growth" characteristics include: above-average long-term projected earnings growth, historical earnings growth, sales growth, cash flow growth, and book value growth—

Variable	Morningstar Direct definition
	amongst others. It is important to note that some of these strategies will weigh the results of their screening criteria by market capitalization. Low/High Beta: Low/High Beta strategies select and weight their constituents based on their beta relative to a standard market capitalization weighted benchmark. Low/Minimum Volatility/Variance: Low/Minimum Volatility/Variance strategies select and weight their constituents on the basis of historical volatility. Momentum: Momentum strategies will select and/or weight their constituent securities on a number of factors which might include price momentum, adjustments to earnings estimates and earnings surprises. Multi-Asset: Multi-asset strategies tend to be income-oriented and will screen eligible securities (which may include but not be limited to stocks, bonds, preferred securities, and MLPs) on the basis of yield—amongst other characteristics. Multifactor: Multifactor strategies set out to combine a variety of factors (e.g. value, growth, size, momentum, quality, low volatility, etc.) in an effort to improve risk-adjusted performance relative to a standard benchmark. Non-Traditional Commodity: Non-traditional commodity benchmarks aim to improve upon the performance of standard indexes (e.g. DJ UBSCI, S&P GSCI) by avoiding their chief drawbacks (e.g. roll losses resulting from contango). These include benchmarks that employ alternative weighting and/or rolling methodologies. Non-Traditional Fixed Income: Non-traditional fixed income benchmarks are not market capitalization weighted. The oft-cited drawback of market capitalization weighting in the case of bond benchmarks is that it results in a portfolio that overweights the most heavily indebted issuers. At present, most non-traditional bond benchmarks weight constituents on the basis of fundamental metrics indicative of debt service capacity which results in portfolios that skew towards more creditworthy issuers. Quality: These strategies look to build a portfolio of stocks comprised of quality companies, which are characterized by their durable business models and sustainable competitive advantages. Quality companies tend to have high and stable levels of profitability and clean balance sheets. Revenue Weight: Revenue weighted indexes assign weights to their constituents according to each company's revenue relative to the total revenue of all the companies in the index. Risk-Weighted: Risk-weighted strategies weight constituents according to their individual expected contributions to overall portfolio risk. Size: We do not consider size on a stand-alone basis, but only within the context of a multi-factor strategy that introduces size "tilts". So, we do not classify products tracking small cap benchmarks as Strategic Beta. Also, we do not classify small- or mid-cap benchmarks that screen constituents for growth or value characteristics as being "Multi-Factor". Only those products that track multi-factor benchmarks that implement a size "tilt" will be tagged with this attribute. Value: Value strategies will screen a segment of the stock market looking to identify those stocks that display "value" characteristics. These characteristics will differ across index providers. Common value characteristics include: low price/prospective earnings, price/book, price/sales, and price/cash flow ratios, and above average dividend yields—amongst others. It is important to note that some of these strategies will weigh the results of their screening criteria by market capitalization.
Strategic Beta Group	Return-Oriented Strategies: They look to improve returns relative to a standard benchmark. Value- and growth-based benchmarks are prime examples of return-oriented strategies. Other return-oriented strategies seek to isolate a specific source of return. Dividend screened/weighted indexes are the chief examples of this type of return-oriented strategy. Strategic Beta Attributes included in this group are Buyback/Shareholder Yield, Dividend Screened/Weighted, Earnings Weighted, Expected Returns, Fundamentally Weighted, Growth, Momentum, Multifactor, Quality, Revenue Weight, Size and Value.

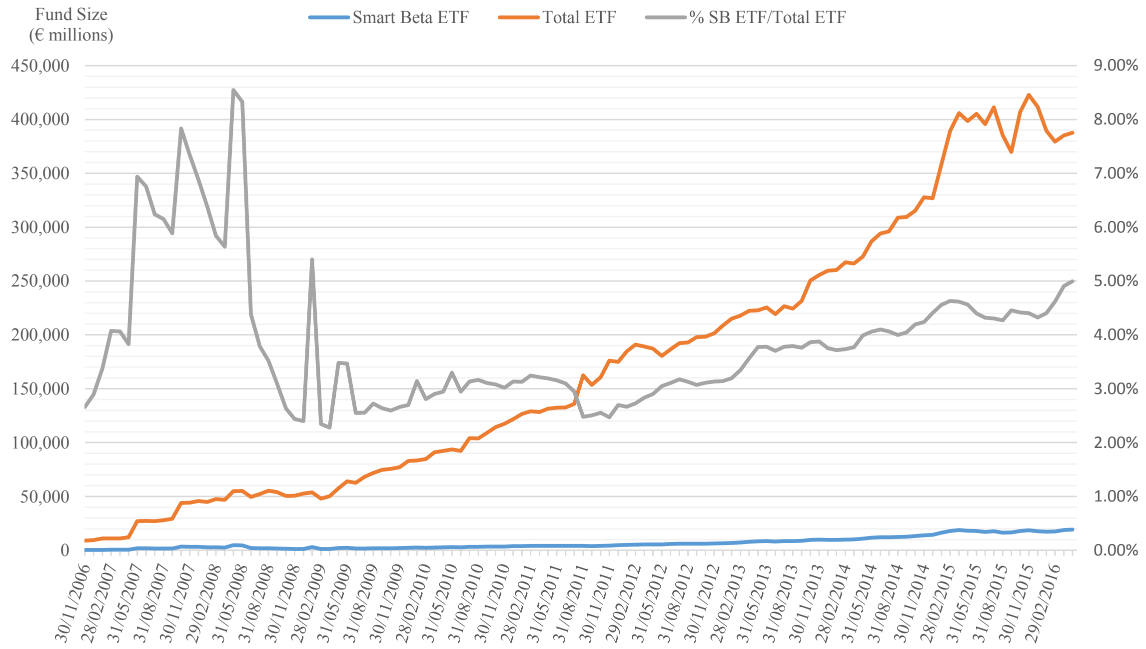
Variable	Morningstar Direct definition
	Risk-Oriented Strategies: Risk-oriented strategies look to either reduce or increase the level of risk relative to a standard benchmark. Low volatility and high beta strategies are the most common examples of risk-oriented strategies. Strategic Beta Attributes included in this group are Low/High Beta, Low/Minimum Volatility/Variance and Risk-Weighted. Other: The Other classification encompasses a wide variety of strategies. These range from non-traditional commodity benchmarks to multi-asset indexes. Strategic Beta Attributes included in this group are Equal-Weighted, Multi-Asset, Non-Traditional Commodity and Non-Traditional Fixed Income.
Total Return	Expressed in percentage terms, Morningstar's calculation of total return is determined each month by taking the change in monthly net asset value, reinvesting all income and capital-gains distributions during that month, and dividing by the starting NAV. Reinvestments are made using the actual reinvestment NAV, and daily payoffs are reinvested monthly. Unless otherwise noted, Morningstar does not adjust total returns for sales charges (such as front-end loads, deferred loads and redemption fees), preferring to give a clearer picture of a fund's performance. The total returns do account for management, administrative, 12b-1 fees and other costs taken out of fund assets. Total returns for periods longer than one year are expressed in terms of compounded average annual returns (also known as geometric total returns), affording a more meaningful picture of fund performance than non-annualized figures. Monthly Return is used in this paper.

This table exhibits the relevant variables used in this paper and taken from Morningstar Direct database with their meanings. Source: Morningstar Direct.

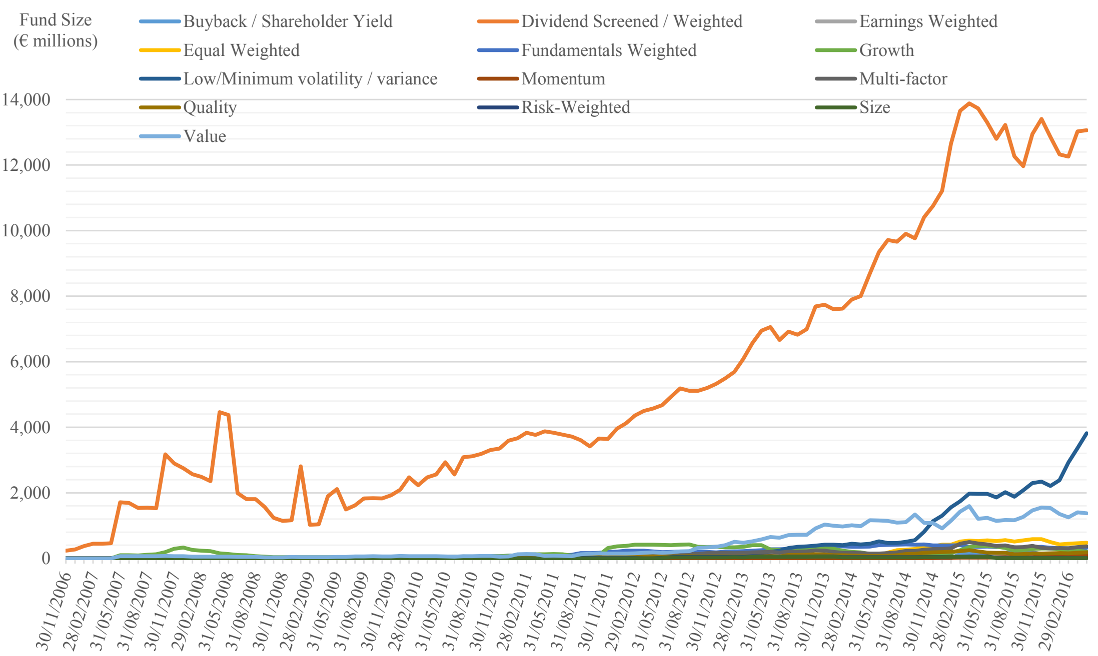
Appendix III. Results

Figure III.1. Absolute and relative growth of ETFs fund size

Panel A. Smart Beta ETFs and Total ETFs



Panel B. Smart Beta ETFs categories



In panel A, the figure shows fund size evolution in Smart Beta ETF and total ETF in € millions (left axis). Grey line shows the aggregated fund size of SB ETFs as a fraction of the aggregated ETF fund size (right axis). In panel B, the figure shows fund size evolution in Smart Beta ETF categories in € millions. Both figures exhibits the growth for the period from November 2006 (inception of the earliest SB of the sample) to April 2016.

Table III.1. Evolution of Equity Europe-domiciled Smart Beta ETF by category

Panel A. Number of ETFs

Smart Beta Category	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Buyback / Shareholder Yield										3	3
Dividend Screened / Weighted	1	12	12	15	15	19	23	29	34	34	34
Earnings Weighted						1	1	1	1	1	1
Equal Weighted						1	1	1	2	4	4
Fundamentals Weighted			5	5	5	7	7	7	8	8	8
Growth		1	1	2	2	6	6	6	6	6	6
Low/Minimum volatility / variance				1	1	1	7	7	8	8	8
Momentum									1	1	1
Multi-factor				2	2	3	5	5	6	8	8
Quality				2	2	2	2	2	3	3	3
Risk-Weighted						1	3	3	3	3	3
Size							2	2	2	2	2
Value		1	1	2	2	5	7	7	8	12	12
Total	1	14	19	29	29	46	64	70	82	93	93

Panel B. Fund size as percentage of overall Equity Europe-domiciled SB ETF

Smart Beta Category	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Buyback / Shareholder Yield										0.58%	0.53%
Dividend Screened / Weighted	100.00%	87.47%	92.01%	91.72%	93.29%	82.05%	79.19%	74.56%	74.62%	69.82%	65.02%
Earnings Weighted						0.12%	1.14%	0.52%	0.39%	0.25%	0.41%
Equal Weighted						0.43%	0.38%	0.72%	2.80%	2.68%	2.38%
Fundamentals Weighted			1.82%	1.37%	2.09%	4.18%	3.00%	3.59%	2.61%	1.76%	1.59%
Growth		10.44%	2.97%	1.75%	2.03%	7.62%	4.86%	2.86%	1.01%	1.62%	1.02%
Low/Minimum volatility / variance				0.24%	0.16%	0.34%	1.17%	4.09%	8.67%	11.98%	19.00%
Momentum									0.09%	0.38%	0.40%
Multi-factor				0.93%	0.49%	1.08%	2.47%	1.95%	1.91%	1.64%	1.81%
Quality				0.93%	0.49%	0.97%	0.86%	0.93%	1.26%	0.84%	0.89%
Risk-Weighted						0.16%	0.62%	0.55%	0.31%	0.08%	0.05%
Size							0.47%	0.50%	0.26%	0.03%	0.03%
Value		2.08%	3.20%	3.06%	1.45%	3.05%	5.85%	9.74%	6.07%	8.33%	6.86%

Panel A shows the evolution of number of SB ETFs by category from 2006 to 2016, while panel B shows the evolution of fund size as percentage of overall SB ETFs by category from 2006 to 2016.

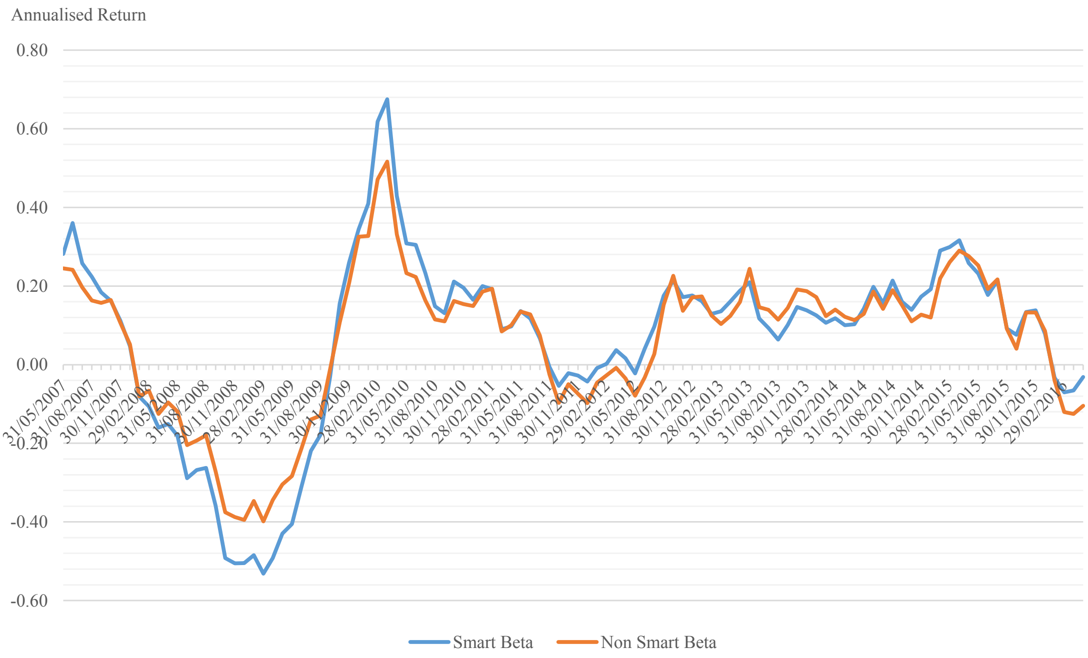
Table III.2. Top 20 Largest Equity Europe-domiciled Smart Beta Exchange-Traded Funds

Name	Strategic Beta Group	Strategic Beta Category	Global Investment Fund Sector (GIFS)	Primary Prospectus Benchmark	Inception Date	Fund Size (€ millions)
iShares Developed Markets Property Yld	Return Oriented	Dividend Screened/Weighted	Property - Indirect Global	FTSE EPRA/NAREIT Dev Dividend+ NR USD	20/10/2006	2,712.09
SPDR® S&P US Dividend Aristocrats ETF	Return Oriented	Dividend Screened/Weighted	US Large-Cap Value Equity	S&P High Yield Dividend Aristcrts NR USD	14/10/2011	1,870.02
iShares Edge S&P 500 Minimum Volatility	Risk Oriented	Low/Minimum Volatility/Variance	US Large-Cap Blend Equity	S&P 500 Minimum Volatility NR USD	30/11/2012	1,562.79
iShares Edge MSCI World Minimum Volatil	Risk Oriented	Low/Minimum Volatility/Variance	Global Large-Cap Blend Equity	MSCI World Minimum Vol (USD) NR USD	30/11/2012	1,124.93
iShares UK Dividend	Return Oriented	Dividend Screened/Weighted	UK Equity Income	FTSE UK Dividend Plus NR GBP	04/11/2005	1,042.04
iShares STOXX Global Sel Div 100 (DE)	Return Oriented	Dividend Screened/Weighted	Global Equity-Income	STOXX Global Select Dividend 100 NR EUR	25/09/2009	990.69
iShares Edge MSCI Europe Minimum Volatil	Risk Oriented	Low/Minimum Volatility/Variance	Europe Large-Cap Blend Equity	MSCI Europe Minimum Vol (USD) NR EUR	30/11/2012	936.10
SPDR® S&P Euro Dividend Aristocrats ETF	Return Oriented	Dividend Screened/Weighted	Eurozone Large-Cap Equity	S&P Euro High Yield Divdnd Arstcr NR EUR	28/02/2012	723.02
iShares EURO Dividend	Return Oriented	Dividend Screened/Weighted	Eurozone Large-Cap Equity	EURO STOXX Select Dividend 30 NR EUR	28/10/2005	676.60
db x-trackers Stoxx Glbl Sel Div 100 1D	Return Oriented	Dividend Screened/Weighted	Global Equity-Income	STOXX Global Select Dividend 100 NR EUR	01/06/2007	555.75
iShares DivDAX® (DE)	Return Oriented	Dividend Screened/Weighted	Germany Large-Cap Equity	FSE DIVDAX TR EUR	04/04/2005	527.27
iShares STOXX Europe Sel Div 30 (DE)	Return Oriented	Dividend Screened/Weighted	Europe Equity-Income	STOXX Europe Select Dividend 30 NR EUR	03/05/2005	516.04
iShares EURO STOXX Select Div 30 (DE)	Return Oriented	Dividend Screened/Weighted	Eurozone Large-Cap Equity	EURO STOXX Select Dividend 30 NR EUR	03/05/2005	503.85
Source MSCI Europe Value ETF	Return Oriented	Value	Europe Large-Cap Value Equity	MSCI Europe Value NR EUR	15/03/2012	393.70
iShares Asia Pacific Dividend	Return Oriented	Dividend Screened/Weighted	Asia-Pacific incl Japan Equity	DJ Asia Pac Select Dividend 30 TR USD	02/06/2006	341.51
UBS ETF MSCI USA Value USD A dis	Return Oriented	Value	US Large-Cap Value Equity	MSCI USA Value NR USD	11/04/2012	341.02
Vanguard FTSE All-World High Div Yld ETF	Return Oriented	Dividend Screened/Weighted	Global Large-Cap Value Equity	FTSE AW High Dividend Yield NR USD	21/05/2013	326.15
db x-trackers S&P 500 Equal Wt (DR) 1C	Other	Equal Weighted	US Large-Cap Blend Equity	S&P 500 Equal Weighted NR USD	10/06/2014	303.55
iShares Asia Property Yield	Return Oriented	Dividend Screened/Weighted	Property - Indirect Asia	FTSE EPRA/NAREIT Dvlp Asia Div+ NR USD	20/10/2006	287.31
iShares DJ US Select Dividend (DE)	Return Oriented	Dividend Screened/Weighted	US Large-Cap Value Equity	DJ US Select Dividend TR USD	28/09/2005	271.31

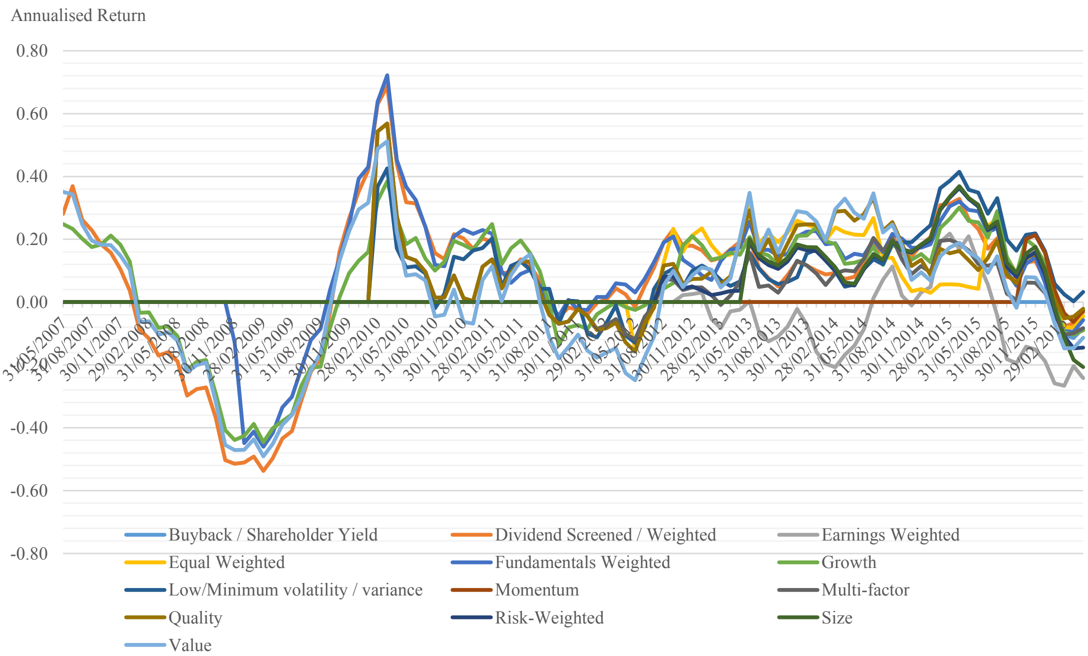
Along with the name and fund size (in € millions) in April 2016, the table also reports the Strategic Beta Group and category and the type of ETF based on Global Investment Fund Sector. Benchmark column reports the respective index reported as “benchmark index” in an ETF summary prospectus/factsheet. If the latter does not contain the specific mention of the benchmark index, the benchmark assigned by Morningstar is used (“Analyst Assigned Benchmark”).

Figure III.2. Annualised Return series

Panel A. Smart Beta ETFs vs. non-SB ETFs



Panel B. Smart Beta ETFs categories



The figure shows Annualised Return series of SB ETFs and non-SB ETFs (in panel A) and Annualised Return series of SB ETFs categories (in panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016.

Table III.3. Descriptive statistics of Annualised Return series

Panel A. Smart Beta ETFs vs. non-SB ETFs

	Mean	Standard Deviation	Minimum	Maximum	% times over the other	# ETFs
Smart Beta	0.0657 ^^^	0.2285	-0.5318	0.6749	57.41%	76
Non Smart Beta	0.0627 ^^^	0.1843	-0.3989	0.5165	42.59%	772
					100.00%	

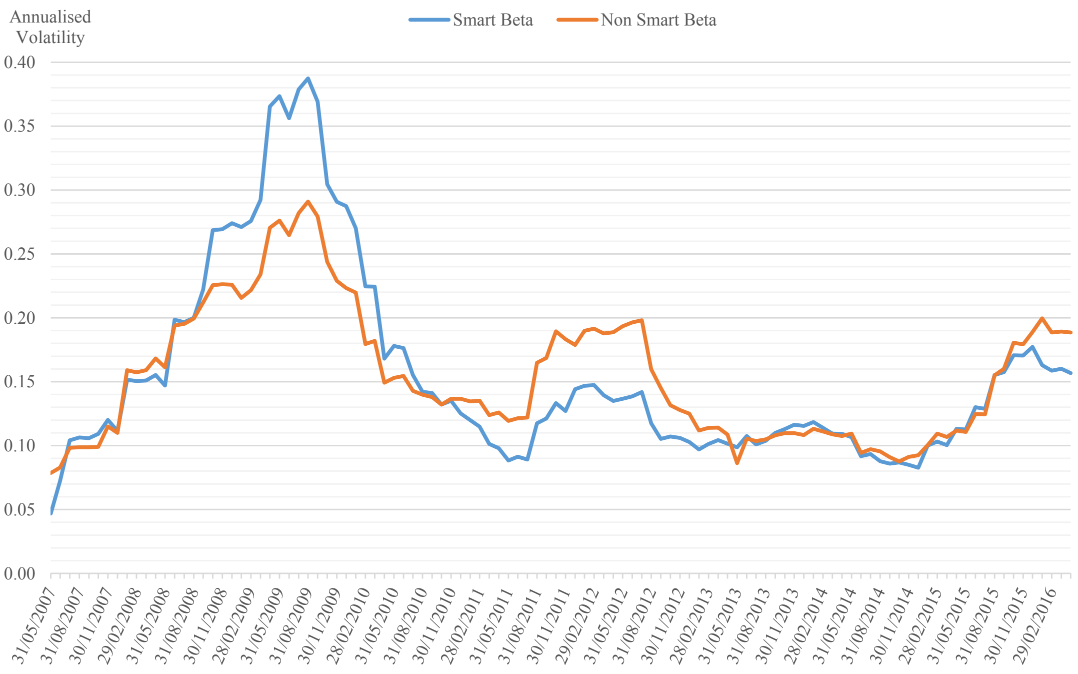
Panel B. Smart Beta ETFs categories

Smart Beta Category	Mean	Standard Deviation	Minimum	Maximum	% times over the others	# ETFs
Buyback / Shareholder Yield	-0.1008	0.0162	-0.1143	-0.0829	0.00%	4
Dividend Screened / Weighted	0.0645	0.2325	-0.5373	0.6870	11.11%	34
Earnings Weighted	-0.0507	0.1288	-0.2661	0.2180	0.00%	1
Equal Weighted	0.1295	0.1099	-0.1503	0.3079	6.48%	4
Fundamentals Weighted	0.1129	0.2006	-0.4601	0.7216	25.93%	8
Growth	0.0601	0.1901	-0.4454	0.3845	22.22%	6
Low/Minimum volatility / variance	0.1181	0.1238	-0.1298	0.4256	19.44%	8
Momentum	0.0691	0.1188	-0.0632	0.2135	0.00%	1
Multi-factor	0.0716	0.1175	-0.1190	0.5686	0.00%	8
Quality	0.1124	0.1338	-0.1580	0.5686	2.78%	3
Risk-Weighted	0.1215	0.1124	-0.1468	0.3632	0.00%	3
Size	0.1449	0.1259	-0.2070	0.3688	0.00%	2
Value	0.0297	0.2181	-0.4908	0.5117	12.04%	12
					100.00%	

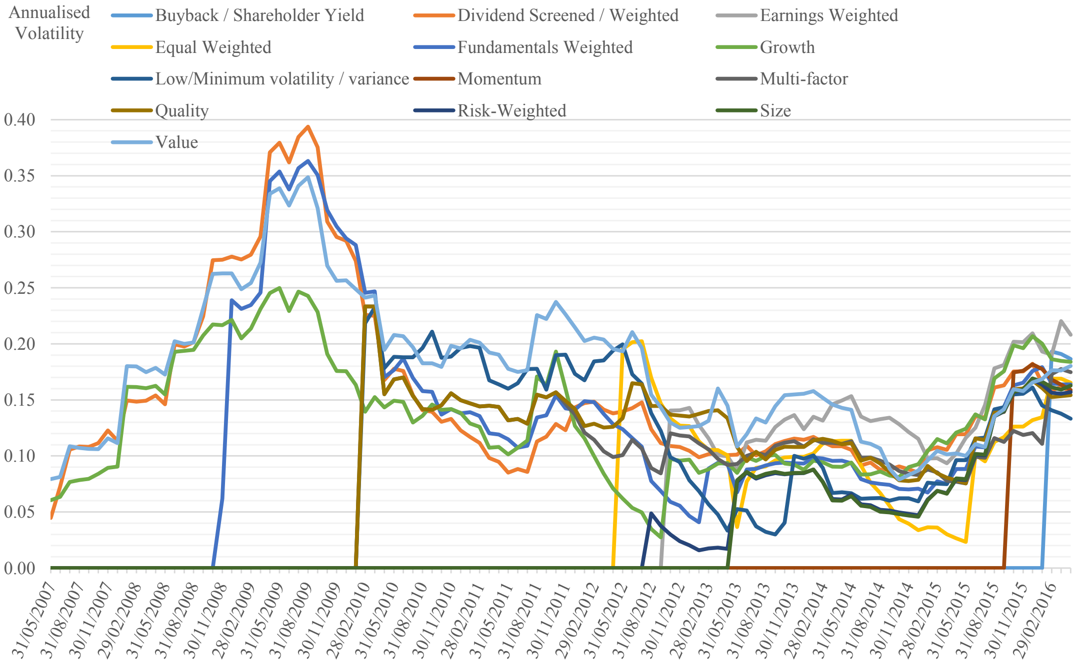
For Annualised Return series of SB ETFs and non-SB ETFs (in panel A) and Annualised Return series of SB ETFs categories (in panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016, the table shows different descriptive statistics of each category: mean, standard deviation, minimum value and maximum value. It also displays the percentage of times that the category is over the other one and the number of ETFs included in the category for calculations. The symbols ***, **, and * indicate that the difference between SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively. The symbols ^^^, ^^, and ^ indicate that the SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively.

Figure III.3. Annualised Volatility series

Panel A. Smart Beta ETFs vs. non-SB ETFs



Panel B. Smart Beta ETFs categories



The figure shows Annualised Volatility series of SB ETFs and non-SB ETFs (in panel A) and Annualised Volatility series of SB ETFs categories (in panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016.

Table III.4. Descriptive statistics of Annualised Volatility series

Panel A. Smart Beta ETFs vs. non-SB ETFs

	Mean ***	Standard Deviation	Minimum	Maximum	% times over the other	# ETFs
Smart Beta	0.1551 ^^^	0.0761	0.0469	0.3874	46.30%	76
Non Smart Beta	0.1543 ^^^	0.0519	0.0785	0.2908	53.70%	772
					100.00%	

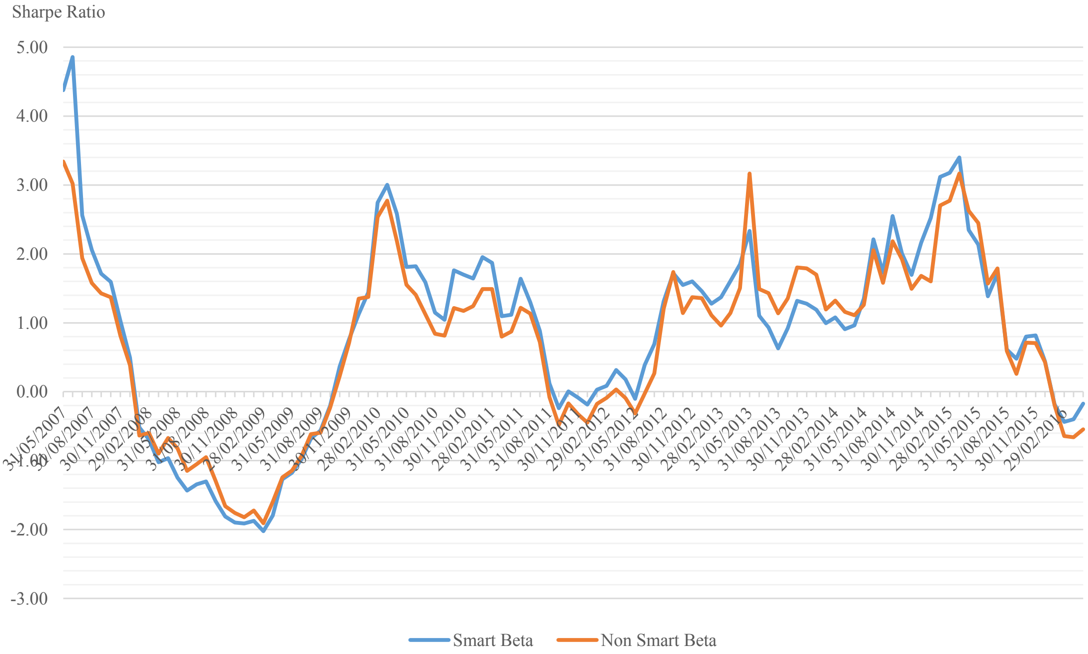
Panel B. Smart Beta ETFs categories

Smart Beta Category	Mean	Standard Deviation	Minimum	Maximum	% times over the others	# ETFs
Buyback / Shareholder Yield	0.1902	0.0034	0.1864	0.1931	0.93%	4
Dividend Screened / Weighted	0.1566	0.0776	0.0448	0.3937	17.59%	34
Earnings Weighted	0.1392	0.0349	0.0867	0.2203	19.44%	1
Equal Weighted	0.1036	0.0465	0.0233	0.2024	2.78%	4
Fundamentals Weighted	0.1457	0.0811	0.0409	0.3631	5.56%	8
Growth	0.1338	0.0532	0.0273	0.2498	5.56%	6
Low/Minimum volatility / variance	0.1270	0.0572	0.0299	0.2325	5.56%	8
Momentum	0.1715	0.0082	0.1590	0.1817	0.00%	1
Multi-factor	0.1217	0.0319	0.0755	0.2333	0.00%	8
Quality	0.1310	0.0312	0.0755	0.2333	1.85%	3
Risk-Weighted	0.0789	0.0445	0.0158	0.1681	0.00%	3
Size	0.0927	0.0405	0.0457	0.1691	0.00%	2
Value	0.1773	0.0629	0.0789	0.3487	40.74%	12
					100.00%	

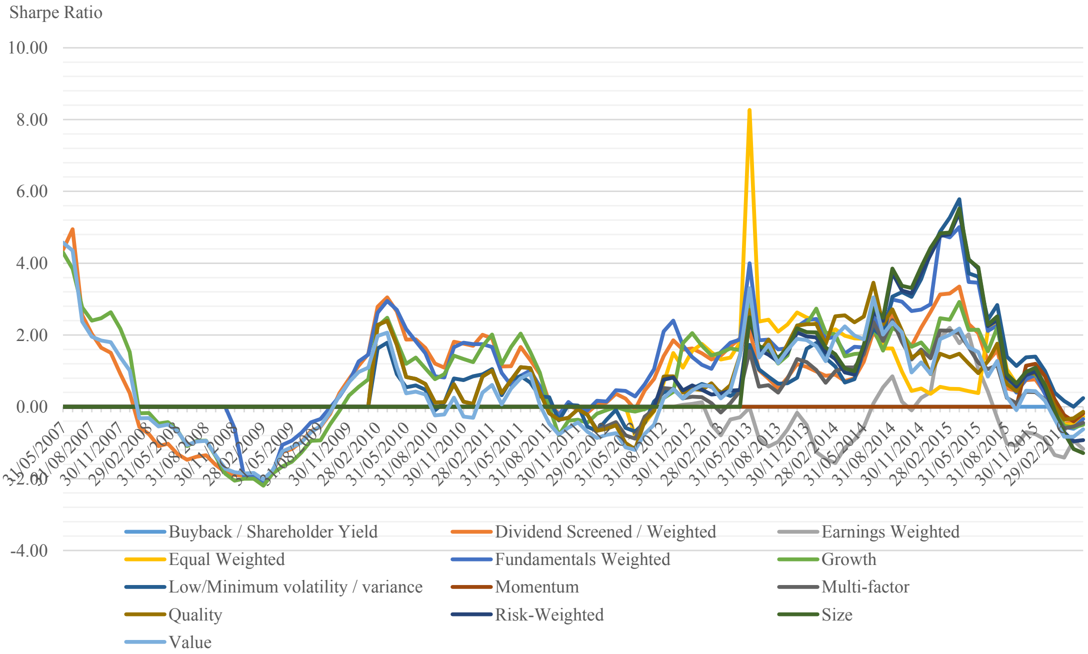
For Annualised Volatility series of SB ETFs and non-SB ETFs (in panel A) and Annualised Volatility series of SB ETFs categories (in panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016, the table shows different descriptive statistics of each category: mean, standard deviation, minimum value and maximum value. It also displays the percentage of times that the category is over the other one and the number of ETFs included in the category for calculations. The symbols ***, **, and * indicate that the difference between SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively. The symbols ^^^, ^^, and ^ indicate that the SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively.

Figure III.4. Sharpe Ratio series

Panel A. Smart Beta ETFs vs. non-SB ETFs



Panel B. Smart Beta ETFs categories



The figure shows Sharpe Ratio series of SB ETFs and non-SB ETFs (in panel A) and Sharpe Ratio series of SB ETFs categories (in panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016.

Table III.5. Descriptive statistics of Sharpe Ratio series

Panel A. Smart Beta ETFs vs. non-SB ETFs

	Mean **	Standard Deviation	Minimum	Maximum	% times over the other	# ETFs
Smart Beta	0.8410 ^^^	1.3922	-2.0245	4.8576	66.67%	76
Non Smart Beta	0.7278 ^^^	1.2517	-1.9078	3.3425	33.33%	772
					100.00%	

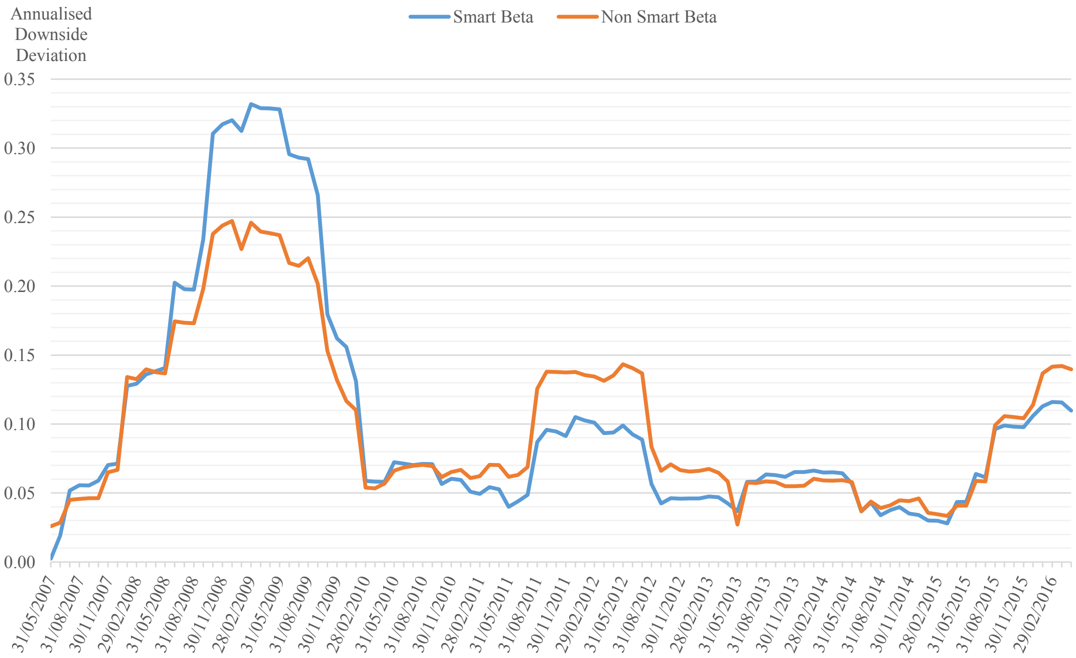
Panel B. Smart Beta ETFs categories

Smart Beta Category	Mean	Standard Deviation	Minimum	Maximum	% times over the others	# ETFs
Buyback / Shareholder Yield	-0.5443	0.0803	-0.6151	-0.4572	0.00%	4
Dividend Screened / Weighted	0.8245	1.4005	-2.0162	4.9464	13.89%	34
Earnings Weighted	-0.2540	0.9659	-1.5672	2.2003	0.00%	1
Equal Weighted	1.3323	1.4048	-0.8063	8.2703	8.33%	4
Fundamentals Weighted	1.2292	1.4454	-2.0781	5.0088	23.15%	8
Growth	0.8419	1.4023	-2.1980	4.2995	21.30%	6
Low/Minimum volatility / variance	1.1398	1.3814	-0.6860	5.7821	14.81%	8
Momentum	0.3688	0.6850	-0.4055	1.1986	0.00%	1
Multi-factor	0.6581	0.8371	-0.8875	2.4135	0.00%	8
Quality	0.9355	1.0132	-1.1781	3.4561	4.63%	3
Risk-Weighted	1.7106	1.5647	-0.9576	5.4075	0.93%	3
Size	2.0836	1.6644	-1.2869	5.5202	6.48%	2
Value	0.4739	1.3245	-2.0257	4.5707	6.48%	12
					100.00%	

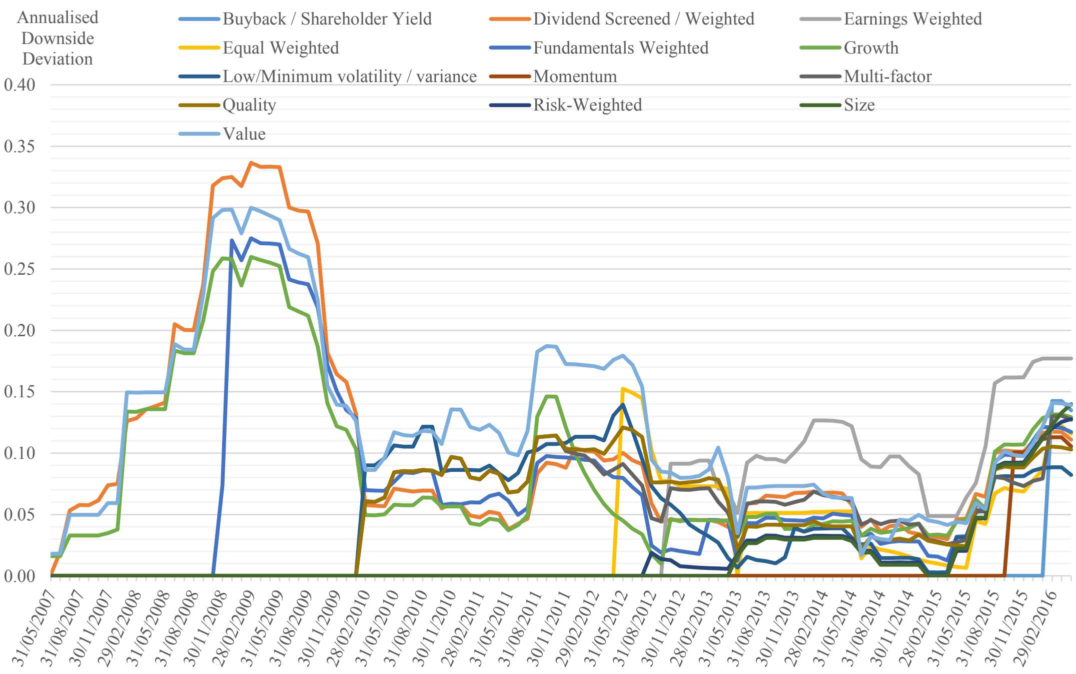
For Sharpe Ratio series of SB ETFs and non-SB ETFs (in panel A) and Sharpe Ratio series of SB ETFs categories (in panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016, the table shows different descriptive statistics of each category: mean, standard deviation, minimum value and maximum value. It also displays the percentage of times that the category is over the other one and the number of ETFs included in the category for calculations. The symbols ***, **, and * indicate that the difference between SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively. The symbols ^^^, ^^, and ^ indicate that the SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively.

Figure III.5. Annualised Downside Deviation series

Panel A. Smart Beta ETFs vs. non-SB ETFs



Panel B. Smart Beta ETFs categories



The figure shows Annualised Downside Deviation series of SB ETFs and non-SB ETFs (in panel A) and Annualised Downside Deviation series of SB ETFs categories (in panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016.

Table III.6. Descriptive statistics of Annualised Downside Deviation series

Panel A. Smart Beta ETFs vs. non-SB ETFs

	Mean ***	Standard Deviation	Minimum	Maximum	% times over the other	# ETFs
Smart Beta	0.1033 ^^^	0.0843	0.0025	0.3320	48.15%	76
Non Smart Beta	0.1005 ^^^	0.0610	0.0259	0.2471	51.85%	772
					100.00%	

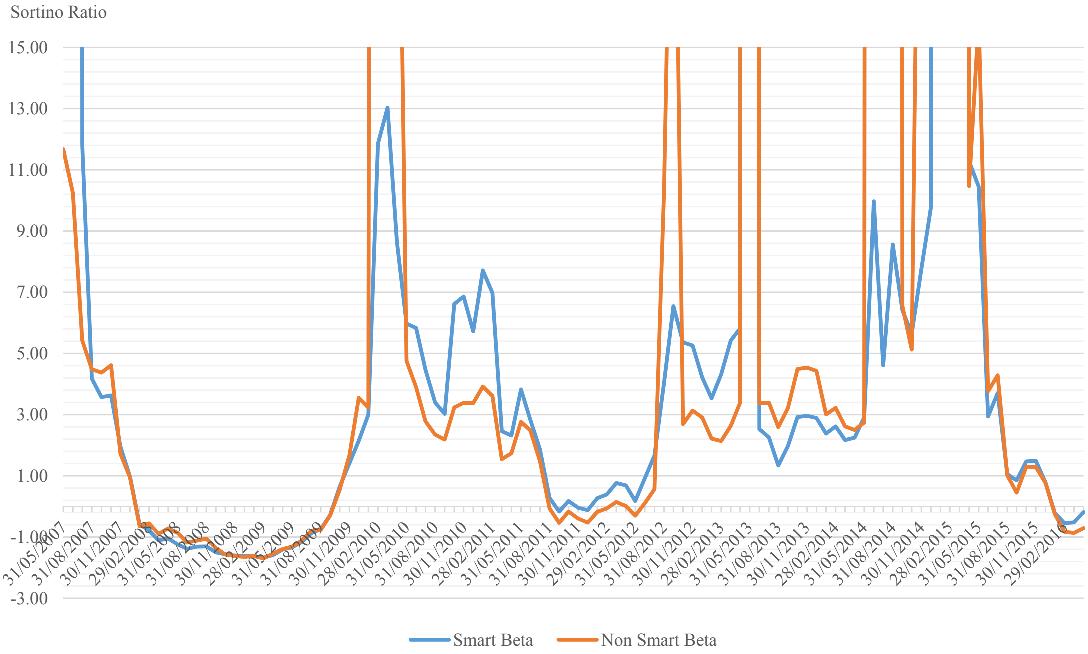
Panel B. Smart Beta ETFs categories

Smart Beta Category	Mean	Standard Deviation	Minimum	Maximum	% times over the others	# ETFs
Buyback / Shareholder Yield	0.1399	0.0045	0.1348	0.1425	0.00%	4
Dividend Screened / Weighted	0.1045	0.0857	0.0011	0.3365	25.00%	34
Earnings Weighted	0.1062	0.0388	0.0487	0.1771	37.96%	1
Equal Weighted	0.0567	0.0363	0.0000	0.1492	0.93%	4
Fundamentals Weighted	0.0857	0.0689	0.0123	0.2750	0.00%	8
Growth	0.0878	0.0683	0.0099	0.2597	0.00%	6
Low/Minimum volatility / variance	0.0646	0.0386	0.0028	0.1395	3.70%	8
Momentum	0.1070	0.0055	0.1007	0.1130	0.00%	1
Multi-factor	0.0708	0.0240	0.0259	0.1305	0.00%	8
Quality	0.0700	0.0294	0.0210	0.1210	0.00%	3
Risk-Weighted	0.0370	0.0373	0.0003	0.1277	0.00%	3
Size	0.0453	0.0417	0.0000	0.1399	0.00%	2
Value	0.1222	0.0731	0.0170	0.2998	32.41%	12
					100.00%	

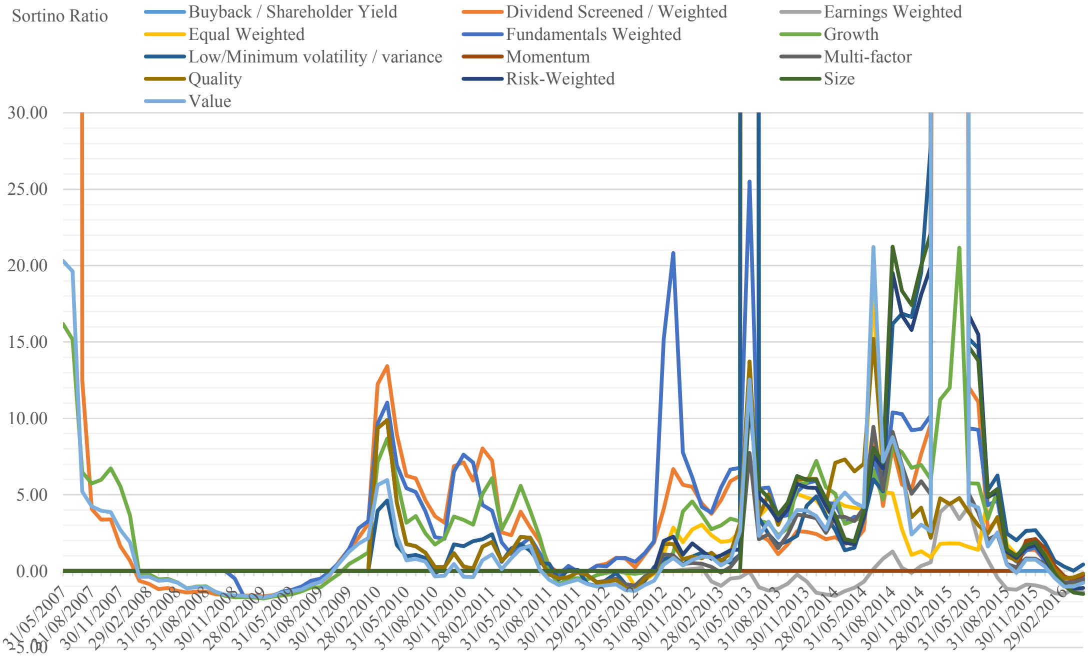
For Annualised Downside Deviation series of SB ETFs and non-SB ETFs (in panel A) and Annualised Downside Deviation series of SB ETFs categories (in panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016, the table shows different descriptive statistics of each category: mean, standard deviation, minimum value and maximum value. It also displays the percentage of times that the category is over the other one and the number of ETFs included in the category for calculations. The symbols ***, **, and * indicate that the difference between SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively. The symbols ^^^, ^^, and ^ indicate that the SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively.

Figure III.6. Sortino Ratio series

Panel A. Smart Beta ETFs vs. non-SB ETFs



Panel B. Smart Beta ETFs categories



The figure shows Sortino Ratio series of SB ETFs and non-SB ETFs (in panel A) and Sortino Ratio series of SB ETFs categories (in panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016. Series tend to infinite in times when it exceeds of the graph axis.

Table III.7. Descriptive statistics of Sortino Ratio series

Panel A. Smart Beta ETFs vs. non-SB ETFs

	Median	Standard Deviation	Minimum	Maximum	% times over the other	# ETFs
Smart Beta	2.3506 ^^	1220.6188	-1.6755	9771.7602	54.63%	76
Non Smart Beta	2.4890 ^^	2181.9809	-1.6962	13038.6063	45.37%	772
					100.00%	

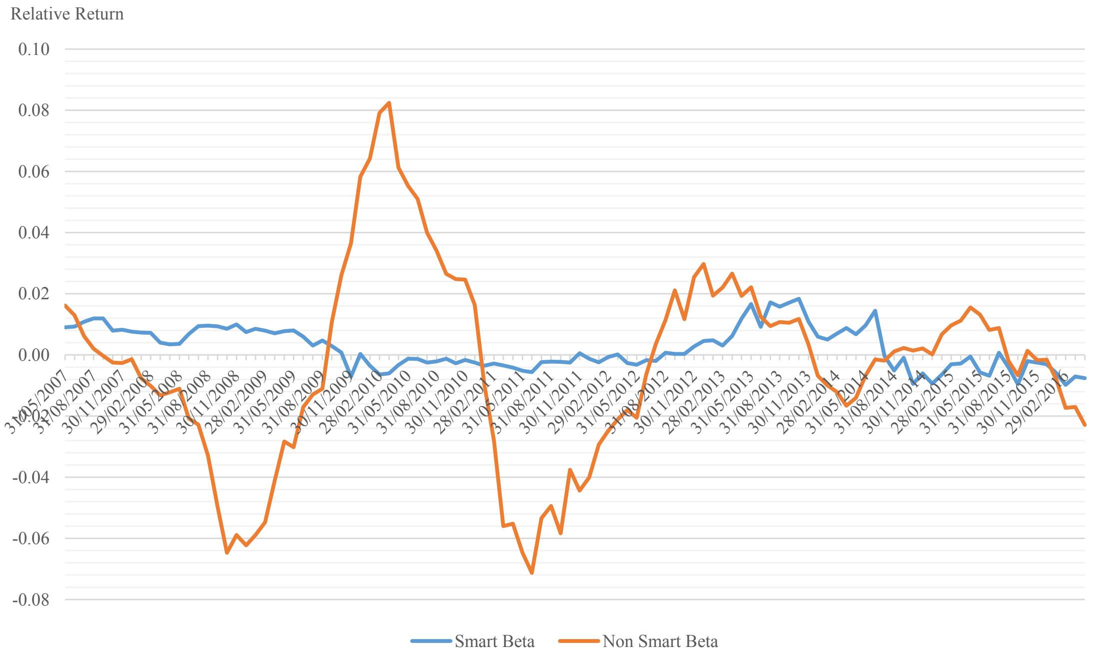
Panel B. Smart Beta ETFs categories

Smart Beta Category	Median	Standard Deviation	Minimum	Maximum	% times over the others	# ETFs
Buyback / Shareholder Yield	-0.7595	0.0977	-0.8243	-0.6323	0.00%	4
Dividend Screened / Weighted	2.2074	1,044.9365	-1.6677	10,852.3374	21.30%	34
Earnings Weighted	-0.6812	1.5563	-1.6281	4.4261	0.00%	1
Equal Weighted	2.1682	8,659.8612	-1.0331	60,000.0000	0.93%	4
Fundamentals Weighted	3.4779	6,833.5173	-1.7637	38,506.9218	25.93%	8
Growth	2.7411	1,633.5098	-1.8087	16,978.7592	17.59%	6
Low/Minimum volatility / variance	1.6943	8,457.5361	-0.9935	42,878.6173	12.96%	8
Momentum	0.3360	1.1575	-0.5870	2.0962	0.00%	1
Multi-factor	1.1984	1,801.6479	-0.9608	9,557.0004	0.00%	8
Quality	1.7039	3.3276	-1.2754	15.2043	4.63%	3
Risk-Weighted	3.6315	12,562.9299	-1.1773	50,029.2037	1.85%	3
Size	5.1400	16,816.4836	-1.4968	60,000.0000	10.19%	2
Value	0.7143	1,189.0525	-1.7187	7,712.6279	4.63%	12
					100.00%	

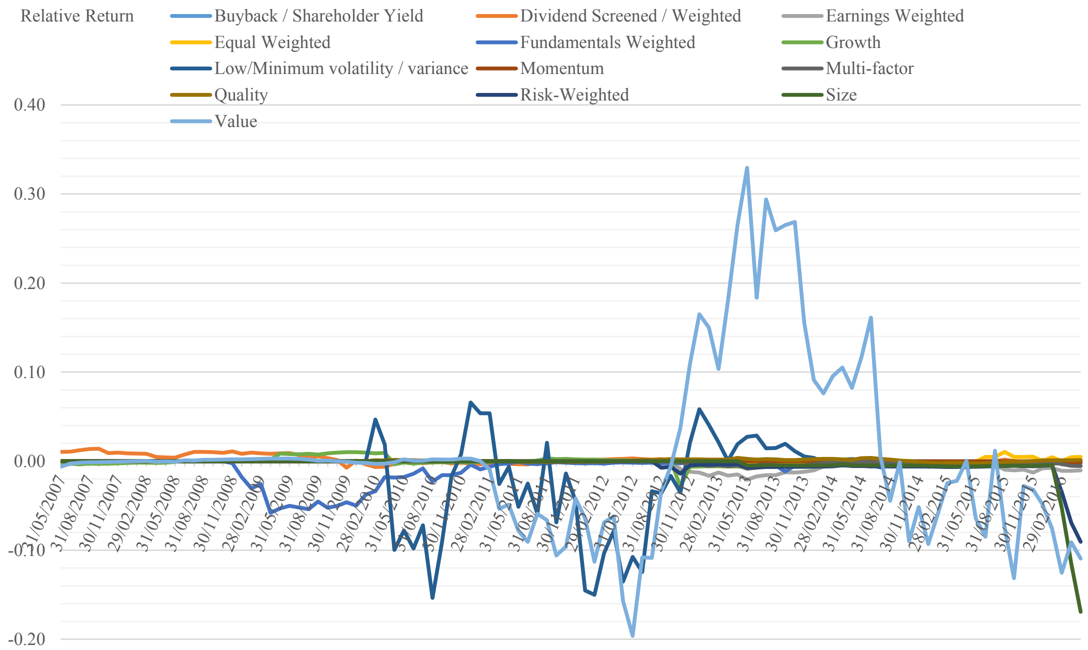
For Sortino Ratio series of SB ETFs and non-SB ETFs (in panel A) and Sortino Ratio series of SB ETFs categories (in panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016, the table shows different descriptive statistics of each category: median, standard deviation, minimum value and maximum value. It also displays the percentage of times that the category is over the other one and the number of ETFs included in the category for calculations. The series tend to infinite in several times, therefore standard deviation and maximum are not informative here. The symbols ***, **, and * indicate that the difference between SB and Non-SB ETF median is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively. The symbols ^^^, ^^, and ^ indicate that the SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively.

Figure III.7. Relative Return series

Panel A. Smart Beta ETFs vs. non-SB ETFs



Panel B. Smart Beta ETFs categories



The figure shows Relative Return series of SB ETFs and non-SB ETFs (in panel A) and Relative Return series of SB ETFs categories (in panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016.

Table III.8. Descriptive statistics of Relative Return series

Panel A. Smart Beta ETFs vs. non-SB ETFs

	Mean	Standard Deviation	Minimum	Maximum	% times over the other	# ETFs
Smart Beta	0.0021 ^^^	0.0068	-0.0098	0.0184	56.48%	76
Non Smart Beta	-0.0035	0.0312	-0.0713	0.0824	43.52%	772
					100.00%	

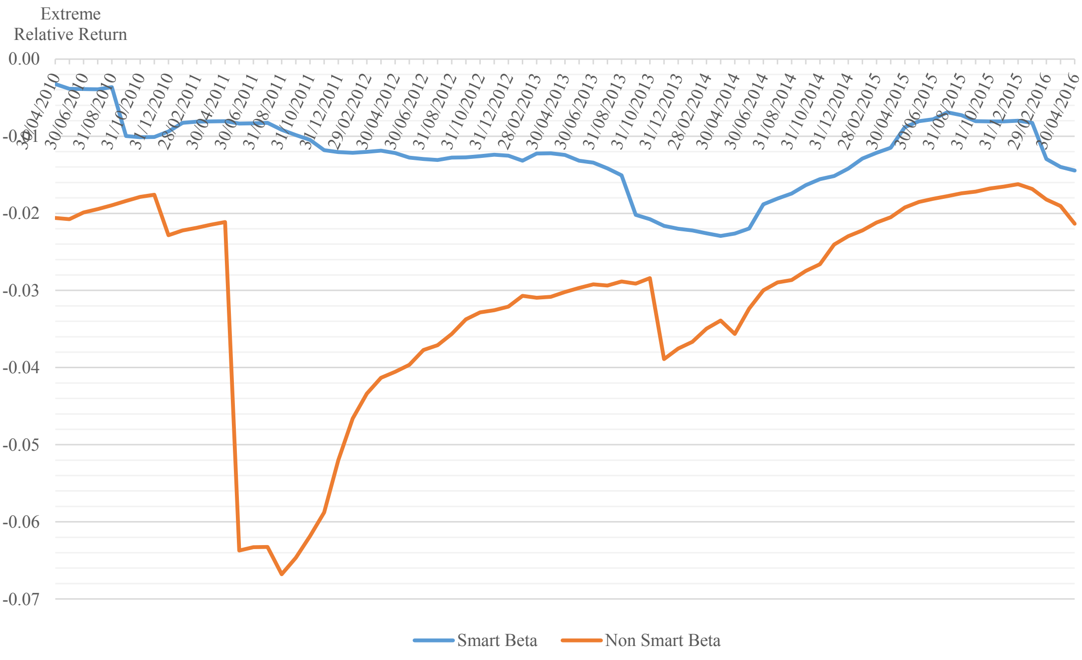
Panel B. Smart Beta ETFs categories

Smart Beta Category	Mean	Standard Deviation	Minimum	Maximum	% times over the others	# ETFs
Buyback / Shareholder Yield	-0.0006	0.0000	-0.0007	-0.0006	0.00%	4
Dividend Screened / Weighted	0.0016	0.0048	-0.0073	0.0139	31.48%	34
Earnings Weighted	-0.0090	0.0048	-0.0207	0.0002	0.93%	1
Equal Weighted	-0.0001	0.0028	-0.0023	0.0103	9.26%	4
Fundamentals Weighted	-0.0115	0.0158	-0.0579	-0.0005	0.93%	8
Growth	-0.0008	0.0049	-0.0283	0.0102	16.67%	6
Low/Minimum volatility / variance	-0.0180	0.0500	-0.1535	0.0660	6.48%	8
Momentum	-0.0022	0.0005	-0.0026	-0.0010	0.00%	1
Multi-factor	-0.0018	0.0023	-0.0084	0.0014	1.85%	8
Quality	0.0006	0.0015	-0.0026	0.0036	6.48%	3
Risk-Weighted	-0.0098	0.0161	-0.0906	-0.0035	0.00%	3
Size	-0.0139	0.0332	-0.1691	-0.0034	0.00%	2
Value	0.0066	0.0959	-0.1960	0.3296	25.93%	12
					100.00%	

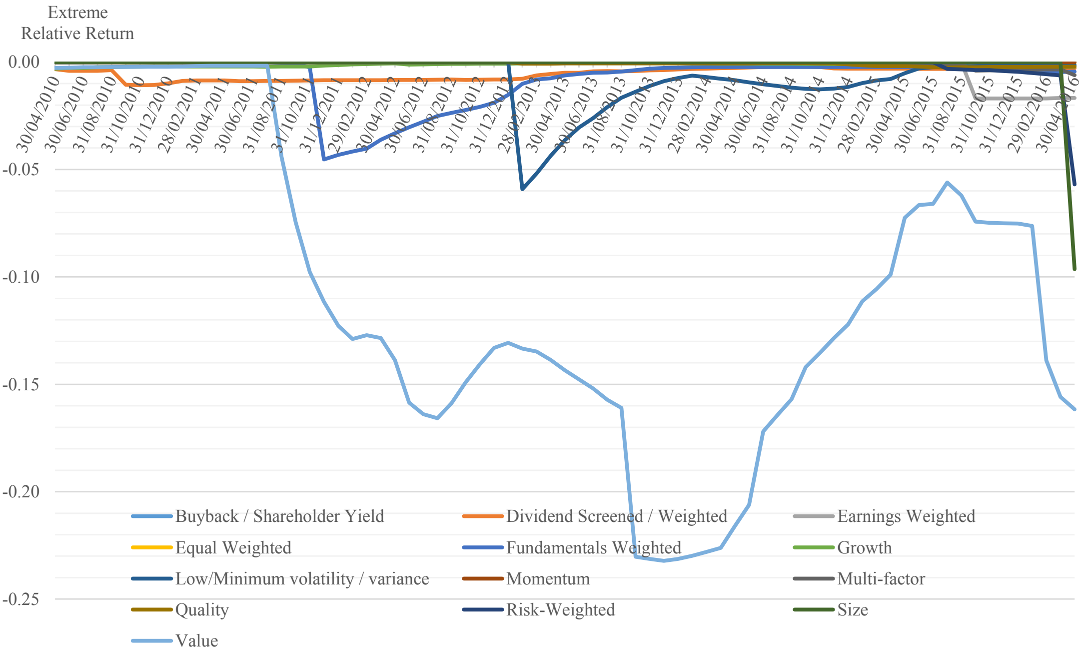
For Relative Return series of SB ETFs and non-SB ETFs (in panel A) and Relative Return series of SB ETFs categories (in panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016, the table shows different descriptive statistics of each category: mean, standard deviation, minimum value and maximum value. It also displays the percentage of times that the category is over the other one and the number of ETFs included in the category for calculations. The symbols ***, **, and * indicate that the difference between SB and Non-SB ETF median is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively. The symbols ^^^, ^^, and ^ indicate that the SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively.

Figure III.8. Extreme Relative Return series

Panel A. Smart Beta ETFs vs. non-SB ETFs



Panel B. Smart Beta ETFs categories



The figure shows Extreme Relative Return series of SB ETFs and non-SB ETFs (in panel A) and Extreme Relative Return series of SB ETFs categories (in panel B) calculated with rolling windows of 36 months for the period from April 2010 to April 2016. Categories Buyback Yield, Momentum and Size haven't got an Extreme Relative Return series, because the Relative Return series is shorter than 36 months (size of the used window in the calculations of ERR).

Table III.9. Descriptive statistics of Extreme Relative Return series

Panel A. Smart Beta ETFs vs. non-SB ETFs

	Mean ***	Standard Deviation	Minimum	Maximum	% times over the other	# ETFs
Smart Beta	-0.0123 ^^^	0.0049	-0.0229	-0.0032	100.00%	76
Non Smart Beta	-0.0307 ^^^	0.0134	-0.0668	-0.0162	0.00%	772
					100.00%	

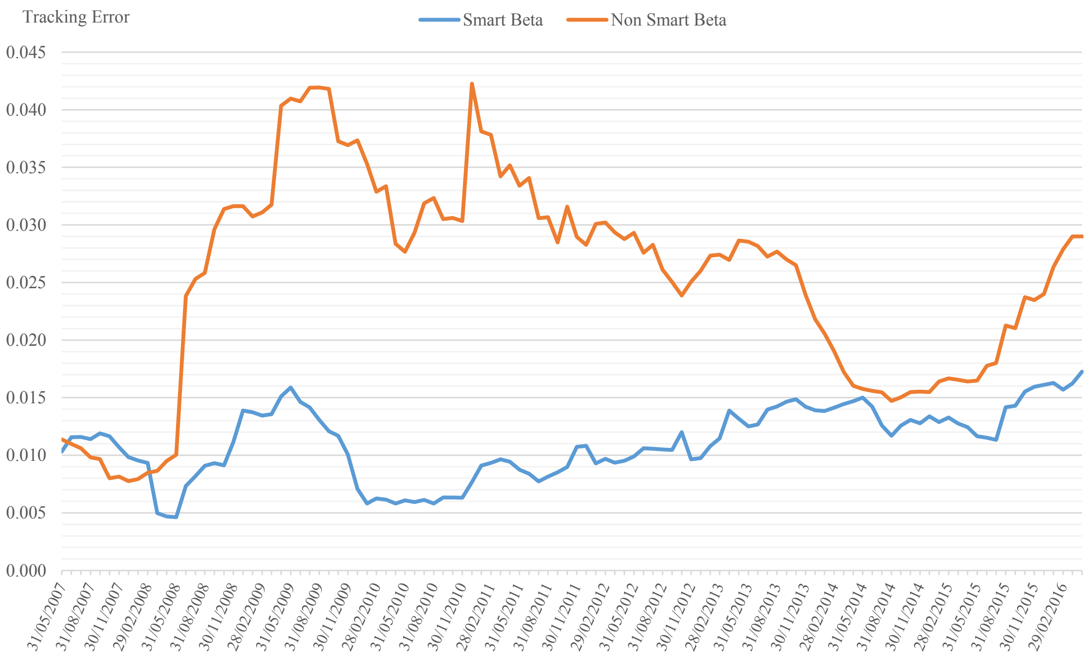
Panel B. Smart Beta ETFs categories

Smart Beta Category	Mean	Standard Deviation	Minimum	Maximum	% times over the others	# ETFs
Buyback / Shareholder Yield	0.0000	0.0000	0.0000	0.0000	0.00%	4
Dividend Screened / Weighted	-0.0055	0.0028	-0.0107	-0.0021	0.00%	34
Earnings Weighted	-0.0169	0.0001	-0.0169	-0.0167	0.00%	1
Equal Weighted	-0.0003	0.0001	-0.0005	-0.0003	17.81%	4
Fundamentals Weighted	-0.0099	0.0128	-0.0454	-0.0003	2.74%	8
Growth	-0.0014	0.0008	-0.0031	-0.0004	27.40%	6
Low/Minimum volatility / variance	-0.0125	0.0139	-0.0592	-0.0011	0.00%	8
Momentum	0.0000	0.0000	0.0000	0.0000	0.00%	1
Multi-factor	-0.0012	0.0015	-0.0061	-0.0002	35.62%	8
Quality	-0.0012	0.0008	-0.0025	-0.0005	0.00%	3
Risk-Weighted	-0.0097	0.0166	-0.0570	-0.0032	0.00%	3
Size	0.0000	0.0000	0.0000	0.0000	0.00%	2
Value	-0.1082	0.0720	-0.2322	-0.0017	16.44%	12
					100.00%	

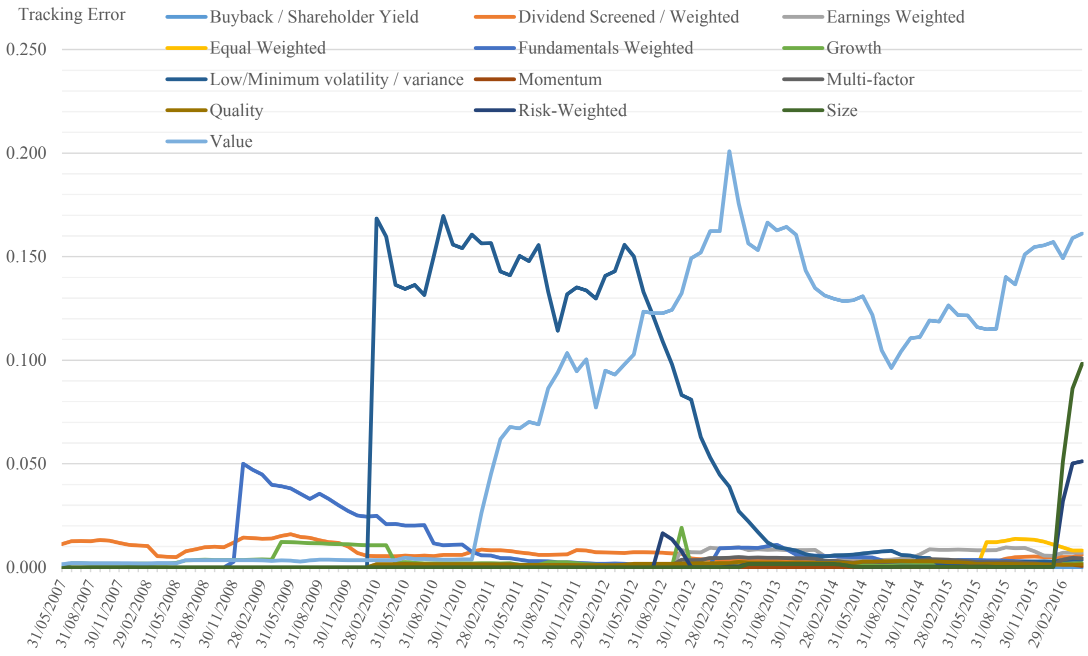
For Extreme Relative Return series of SB ETFs and non-SB ETFs (in panel A) and Extreme Relative Return series of SB ETFs categories (in panel B) calculated with rolling windows of 36 months for the period from April 2010 to April 2016, the table shows different descriptive statistics of each category: mean, standard deviation, minimum value and maximum value. It also displays the percentage of times that the category is over the other one and the number of ETFs included in the category for calculations. Categories Buyback Yield, Momentum and Size haven't got an Extreme Relative Return series, because the Relative Return series is shorter than 36 months (size of the used window in the calculations of ERR). The symbols ***, **, and * indicate that the difference between SB and Non-SB ETF median is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively. The symbols ^^^, ^^, and ^ indicate that the SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively.

Figure III.9. Tracking Error series

Panel A. Smart Beta ETFs vs. non-SB ETFs



Panel B. Smart Beta ETFs categories



The figure shows Tracking Error series of SB ETFs and non-SB ETFs (panel A) and Tracking Error series of SB ETFs categories (panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016.

Table III.10. Descriptive statistics of Tracking Error series

Panel A. Smart Beta ETFs vs. non-SB ETFs

	Mean ***	Standard Deviation	Minimum	Maximum	% times over the other	# ETFs
Smart Beta	0.0111 ^^^	0.0031	0.0046	0.0173	8.33%	76
Non Smart Beta	0.0254 ^^^	0.0091	0.0077	0.0423	91.67%	772
					100.00%	

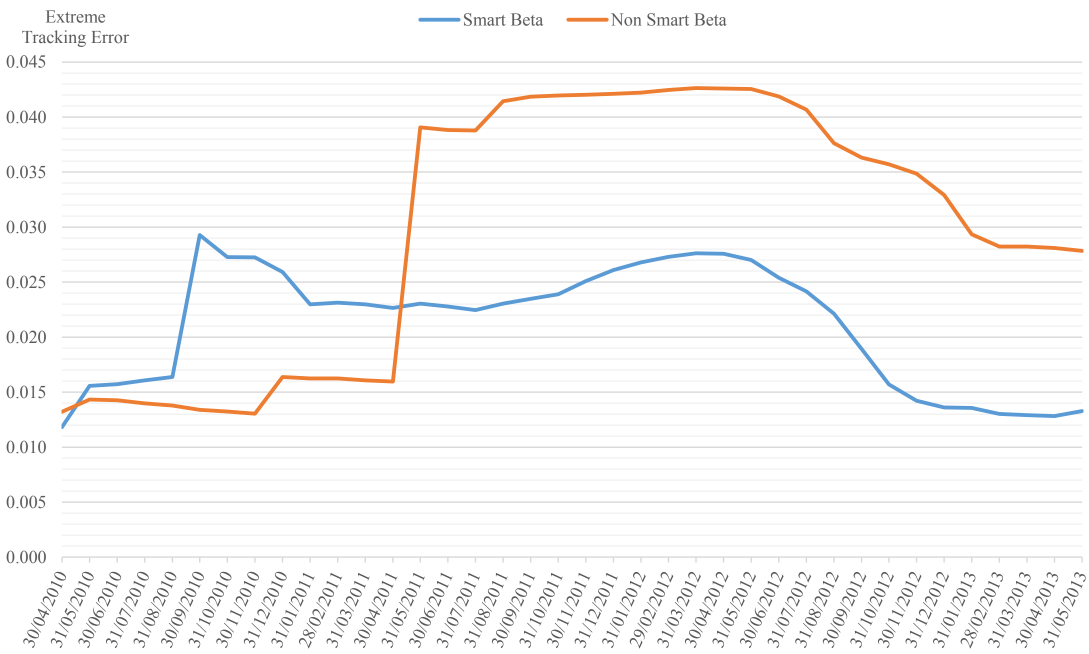
Panel B. Smart Beta ETFs categories

Smart Beta Category	Mean	Standard Deviation	Minimum	Maximum	% times over the others	# ETFs
Buyback / Shareholder Yield	0.0001	0.0000	0.0001	0.0001	0.00%	4
Dividend Screened / Weighted	0.0068	0.0037	0.0025	0.0160	17.59%	34
Earnings Weighted	0.0073	0.0019	0.0036	0.0097	0.00%	1
Equal Weighted	0.0031	0.0047	0.0001	0.0138	0.00%	4
Fundamentals Weighted	0.0103	0.0125	0.0011	0.0500	12.96%	8
Growth	0.0029	0.0035	0.0003	0.0191	0.00%	6
Low/Minimum volatility / variance	0.0683	0.0665	0.0013	0.1696	26.85%	8
Momentum	0.0013	0.0003	0.0007	0.0015	0.00%	1
Multi-factor	0.0025	0.0013	0.0009	0.0049	0.00%	8
Quality	0.0018	0.0006	0.0010	0.0031	0.00%	3
Risk-Weighted	0.0043	0.0115	0.0000	0.0511	0.00%	3
Size	0.0072	0.0226	0.0002	0.0983	0.00%	2
Value	0.0738	0.0644	0.0015	0.2009	42.59%	12
					100.00%	

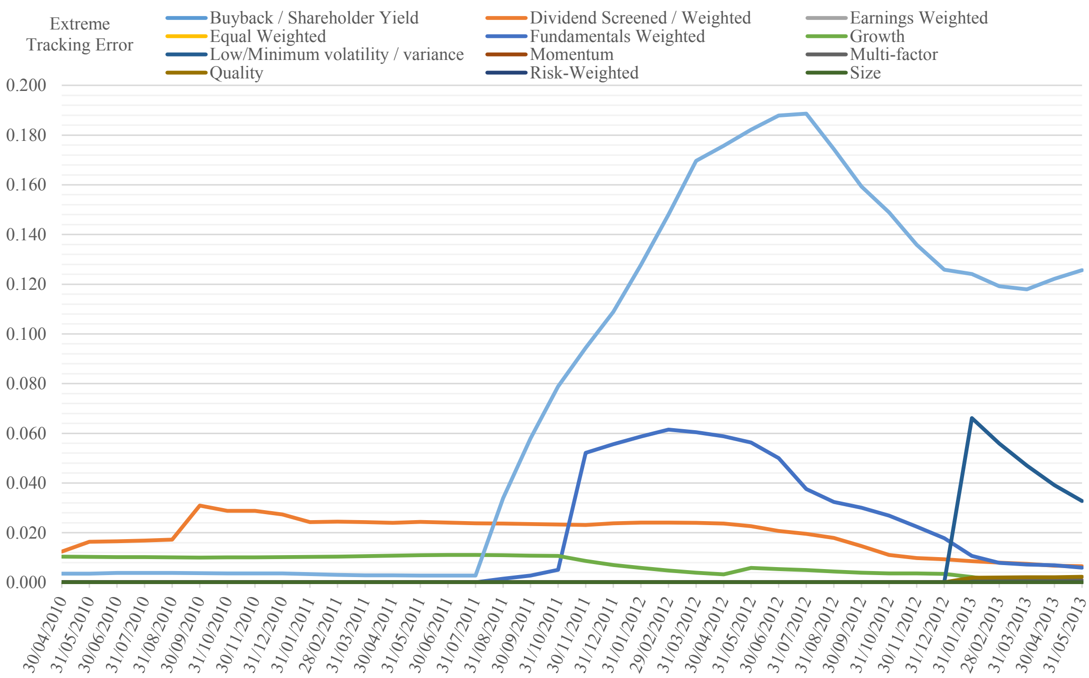
For Tracking Error series of SB ETFs and non-SB ETFs (panel A) and Tracking Error series of SB ETFs categories (panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016, the table shows different descriptive statistics of each category: mean, standard deviation, minimum value and maximum value. It also displays the percentage of times that the category is over the other one and the number of ETFs included in the category for calculations. The symbols ***, **, and * indicate that the difference between SB and Non-SB ETF median is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively. The symbols ^^^, ^^, and ^ indicate that the SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively.

Figure III.10. Extreme Tracking Error series

Panel A. Smart Beta ETFs vs. non-SB ETFs



Panel B. Smart Beta ETFs categories



The figure shows Extreme Tracking Error series of SB ETFs and non-SB ETFs in panel A and Extreme Tracking Error series of SB ETFs categories in panel B calculated with rolling windows of 36 months for the period from April 2010 to April 2016. Categories Buyback Yield, Momentum and Size haven't got an Extreme Tracking Error series, because the Tracking Error series is shorter than 36 months (size of the used window in the calculations of ETE).

Table III.11. Descriptive statistics of Extreme Tracking Error series

Panel A. Smart Beta ETFs vs. non-SB ETFs

	Mean ***	Standard Deviation	Minimum	Maximum	% times over the other	# ETFs
Smart Beta	0.0189 ^^^	0.0053	0.0112	0.0293	16.44%	76
Non Smart Beta	0.0268 ^^^	0.0093	0.0130	0.0426	83.56%	772
					100.00%	

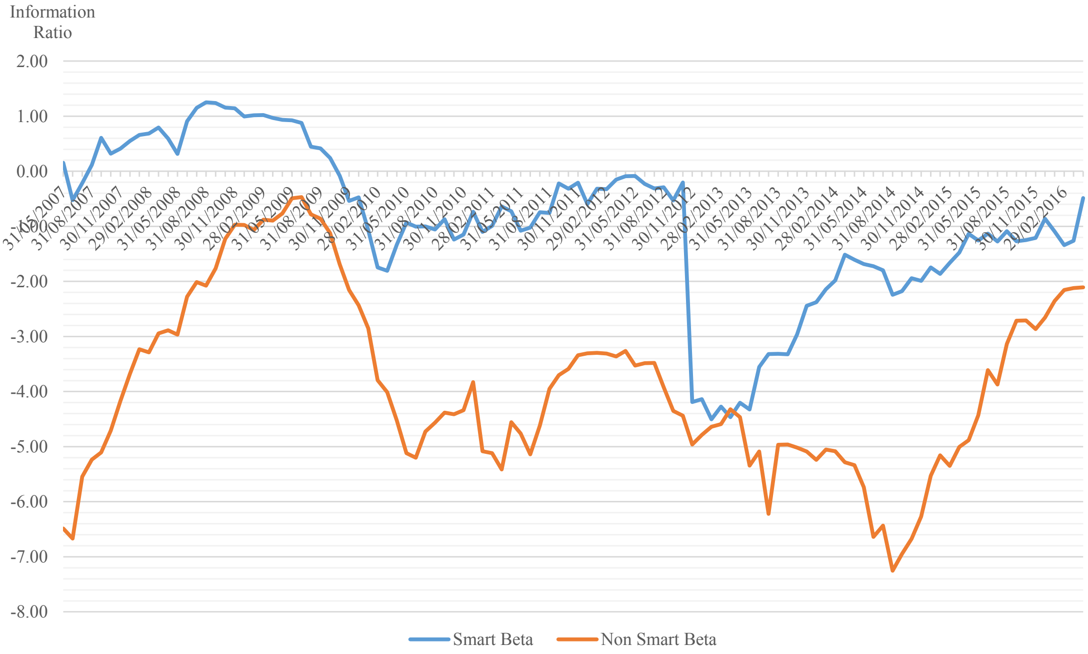
Panel B. Smart Beta ETFs categories

Smart Beta Category	Mean	Standard Deviation	Minimum	Maximum	% times over the others	# ETFs
Buyback / Shareholder Yield	0.0000	0.0000	0.0000	0.0000	0.00%	4
Dividend Screened / Weighted	0.0130	0.0085	0.0048	0.0310	21.92%	34
Earnings Weighted	0.0095	0.0001	0.0093	0.0095	0.00%	1
Equal Weighted	0.0002	0.0000	0.0002	0.0002	0.00%	4
Fundamentals Weighted	0.0131	0.0196	0.0013	0.0615	0.00%	8
Growth	0.0046	0.0038	0.0006	0.0111	0.00%	6
Low/Minimum volatility / variance	0.0145	0.0146	0.0021	0.0661	0.00%	8
Momentum	0.0000	0.0000	0.0000	0.0000	0.00%	1
Multi-factor	0.0015	0.0007	0.0008	0.0042	0.00%	8
Quality	0.0023	0.0003	0.0018	0.0029	0.00%	3
Risk-Weighted	0.0054	0.0124	0.0004	0.0403	0.00%	3
Size	0.0000	0.0000	0.0000	0.0000	0.00%	2
Value	0.1067	0.0648	0.0028	0.1948	78.08%	12
					100.00%	

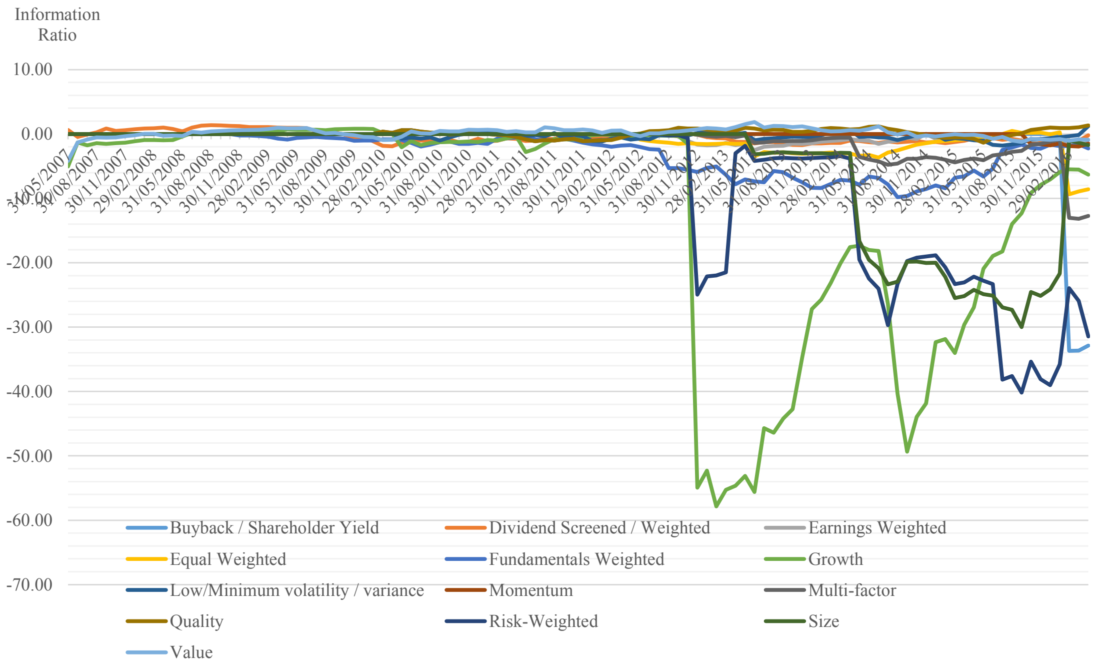
For Extreme Tracking Error series of SB ETFs and non-SB ETFs (panel A) and Extreme Tracking Error series of SB ETFs categories (panel B) calculated with rolling windows of 36 months for the period from April 2010 to April 2016, the table shows different descriptive statistics of each category: mean, standard deviation, minimum value and maximum value. It also displays the percentage of times that the category is over the other one and the number of ETFs included in the category for calculations. Categories Buyback Yield, Momentum and Size haven't got an Extreme Tracking Error series, because the Tracking Error series is shorter than 36 months (size of the used window in the calculations of ETE). The symbols ***, **, and * indicate that the difference between SB and Non-SB ETF median is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively. The symbols ^^^, ^^, and ^ indicate that the SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively.

Figure III.11. Information Ratio series

Panel A. Smart Beta ETFs vs. non-SB ETFs



Panel B. Smart Beta ETFs categories



The figure shows Information Ratio series of SB ETFs and non-SB ETFs (panel A) and Information Ratio series of SB ETFs categories (panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016.

Table III.12. Descriptive statistics of Information Ratio series

Panel A. Smart Beta ETFs vs. non-SB ETFs

	Mean ***	Standard Deviation	Minimum	Maximum	% times over the other	# ETFs
Smart Beta	-0.9297 ^^^	1.4162	-4.5037	1.2539	99.07%	76
Non Smart Beta	-3.8856 ^^^	1.6202	-7.2506	-0.4711	0.93%	772
					100.00%	

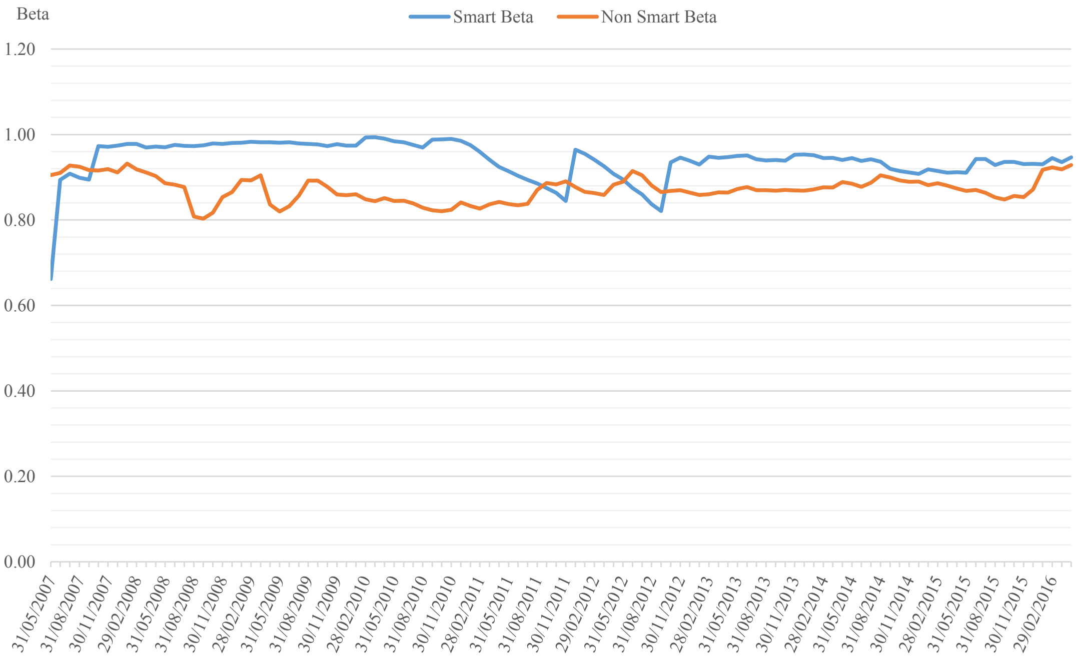
Panel B. Smart Beta ETFs categories

Smart Beta Category	Mean	Standard Deviation	Minimum	Maximum	% times over the others	# ETFs
Buyback / Shareholder Yield	-33.3921	0.4665	-33.6756	-32.8538	0.00%	4
Dividend Screened / Weighted	-0.4566	0.8820	-1.8979	1.3701	23.15%	34
Earnings Weighted	-1.2139	0.4964	-2.5052	0.0276	0.93%	1
Equal Weighted	-2.1116	2.1347	-9.3570	0.4825	3.70%	4
Fundamentals Weighted	-3.5127	2.9918	-9.8286	-0.2376	0.00%	8
Growth	-11.9671	17.7171	-57.8544	0.8238	6.48%	6
Low/Minimum volatility / variance	-0.4037	0.5410	-1.7883	1.2102	0.93%	8
Momentum	-1.6775	0.1890	-1.9505	-1.4642	0.00%	1
Multi-factor	-1.7584	2.7748	-13.1863	0.6006	2.78%	8
Quality	0.1567	0.6863	-1.3590	1.3330	25.00%	3
Risk-Weighted	-18.1077	12.7251	-40.1635	-0.1878	0.00%	3
Size	-15.1873	10.4550	-29.9775	-1.0154	0.00%	2
Value	0.1509	0.7755	-4.1956	1.8670	37.04%	12
					100.00%	

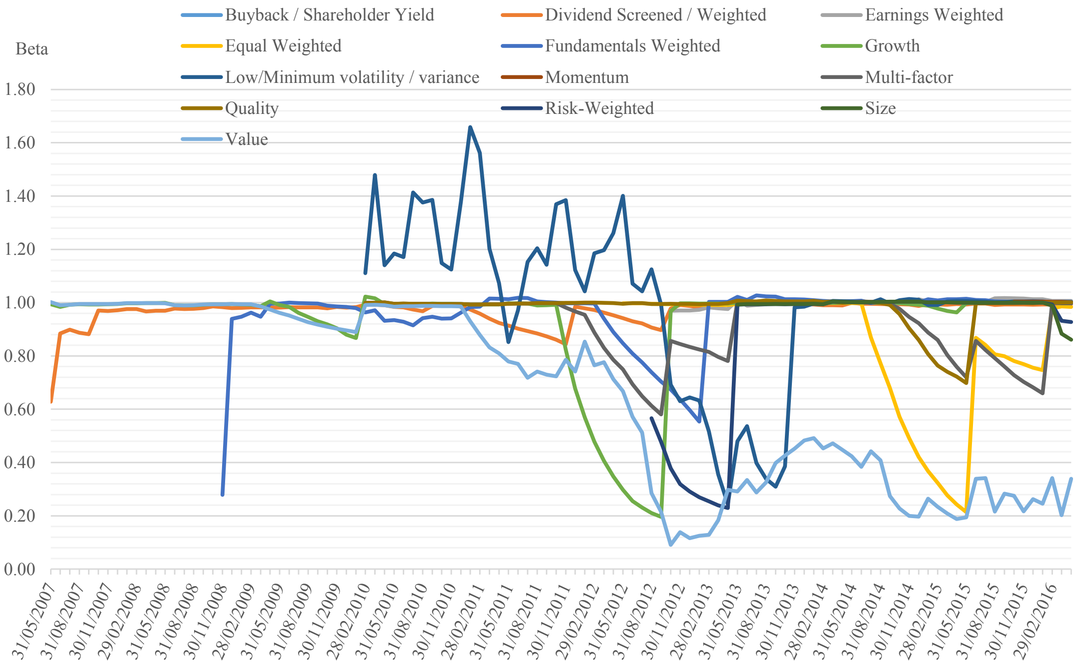
For Information Ratio series of SB ETFs and non-SB ETFs (panel A) and Information Ratio series of SB ETFs categories (panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016, the table shows different descriptive statistics of each category: mean, standard deviation, minimum value and maximum value. It also displays the percentage of times that the category is over the other one and the number of ETFs included in the category for calculations. The symbols ***, **, and * indicate that the difference between SB and Non-SB ETF median is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively. The symbols ^^^, ^^, and ^ indicate that the SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively.

Figure III.12. Beta series

Panel A. Smart Beta ETFs vs. non-SB ETFs



Panel B. Smart Beta ETFs categories



The figure shows Beta series of SB ETFs and non-SB ETFs (panel A) and Beta series of SB ETFs categories (panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016.

Table III.13. Descriptive statistics of Beta series

Panel A. Smart Beta ETFs vs. non-SB ETFs

	Mean ***	Standard Deviation	Minimum	Maximum	% times over the other	# ETFs
Smart Beta	0.9410 ^^^	0.0455	0.6619	0.9938	88.89%	76
Non Smart Beta	0.8722 ^^^	0.0291	0.8028	0.9320	11.11%	772
					100.00%	

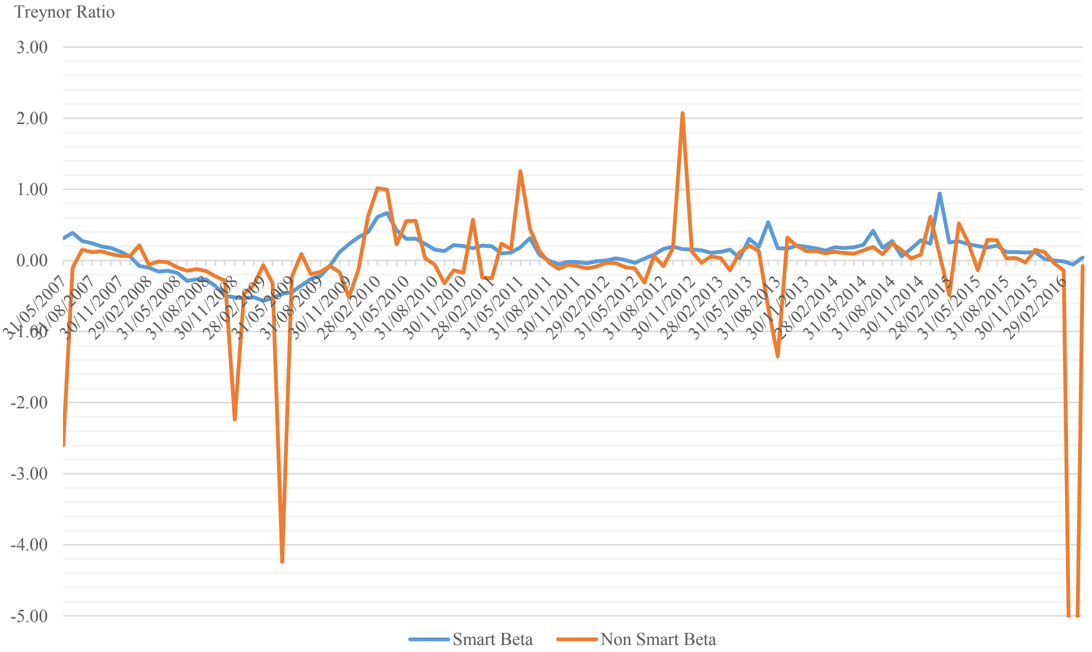
Panel B. Smart Beta ETFs categories

Smart Beta Category	Mean	Standard Deviation	Minimum	Maximum	% times over the others	# ETFs
Buyback / Shareholder Yield	0.9999	0.0001	0.9998	0.9999	0.00%	4
Dividend Screened / Weighted	0.9677	0.0482	0.6286	0.9989	0.93%	34
Earnings Weighted	1.0000	0.0132	0.9700	1.0168	9.26%	1
Equal Weighted	0.8426	0.2388	0.2139	0.9982	0.00%	4
Fundamentals Weighted	0.9540	0.1193	0.2787	1.0271	29.63%	8
Growth	0.9303	0.1889	0.1958	1.0227	8.33%	6
Low/Minimum volatility / variance	1.0020	0.2929	0.2437	1.6586	31.48%	8
Momentum	1.0032	0.0008	1.0015	1.0042	0.00%	1
Multi-factor	0.9101	0.1200	0.5804	1.0054	0.00%	8
Quality	0.9781	0.0662	0.6987	1.0085	2.78%	3
Risk-Weighted	0.8634	0.2717	0.2289	1.0039	0.00%	3
Size	0.9922	0.0299	0.8614	1.0045	0.93%	2
Value	0.6523	0.3267	0.0908	1.0021	16.67%	12
					100.00%	

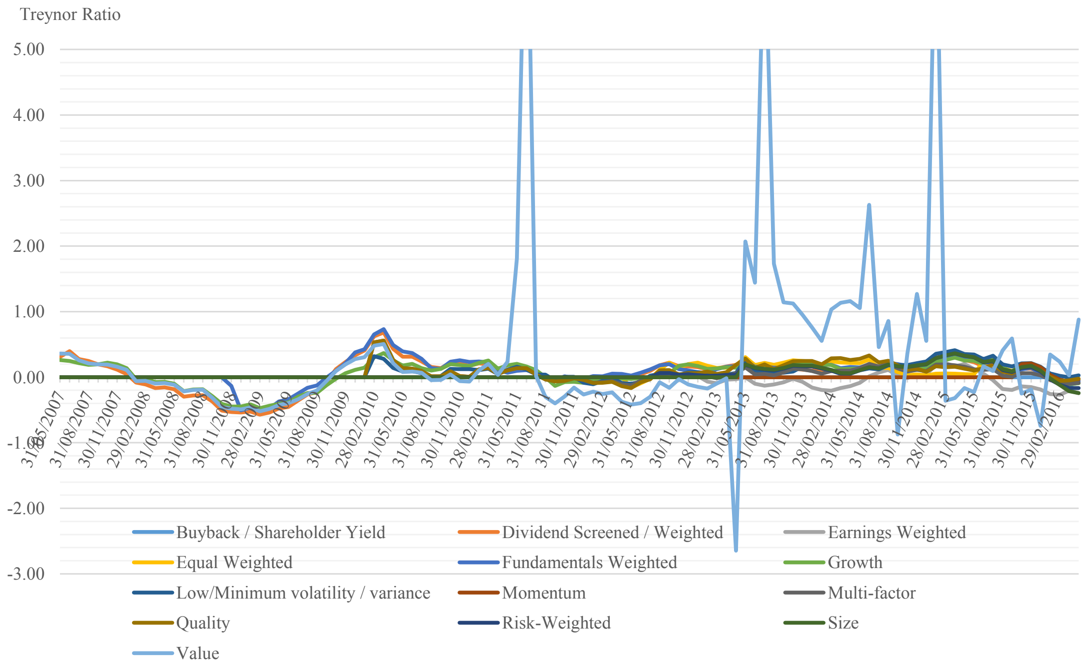
For Beta series of SB ETFs and non-SB ETFs (panel A) and Beta series of SB ETFs categories (panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016, the table shows different descriptive statistics of each category: mean, standard deviation, minimum value and maximum value. It also displays the percentage of times that the category is over the other one and the number of ETFs included in the category for calculations. The symbols ***, **, and * indicate that the difference between SB and Non-SB ETF median is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively. The symbols ^^^, ^^, and ^ indicate that the SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively.

Figure III.13. Treynor Ratio series

Panel A. Smart Beta ETFs vs. non-SB ETFs



Panel B. Smart Beta ETFs categories



The figure shows Treynor Ratio series of SB ETFs and non-SB ETFs (panel A) and Treynor Ratio series of SB ETFs categories (panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016.

Table III.14. Descriptive statistics of Treynor Ratio series

Panel A. Smart Beta ETFs vs. non-SB ETFs

	Mean	Standard Deviation	Minimum	Maximum	% times over the other	# ETFs
Smart Beta	0.0831 ^^^	0.2581	-0.5667	0.9422	62.04%	76
Non Smart Beta	-0.1181	1.1161	-9.4759	2.0719	37.96%	772
					100.00%	

Panel B. Smart Beta ETFs categories

Smart Beta Category	Mean	Standard Deviation	Minimum	Maximum	% times over the others	# ETFs
Buyback / Shareholder Yield	-0.1037	0.0166	-0.1175	-0.0852	0.00%	4
Dividend Screened / Weighted	0.0609	0.2391	-0.5725	0.6815	9.26%	34
Earnings Weighted	-0.0532	0.1272	-0.2674	0.2148	0.00%	1
Equal Weighted	0.1272	0.1112	-0.1578	0.3043	3.70%	4
Fundamentals Weighted	0.1088	0.2136	-0.5072	0.7348	28.70%	8
Growth	0.0569	0.1953	-0.4734	0.3686	19.44%	6
Low/Minimum volatility / variance	0.1112	0.1172	-0.1080	0.4114	10.19%	8
Momentum	0.0666	0.1188	-0.0661	0.2103	0.00%	1
Multi-factor	0.0702	0.1165	-0.1251	0.5587	0.00%	8
Quality	0.1105	0.1330	-0.1660	0.5587	0.93%	3
Risk-Weighted	0.1186	0.1145	-0.1650	0.3602	0.00%	3
Size	0.1420	0.1305	-0.2430	0.3659	0.00%	2
Value	0.3358	1.4022	-2.6459	8.3001	27.78%	12
					100.00%	

For Treynor Ratio series of SB ETFs and non-SB ETFs (panel A) and Treynor Ratio series of SB ETFs categories (panel B) calculated with rolling windows of 12 months for the period from May 2007 to April 2016, the table shows different descriptive statistics of each category: mean, standard deviation, minimum value and maximum value. It also displays the percentage of times that the category is over the other one and the number of ETFs included in the category for calculations. The symbols ***, **, and * indicate that the difference between SB and Non-SB ETF median is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively. The symbols ^^^, ^^, and ^ indicate that the SB and Non-SB ETF mean is statistically significant (that is, significantly different from zero) at the 1%, 5%, and 10% significance levels, respectively.

Table III.15. Factor portfolios descriptive statistics and correlations

Factors	Size	Value	Operating Profitability	Investment	Momentum
Mean	0.1825	0.3577	0.4549	0.3280	1.0471
Standard Deviation	2.5819	3.1243	1.9082	2.2333	5.3681
			Factor correlations		
Size	1	-0.0750	-0.0092	-0.1357	0.1177
Value	-0.0750	1	-0.6266	0.5224	-0.3691
Operating Profitability	-0.0092	-0.6266	1	-0.2352	0.4533
Investment	-0.1357	0.5224	-0.2352	1	0.0981
Momentum	0.1177	-0.3691	0.4533	0.0981	1

The table contains mean and standard deviation along with pairwise correlations of factors series. Factors used in the paper are Fama and French factors (size, value, operating profitability and investment) and momentum factor.

Table III.16. Factor loadings of one-factor regression

Panel A. Smart Beta ETFs vs. non-SB ETFs

	α	Benchmark	R2	# ETFs
Smart Beta	0.0001	0.9265	90.44%	76
	48.68%	93.42%		
Non Smart Beta	0.0002	0.9267	91.19%	772
	44.56%	93.91%		

Panel B. Smart Beta ETFs categories

Smart Beta Category	α	Benchmark	R2	# ETFs
Buyback / Shareholder Yield	-0.0002	0.9990	99.99%	4
	100.00%	100.00%		
Dividend Screened / Weighted	0.0001	0.9359	93.51%	34
	44.12%	94.12%		
Earnings Weighted	-0.0008	1.0000	99.76%	1
	100.00%	100.00%		
Equal Weighted	0.0001	0.9956	99.75%	4
	75.00%	100.00%		
Fundamentals Weighted	-0.0007	0.9909	97.59%	8
	50.00%	100.00%		
Growth	-0.0003	1.0000	99.48%	6
	66.67%	100.00%		
Low/Minimum volatility / variance	-0.0011	1.0143	88.46%	8
	50.00%	100.00%		
Momentum	-0.0002	1.0030	99.99%	1
	100.00%	100.00%		
Multi-factor	-0.0011	0.9962	94.54%	8
	75.00%	100.00%		
Quality	0.0001	0.9994	99.99%	3
	33.33%	100.00%		
Risk-Weighted	-0.0031	0.9960	84.84%	3
	66.67%	100.00%		
Size	-0.0041	0.9858	78.30%	2
	100.00%	100.00%		
Value	0.0019	0.7126	67.67%	12
	33.33%	75.00%		

The table contains the average results of monthly time-series regressions of excess returns of SB ETF and non-SB ETF (panel A) and SB ETF categories (panel B) on excess returns of declared benchmarks for the period from May 2007 to April 2016. The individual results of each ETF are weighted by its mean fund size during the period of the sample. Below the mean value of the coefficient alpha or beta for each category, it is shown the percentage of ETFs for which that coefficient is significantly different from zero. It also displays the average R^2 of the category as a measure of the goodness of regression and the number of ETFs included in each category for calculations.

Table III.17. Factor loadings of six-factor regression

Panel A. Smart Beta ETFs vs. non-SB ETFs

	α	Benchmark	SMB	HML	RMW	CMA	WML	R2	# ETFs
Smart Beta	0.0010	0.9184	-0.0008	0.0003	-0.0004	-0.0011	-0.0002	95.03%	76
	42.11%	92.11%	21.05%	6.58%	3.95%	18.42%	11.84%		
Non Smart Beta	0.0011	0.9202	-0.0008	0.0000	-0.0006	-0.0011	-0.0001	94.30%	772
	48.32%	93.39%	22.54%	13.86%	12.69%	16.84%	11.14%		

Panel B. Smart Beta ETFs categories

Smart Beta Category	α	Benchmark	SMB	HML	RMW	CMA	WML	R2	# ETFs
Buyback / Shareholder Yield	-0.0001	0.9971	0.0000	-0.0002	-0.0001	0.0000	-0.0001	100.00%	4
	50.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%		
Dividend Screened / Weighted	0.0012	0.9342	-0.0010	-0.0002	-0.0003	-0.0013	-0.0005	97.85%	34
	44.12%	94.12%	20.59%	0.00%	2.94%	20.59%	8.82%		
Earnings Weighted	-0.0009	1.0003	-0.0003	0.0000	0.0003	0.0003	0.0000	99.81%	1
	100.00%	100.00%	100.00%	0.00%	0.00%	0.00%	0.00%		
Equal Weighted	0.0000	0.9989	0.0002	-0.0002	-0.0002	0.0000	-0.0002	99.83%	4
	75.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%		
Fundamentals Weighted	-0.0006	0.9909	0.0003	-0.0001	-0.0003	-0.0001	-0.0001	97.93%	8
	37.50%	100.00%	37.50%	25.00%	12.50%	25.00%	0.00%		
Growth	-0.0003	1.0041	0.0002	-0.0001	-0.0001	0.0001	-0.0001	99.55%	6
	50.00%	100.00%	33.33%	0.00%	0.00%	16.67%	50.00%		
Low/Minimum volatility / variance	-0.0007	0.9877	-0.0002	-0.0001	-0.0009	-0.0002	0.0003	90.40%	8
	12.50%	100.00%	0.00%	0.00%	12.50%	12.50%	37.50%		
Momentum	-0.0002	1.0061	0.0000	0.0001	0.0000	0.0001	0.0001	100.00%	1
	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%		
Multi-factor	-0.0010	0.9821	-0.0004	-0.0004	-0.0005	0.0004	0.0004	95.39%	8
	50.00%	100.00%	12.50%	0.00%	0.00%	0.00%	25.00%		
Quality	0.0001	0.9990	0.0000	0.0000	0.0000	0.0000	0.0000	99.99%	3
	33.33%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%		
Risk-Weighted	-0.0027	0.9521	-0.0011	-0.0010	-0.0015	0.0007	0.0010	87.17%	3
	0.00%	100.00%	0.00%	0.00%	0.00%	33.33%	66.67%		
Size	-0.0038	0.9299	-0.0017	-0.0017	-0.0023	0.0016	0.0016	81.68%	2
	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	100.00%		
Value	0.0039	0.6827	-0.0023	0.0023	-0.0007	-0.0027	-0.0001	82.84%	12
	58.33%	66.67%	33.33%	25.00%	0.00%	16.67%	0.00%		

The table contains the average results of monthly time-series regressions of excess returns of SB ETF and non-SB ETF (panel A) and SB ETF categories (panel B) on six factors: (1) excess returns of declared benchmarks, (2) size (SMB), (3) value (HML), (4) operating profitability (RMW), (5) investment (CMA) and (6) momentum (WML), for the period from May 2007 to April 2016. The individual results of each ETF are weighted by its mean fund size during the period of the sample. Below the mean value of the coefficient alpha or beta for each category, it is shown the percentage of ETFs for which that coefficient is significantly different from zero. It also displays the average R^2 of the category as a measure of the goodness of regression and the number of ETFs included in each category for calculations.