António Afonso
ISEG
Universidade de Lisboa, REM, UECE
aafonso@iseg.ulisboa.pt
Pedro Cardoso
ISEG
Universidade de Lisboa
pedro.mmartins.cardoso@gmail.com

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Exchange-traded funds as an alternative investment option

Exchange-traded funds como uma opção alternativa de investimento

António Afonso
Pedro Cardoso

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ABSTRACT

We conduct an analysis of Exchange-traded Funds (ETFs), Index and Equity mutual funds and their respective benchmark during the 2010-2015 period for the Portuguese fund industry. For the period 2010-2017, we test ETFs for price inefficiency (existence of deviations between prices and the Net Asset Value) and persistence. We find that the studied ETF does not always outperform index funds in replicating the variations of the PSI 20 index, despite exhibiting better tracking ability when facing downside deviations of the benchmark and a better capacity of smoothing tracking deviations. Regarding ETFs price efficiency and its persistence, the study reveals that the examined ETF is priced at a low average discount with evidence of deviations persistence of at least two days. The investment schemes with the highest ability to track the PSI 20 Index were PSI20 (ETF), BBVA PPA Índice PSI20, and the equity mutual fund BPI Portugal.

Keywords: Exchange-traded fund; mutual fund; performance evaluation; tracking error; price efficiency.

JEL Classification: G11; G12; G14

RESUMO

Foi conduzida uma análise a Exchange-traded Funds (ETFs), Fundos de Investimento mobiliário de Índice, Fundos de Investimento mobiliário de ações e respetivo índice de referência (benchmark) no período 2010-2015 para a indústria de fundos portuguesa. Para o período 2010-2017 foi testada a ineficiência de preço para os ETFs (existência de desvios entre os preços de negociação e o valor intrínseco da unidade de participação) e a sua persistência. Concluiu-se que o ETF analisado nem sempre supera os fundos de investimento mobiliários de índice na replicação das variações do Índice PSI 20, não obstante exibir uma melhor capacidade de replicação das variações negativas do benchmark e uma melhor capacidade de alisar os desvios da replicação. Em relação à eficiência de preços dos ETFs e à sua persistência, o estudo revela que os preços do ETF examinado apresentam um valor médio

inferior (embora baixo) face seu valor intrínseco, com evidência de persistência de desvios de pelo menos dois dias. Os organismos de investimento analisados com maior capacidade de acompanhar o Índice PSI 20 foram o PSI20 (ETF), o BBVA PPA Índice PSI20 e o fundo de investimento mobiliário de acções BPI Portugal.
Palavras-chave: Exchange-traded fund; fundos de investimento; replicação de benchmark; ineficiência de preço.

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1. Introduction

Since its initial appearance in 1993, Exchange-Traded Funds (ETFs) have exhibited a steady asset growth as a result of their popularity worldwide and have become a relevant investment alternative for investors. With primary roots in the United States (U.S.), the overcome of the European market happened rapidly in the beginning of the 21st Century.

However, the Portuguese Investors' access to this type of funds traded in the local exchange (Euronext Lisbon) with the Portuguese Stock Index (PSI 20) as the underlying index (i.e. Benchmark) has only happened late in 2010, but, since then, the acceptance in the Portuguese market has been verified.[1] This paper evaluates ETFs as a comparative relevant investment option for Portuguese investors by conducting a descriptive statistics, regression and index tracking comparative examination of returns with other types of investment products normally considered substitutes [index mutual funds and mutual equity funds (sharing the same benchmark)]. It also aims to examine the price efficiency and deviation persistence of the ETF prices.

Our main result shows that ETF do not always outperform index funds in replicating the variations of the PSI 20 index, despite exhibiting better tracking ability when facing downside deviations of the benchmark and a better capacity of smoothing tracking deviations. Regarding ETF price efficiency and its persistence, we find that the evaluated ETF is priced at a low average discount with evidence of deviations persistence of at least two days. In addition, the lowest results of tracking error measures (i.e. the investment schemes with the highest ability to track the PSI 20 Index) were from PSI20 (ETF), BBVA PPA Índice PSI20 (Index Fund) and from the equity mutual fund BPI Portugal.

The remainder of the paper is organized as follows. Section 2 discusses ETFs origins, main characteristics and comparative advantages. Section 3 reviews the related literature. Data and methodologies will be described in Section 4. Section 5 presents the results of the empirical analysis. Section 6 is the conclusion.

2. Exchange-Traded Funds

Origins

Exchange-Traded Funds in the U.S. were first introduced in 1993 by the American Stock Exchange. This first ETF "Standard & Poor's Depositary Receipts" (SPRDS)[2] traded in the U.S. was developed as simple unit trust that invested in the 500 shares of the underlying index[3] (Standard & Poor's 500 Index) and was the consequence of the consistent progress in the financial industry aiming to reduce the costs and to increase the accessibility of this type

[1] In the end of August 2017, the total amount of Assets under Management (AuM) of the Comstage PSI20 (only non-leverage ETF traded in Euronext Lisbon with the PSI20 Index as Benchmark) is close to 68 million euros, a value similar to the average AuM in the previous month of each Undertakings for the Collective Investment of Transferable Securities (UCITS) in Portugal (74 million euros). Sources: Morningstar (2017) and CMVM (2017).

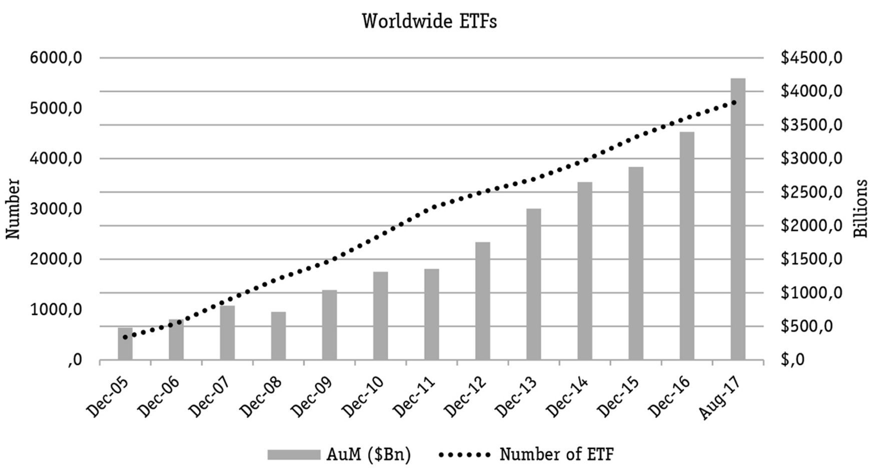
[2] Pronounced "spiders".

[3] The term underlying index and benchmark will be used to refer to the index that is tracked by the ETF.

of financial products to retail investors. The full history behind the precedents which lead to the creation of the first ETFs [which include Index Participation Shares (IPS) and Toronto Stock Exchange Index Participations (TIPs)] was examined in detail by Gastineau (2001).

The innovation was introduced in the Asian continent in 1999 and reached Europe in April 2000 with the launch of the EURO STOXX 50 and STOXX Europe 50 traded in the Frankfurt Stock Exchange. Since then, as showed in Figure 1, the ETF industry has grown worldwide, both in number and Assets under Management (AuM), with more indices as underlying.

Figure 1: Total amount of assets under management (AuM) and number of exchange-traded funds



Source: ETFGI (2017).

Main characteristics

An Exchange-Traded Fund is a form of collective investment scheme whose units or shares[4] are traded in an Exchange market. For the purpose of this investigation, the scope of ETF will be limited to the ones that aim to replicate specific indices as close as possible. It's comparability with mutual funds, in particular with index funds, is understandable since the main portfolio characteristics and fund features are present. Moreover, ETFs combine the attributes of mutual funds with the characteristics of common stock, making it possible to trade each share on an exchange market which leads to the intraday possibility of sell each position instead of having to wait, like in mutual funds, for the process of redemption from the fund (which occurs at the end of the day Net Asset Value (NAV) per share that

[4] For simplification, in the paper the term Units will be omitted and share will represent both realities in discussion.

is calculated with the close of the market prices). Since shares are traded in an exchange market, each ETF has two different prices, the value in which the security (fund's shares) is being traded and also the intrinsic value of the fund assets that results from the net asset value of the ETF divided by the total number of existing shares. As understandable, each deviation between both values leaves space for arbitrage opportunities. These differences have made ETFs a very relevant investment option for investors that demand short-term liquidity and buy in large lots while mutual funds remain a relevant option for an investor looking for high trading of small purchases or sales and for those who do not demand short-term liquidity (Poterba and Shoven, 2002).

ETFs can be divided into multiple subsets by their most relevant specific features. Firstly, they can be divided by the type of management associated, active or passive. An actively managed ETF is an investment fund in which the intervention of the management company is determinant for the portfolio capability of index tracking, while in passively managed ETFs (most common) the involvement of the management company is kept as low as possible which is one of the main reasons for the comparative low annual expense ratio. Secondly, by the type of exposition: a) Physical – in which the ETF holds the shares that are the constituents of the underlying index; or b) Synthetic, in which ETF replicates the underlying index performance through the use of derivative instruments (e.g. replication through the use of swaps or futures contracts). Another distinctive factor among ETFs is the degree of replication of the underlying index, meaning the degree of leverage of the underlying index performance (e.g. an ETF that has the aim of duplicate the effect of the underlying index has a replication degree of 2).

Comparative advantages

In addition to the main characteristic of ETFs that can be considered a comparative advantage (liquidity access), other key aspects are typically presented as advantages to investors. The first advantage to arise is the process associated with creation and redemption of ETF shares (known as in-kind creation/redemption). Specifically, in addition to the possibility of trading shares on an exchange market, some types of investors (known as Authorized Participants) have the possibility of create/redeem shares as in the traditional mutual funds (subscriptions and redemptions) making it possible to these shares to be resold in exchange markets for profits or kept in the investors' portfolio. This process of creation/redemptions is mainly motivated by the arbitrage opportunities mentioned before and by the market pressure on the shares. For example, if investors are buying the shares of an ETF from the market, it generates pressure on the Authorized Participants to create new shares to supply the market demand pressure. As the Authorized Participants, in the case of a non-synthetic replication ETF, have to buy shares of the constituents of the index for the creation process of the new ETF shares (in-kind creation), it's likely to raise the price of the index it tracks, ensuring market prices close to the intrinsic Net Asset Value (Petajisto, 2017; Shin and Soydemir, 2010; Xu and Yin, 2017). Additionally, the in-kind process (for redemption) enhances tax efficiency as it delays capital gains up to the end to pay for redemptions (Gastineau, 2001).

Other advantage that is normally pointed out to this type of financial instruments is the low total expense ratio (which includes the management fee) associated to the passive managed, but efficient, portfolio structure. Also, as mentioned by Gastineau (2001), the low expense ratio comes from the elimination of the transfer agent function (i.e. the elimination of shareholders accounting) at the fund level.

Furthermore, as stated in Rompotis (2011a), another comparative advantage of ETF is associated with the fact that shares can be purchased on margin, traded using limits and stop orders as well as short-sold.

Lastly, the possibility for small quantity transactions allows retail investors to participate in the market, in contrast with equivalent future products that are relatively large in notional size with expensive variation margin requirements for small investors (Kearney *et al.*, 2014).

3. Literature

Since the appearance of the first ETF, the relative performance of its underlying index (i.e. if the return of the ETF outperforms or underperforms the underlying index) has always been examined as the key factor for comparison purposes. However, the first studies on ETFs aimed to examine price efficiency (comparison of market prices vs. the intrinsic NAV per share of the ETF) which is an alternative way of looking the relative performance issue since if it is assumed that NAV perfectly replicates the index, only prices lead to inefficiency (existence of premium/outperformance and discount/underperformance). Using the SPRDS data Ackert and Tian (2000) concluded no economically significant mispricing in the S&P500 SPDRs market and Elton *et al.* (2002) observed an average discount of 1.8 basis points per year to its NAV and that almost all the differences (prices inefficiencies) disappeared within one day. This last investigation also concluded that the amount of income that is lost by the holding dividends received in cash was the main cause of the underperformance of the SPDR. Likewise, Poterba and Shoven (2002) corroborate the previous underperformance conclusions in their study of SPDR for 1993-2001. Additionally, Charteris (2013) conducted a price efficiency analysis for the South African ETFs and found that funds were reasonably efficiently priced (low premium and discounts) to mainly all ETF and justify this conclusion by the efficient execution of arbitrage. Additionally, respectively to the Dow Jones Istanbul 20 Fund and the Taiwan Top 50 Tracker Fund, Kayali (2007) and Lin *et al.* (2005) found that these ETFs were trading at a small discount (₺0.008, which is 0.11% of the average close price) and at a small premium [$0.018, which is 0.041% of the average close price (although not statistically significant)], respectively.

Regarding the comparison between index funds and ETFs, Kotosvestky (2003) found through a multi-period model that the differences between the returns of both types of investment schemes come mainly from transaction and management fees, taxation efficiency and qualitative difference (i.e. convenience and ability to buy on margin and sell short). Within a European geographical focus, Blitz *et al.* (2012) examined the relative performance of ETFs and European Index Funds to their benchmarks and found that both types of funds exhibit an underperformance between 50 to 150 basis points per annum, being the dividend withholding taxes on par with fund expenses the determinants for underperformance.

In complement, but still in the same comparable scope (ETFs and Index Funds), Agapova (2011) concluded that conventional index funds and ETFs are substitutes investment products, but not perfect ones, meaning that ETFs have not replaced the conventional index funds but have introduced a new alternative investment vehicle. This study was conducted through the analysis of ETFs and Index funds flows.

In addition to this type of investigation which aim exclusively to the ETF and Mutual Funds performance, Rompotis (2011a) conducted a cross-section examination of performance on Greek ETFs, Index Mutual Funds and Equity Mutual Funds concluding that classic mutual funds, despite having high expense ratios, performed better and are less volatile for the period under examination. In terms of the tracking error of ETFs, it was found that they were reasonably lower than the tracking error of the actively managed funds but greater than the tracking error of the index fund.

Regarding Risk-adjusted measures of ETF, the examination conducted by Rompotis (2011b) for the 2002-2007 period for 50 iShares ETFs found that the high majority of ETFs outperformed the S&P 500 annually and in aggregate values. This finding was obtained through the calculation of indicators like Sharpe and Sortino Ratios. Moreover, Wong and Shum (2010) found that ETFs perform differently when facing bearish and bullish markets from 1999 to 2007. In their 15 ETFs examination, it was concluded through the Sharpe ratio test that ETF provides relatively higher returns in a bullish market than in a bearish market. Pinheiro and Varela (2018) didn't find evidence that ETFs tracking the PSI20 outperform the market using the risk-return model and analysing Jensen's alpha for the period of December 2012 to June 2017.

In terms of market type comparative analysis of ETFs and the tracking activity, Blitz and Huij (2012) concluded that global emerging markets ETFs exhibit higher levels of tracking error than developed markets ETFs, which the authors relate to the cross-sectional dispersion in stock returns being structurally larger in emerging markets. Lastly, to summarize the different results among the relevant literature regarding ETFs outperformance/underperformance and price premium/discount, Figure 2 is presented.

Figure 2: Literature evidence of ETFs outperformance/underperformance and price premium/discount. The repeated references on both sides (e.g. outperformance and underperformance) are the result of both conclusions among different ETFs in that particular study

OUTPERFORMANCE	UNDERPERFORMANCE
BLITZ AND HUIJ, 2012 BUETOW AND HENDERSON, 2012 KEARNEY et al., 2014 ROMPOTIS, 2011a ROMPOTIS, 2011b	BLITZ AND HUIJ, 2012 BLITZ et al., 2012 BUETOW AND HENDERSON, 2012 FRINO AND GALLAGHER, 2001 POTERBA AND SHOVEN, 2002 SHIN AND SOYDEMIR, 2010
PREMIUM	**DISCOUNT**
CHARTERIS, 2013 KEARNEY et al., 2014 PETAJISTO, 2017	CHARTERIS, 2013 ELTON et al., 2002 KAYALI, 2007 PETAJISTO, 2017

4. Methodology

Following the procedures taken by the literature, different measures will be applied to the ETFs, index mutual funds and equity mutual funds in the sample to conduct a complete test of relative performance. Previously to the calculation of tracking error (which is the most used measure of relative performance in the literature [see Buetow and Henderson (2012), Frino and Gallagher (2001), Rompotis (2011a), Shin and Soydemir (2010), Wong and Shum (2010)]), some descriptive statistics and regression related to the binominal return/risk as performance measures will be calculated in line with Blitz *et al.* (2012) and Gastineau (2004). In the end, with the aim of better understanding of the ETF price efficiency, a relation regression, a deviation and persistence analysis between the exchange price and the intrinsic NAV per share will be conducted as in Charteris (2013), Kayali (2007) and Shin and Soydemir (2010).

4.1. Descriptive statistics

The first analysis that will be conducted is related to the average return and risk (obtained by the standard deviation of returns) from the examined investment schemes and indices.

The daily returns of ETF, indices and equity mutual funds are expressed by the following equations:

$$RE_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \quad (1) \quad \text{and} \qquad RM_{i,t} = \frac{NAV_{i,t} - NAV_{i,t-1}}{NAV_{i,t-1}} \quad (2)$$

where $RE_{i,t}$ = Return of ETF or of the Index in day t; $RM_{i,t}$ = Return of index mutual funds and equity mutual funds in day t; $P_{i,t}$ = End of the day (last) Price of the ETF or value of the Index in day t; $NAV_{i,t}$ = Net Asset Value per share of the Index Mutual Funds and Equity Mutual Funds in day t. The use of the end of the day (last) Price of the ETF instead of Bid or Ask prices is related to the low Bid/Ask percentage average spread (0.42%).[5]

Regarding the risk, it will be expressed by the standard deviation of returns in the following way:

$$\sigma_{pi} = \sqrt{\frac{\sum_{t=1}^{n}\left(RE_{i,t} - \overline{RE}_{i}\right)}{n-1}} \quad (3) \quad \text{and} \quad \sigma_{NAVt} = \sqrt{\frac{\sum_{t=1}^{n}\left(RM_{i,t} - \overline{RM}_{i}\right)}{n-1}} \quad (4)$$

where $\overline{RE}_t$ is the average return of ETF or Index i and $\overline{RM}_t$ is the average return of the index mutual fund and equity mutual fund i; n is the number of observations.

In addition, it is also going to be computed the minimum, maximum, median, Skewness and Kurtosis values to obtain a clear understanding of each distribution of returns with the aim of avoiding a biased analysis. Also, with the same goal, a normality test (Jarque-Bera test) will be applied to the sample.

4.2. Regression statistics

In accordance with the literature mentioned in Section 3, to examine the performance of ETF, index mutual fund and equity mutual fund in comparison with the respective benchmarks a model regressing the return of this investment schemes on the return of the benchmark will be conducted. For that purpose, a Jensen's model [Jensen (1968)] is employed (through ordinary least squares estimation) to each ETF, index mutual fund and equity mutual fund as:

$$R_{i,t} - R_f = \alpha + \beta\,(RI_{i,t} - R_f) + \varepsilon_t \quad (5)$$

In (5) $R_{i,t}$ is the return of the ETF, index mutual fund and equity mutual fund [for simplification RM and RE (for ETFs) were merged in R]; R_f is the risk-free rate proxy and will be the result of the daily one-month interbank (Euribor) rate; $RI_{i,t}$ is the return of the Index; α is the measure of the performance (return part explained by other factors than the replication of the index); β describes the slope of the regression, being the relation of risk adjusted returns of the investment schemes and their benchmarks; ε_t is the residual. The aim is to exam the statistical significance of β with the purpose of examine the benchmark linkage to the ETF returns.

[5] Using all available information. Additionally, we also conducted all calculations using ask, bid and end of the day prices for the ETF, which lead to similar results and conclusions.

4.3. Performance and tracking error

The first examinations that are going to be conducted regarding relative performance among the investment schemes and the benchmark will aim to identify under or outperformance in relation to the benchmark for the sampling period. The identification of the number of days and the average underperformance and outperformance return will also be computed. Additionally, the ex-post Sharpe Ratio (Sharpe, 1966) and Sortino Ratio (Sortino and Price, 1994), will be computed as in (6) and (7) to evaluate comparatively all the funds:

$$SH = \frac{\overline{R}i - R_f}{\sigma_i} \quad (6) \quad \text{and} \qquad SO = \frac{\overline{R}i - R_f}{\sigma_n} \qquad (7)$$

where σ_i is the standard deviation of returns and σ_n is the standard deviation of negative returns (downside deviations).[6]

Regarding each investment scheme capability of benchmark replication, the tracking error deviations between their performance and the performance of the benchmark will be measured. Although the idea behind the tracking error seems simple, relevant studies applied different approaches to its calculation, specifically regarding ETFs. In the present paper we will compute four tracking error methodologies:

Average of absolute differences between the returns on investment schemes and their benchmark (TE_1) as:

$$TE_1 - \frac{\sum_{t=1}^{n} | R_{i,t} - RI_{i,t} |}{n} \qquad (8)$$

Standard deviation of daily relative negative returns (TE_2). This measure applies the same idea as in Sortino Ratio (downside deviations) (Sortino and Price, 1994). In detail, since investors will not dislike positive or equal to zero tracking errors (outperformance) only the daily negative relative returns will be taken into account in the calculation of the tracking error. This measure, computed as follows, will be helpful for the verification of out or underperformance of the previous calculation of tracking errors (TE_1):

$$TE_2 = \sqrt{\frac{\sum_{t=1}^{n} \left(R_{i,t} - RI_{i,t}\right)^2}{n-1}} \qquad (9)$$

in which $R_{i,t} - RI_{i,t} < 0$.

6

$$\sigma_i = \sqrt{\frac{\sum_{t=1}^{n} \left(R_{i,t} - \overline{R}_{i,t}\right)^2}{n-1}} \quad \text{and} \quad \sigma_n = \sqrt{\frac{\sum_{t=1}^{n} \left(R_{n,t} - \overline{R}_{n,t}\right)^2}{n-1}}, \text{ where } \quad R_{n,t} - \overline{R}_{n,t} < 0.$$

Standard deviation of return differences between the return of funds and the index (, measured as the following:

$$TE_3 = \sqrt{\frac{\Sigma_{t=1}^{n}\left(RD_{i,t} - RD_{i,t}\right)^2}{n-1}} \qquad (10)$$

where $RD_{i,t}$ is the difference between the return on the investment scheme and its benchmark in day t; $\overline{RD}_i$ is the average difference between the return on the investment scheme and its benchmark.

Single index model (TE_4), which is a simplified version of the regression (5). In the following regression (calculated through an ordinary least squares estimation), the focus will be on the residual that will be the proxy for the standard deviation as if, for example, an ETF perfectly replicates its benchmark it is expected to have a tracking error of zero and an residual also equal to zero.

$$R_{i,t} = \alpha + \beta\,(RI_{i,t}) + \varepsilon_t \qquad (11)$$

4.4. Etfs price efficiency and persistence

ETFs, due to the fact they're exchange-traded, may experience some price inefficiencies which may be one cause of higher than normal tracking errors. In order to examine this possibility, the link between the ETF Price and the NAV is going to be regressed (12) through an ordinary least squares estimation without any constant term since it is theoretically assumed that with a zero intrinsic NAV value nondifferent from zero-priced transactions will not occur. Deviation calculation (13) and descriptive statistics of its results are going to be computed for all the period available (from 2010 to 2017) since the comparison principle does not need to be verified. Also, with the purpose of examining the persistence of price inefficiency the regressions (14) and (15) will be computed with the same estimation methodology and the expected results for price efficiency are insignificant values of and meaning that the premium and discount do not persist within 1 or 2 trading days.

$$P_{t,i} = \beta\,(NAV_{t,i}) + \varepsilon_t \qquad (12)$$
$$D_{i,t} = P_{t,i} - NAV_{t,i} \qquad (13)$$
$$D_{i,t} = \gamma_0 + \gamma_1 D_{t-1} + \varepsilon_t \qquad (14)$$
$$D_{i,t} = \gamma_0 + \gamma_1 D_{t-1} + \gamma_2 D_{t-2} + \varepsilon_t \qquad (15)$$

5. EMPIRICAL ANALYSIS

5.1. DATA

The sample used in this paper is focused on the Portuguese fund industry, including one ETF listed on the Euronext Lisbon and seven mutual funds, one of which is an index mutual fund. The index mutual fund and two other equity mutual funds have the Portuguese Stock Index (PSI 20) as clear benchmark, with its identification on their prospectus while the other four are equity mutual funds with an investment strategy limited to Portuguese stocks many of which (in particular the most liquids) are constituents of the PSI 20 Index. The author assumption of including these four equity mutual funds aims to avoid the risk of non-inclusion of funds with closet index behavior.[7]

The detailed information of each fund is presented in the Table 1. All the data used was from Thomson Reuters Datastream (accessed on September 2017) (Thomson Reuters, 2017) and was confronted (sample testing) with data available at CMVM (2017) and Euronext (2017) for validation purposes. The information will cover the period between the 30th of September 2010 and the 31st of August 2017, except for two funds that were liquidated previously (see Table 1). For each comparative examination, the period that is going to be used is from the 30th of September 2010 to the 29th of October 2015, which is the period for each all information for all funds is available.

For the ETF specific analysis, NAV was obtained from the management company website (Comstage, 2017). Lastly, it is important to mention that some daily prices of the ETF arise from valuation prices calculated by Euronext (Euronext, 2017).[8] As an example, in days in which no trade occurs the final price results from the average of the last best bid and ask prices (valuation price).

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7 Actively managed funds that use a portfolio strategy to achieve similar returns to a benchmark, without clearly mentioning this strategy and charging a relatively high management fee.

8 The use of all observations in the study is justified by the impossibility to distinguish the source of the last price (market vs Euronext valuation) from the data source. However, since no transaction occurred in 22.5% of the observations, it is possible to conclude that this valuation occurred at least on these observations. The studied was also conducted excluding these days leading to the same conclusions.

Table 1: List of investment schemes

Type	Name	Acronym	ISIN	Benchmark	Total Expense Ratio (%NAV)
Equity Mutual Fund	Banif Acções Portugal[a]	BAN	PTYBNKLM0003	PSI 20	2.06
Index Mutual Fund	Bbva Ppa Indice Psi20[b]	BBV	PTYBBGLM0003		0.54
Equity Mutual Fund	Bpi Portugal	BPI	PTYPIGLM0000	NA	1.29
Equity Mutual Fund	Caixagest Acções Portugal	CAI	PTYCXNLP0004		2.03
Exchange-Traded Fund	Comstage Psi20	COM	LU0444605215	PSI 20	0.35
Equity Mutual Fund	Imga Ações Portugal	IMG	PTAFIALM0006		2.30
Equity Mutual Fund	Nb Portugal Ações	NBP	PTYESYLM0009	NA	2.31
Equity Mutual Fund	Santander Acções Portugal	SAN	PTYSAFLM0006		2.03

Notes: (a) Liquidated in January 2017; (b) Liquidated in October 2015.
Source: Thomson Reuters (2017).

5.2. Results

5.2.1. *Descriptive statistics*

The descriptive analysis of the returns was conducted to the subset of data for which all funds could be directly compared and the results are present in Table 2. For the total 1,301 observations, it was found that all the investment schemes in the analysis had a daily return mean higher than the Benchmark (outperformance). In detail, five of the eight funds exhibit a positive daily return mean for the period and only three had a negative daily return mean, as occurred for the benchmark.

The series that presented the results closer to the benchmark performance (-0.0158%) were BBVA PPA Índice PSI20 (-0.0085%) and Comstage PSI20 ETF (-0.006%). Regarding standard deviation, the results were mainly the same, having Comstage PSI20 ETF and BBVA PPA Índice PSI20 values of 1.3306 and 1.3264, respectively, which are very similar to the benchmark standard deviation (1.3217). Regarding minimal and maximal values, it is important to mention that only Comstage PSI20 ETF had a lower maximum daily return than the benchmark. In terms of the normality of all the series it is observed small distributions skewed to the left and a leptokurtic behavior (skewness negative but less than |0.5| and Kurtosis positive and moderately higher than 3). When applying the Jarque-Bera test for normality, the normal distribution hypothesis is rejected (at a significance level of 1%) for all returns under analysis. Its result demonstrates that the used sample is made of statistically different means and median values.

Table 2: Descriptive statistics of daily returns

Name (Acro Nym)	Mean	Median	Maxi mum	Mini mum	Std. Dev.	Skewness	Kurtosis	Obser Vations	Jarque-Bera	P-Value of Jarque-Bera Test
Period: 01-Oct-2010 29-Oct-2015										
BAN	0.0086	0.0000	5.3151	-5.8854	1.1905	-0.2482	4.8142	1,301	191.785	0.00
BBV	-0.0085	0.0000	4.9266	-6.5749	1.3264	-0.2774	4.6720	1,301	168.245	0.00
BPI	0.0115	0.0223	4.9546	-5.8460	1.1833	-0.2544	4.8383	1,301	197.237	0.00
CAI	-0.0010	0.0000	5.5550	-5.5994	1.1533	-0.2080	4.8441	1,301	193.729	0.00
COM	-0.0062	0.0696	4.6914	-5.6161	1.3306	-0.3302	3.9837	1,301	76.0985	0.00
IMG	0.0082	0.0000	5.3395	-5.5248	1.2308	-0.2278	4.8652	1,301	199.847	0.00
NBP	0.0038	0.0000	5.2779	-5.2359	1.1667	-0.2542	4.8872	1,301	207.092	0.00
SAN	0.0077	0.0000	6.6368	-5.7410	1.2467	-0.1191	5.4407	1,301	325.997	0.00
PSI20	-0.0158	0.0061	4.7119	-5.8028	1.3217	-0.2833	4.0207	1,301	73.884	0.00

The overall behavior was also observed biennially (for the period from 2010 to 2017) being the result in accordance with the ones presented for the sample [for detail, see Table A1].

5.2.2. *Regression analysis*

The results of the Jensen's model regression are expressed in Table 3. This examination showed that for seven of eight mutual funds β values were higher than 0.75 with a R-squared of at least 0.71. Moreover, for all funds the result of β was significant at 1% level. Concerning the higher β values, they were observed in the ETF (Comstage PSI20 ETF) and the index fund (BBVA PPA Índice PSI20) with a value of 0.97 and 0.93 for an R-squared of 0.93 and 0.86, respectively. Regarding equity mutual funds that don't have the PSI 20 index as benchmark, diverge results were observed. On one hand, BPI Portugal has a relatively high β value of 0.825 with a considerable data fitness to the regression line (R-squared of 0.85), but, on other hand, NB Portugal Ações reveals the lowest β value among the sample (0.61) with a R-squared of 0.48 making it questionable its linkage to the benchmark performance.

Additionally, it is relevant to mention that BPI Portugal was the only investment fund to exhibit a statistical significant α value (significant at a 10% level) meaning that a significant part of the return is positively explained by other factors than the replication of the index (e.g. active management). For comparison purposes, the results of the BPI Portugal have to be understood in line with the relatively low total expense ratio (TER) among the other equity mutual funds.

Table 3: Regression results

VARIABLES	BAN	BBV	BPI	CAI	COM	IMG	NBP	SAN
α	0.00018	0.00005	0.00022**	0.00007	0.00009	0.00018	0.00008	0.00018
t-Statistic#α	1.16112	0.37599	1.73549	0.46276	0.87709	0.96377	0.35305	0.96134
β	0.79244*	0.92908*	0.82511*	0.75386*	0.96928*	0.78551*	0.61452*	0.80022*
t-Statistic#β	66.59637	88.2812	85.42982	61.7454	128.4362	56.55615	34.92727	57.71576
R^2	0.77346	0.85714	0.84891	0.74587	0.92700	0.71118	0.48430	0.71945
Observations	1,301	1,301	1301	1301	1301	1301	1301	1301

Note: * (**) denotes significance at 1% (10%).

When increasing the sample date for the maximum of observations [which makes it necessary to exclude two investment funds (BBVA PPA Índice PSI20 and Banif Acções Portugal) for comparison purposes] the regression results (summarized in Table A2) show that the indications found in the sample were also observed and reinforced with a higher data range. In detail, the increase of data led to with a relevant increase of the β value and the R-squared for the regressions for Caixagest Acções Portugal, IMGA Ações Portugal and Novo Banco Acções Portugal. For example, Novo Banco Acções Portugal, which was the investment fund with the lowest values in the sample, increased both it's β from 0.61 to 0.67 and the R-squared from 0.48 to 0.56.

5.2.3. *Performance and tracking error*

5.2.3.1. General performance statistics and ratios

The idea behind the computation and study of tracking errors is mainly originated by the need to understand the capability of the fund to underperform or outperform its benchmark. For that purpose, before the examination of tracking errors, a summary of the absolute performance and relevant ratios values for the comparable period is presented in Table 4. During this period all funds outperformed (had a higher return) the PSI 20 Index (which faced a negative variation of 27.38%). The index fund (BBVA PPA Índice PSI20) and the ETF (Comstage PSI20) were the ones presenting closer to benchmark performances (-20.17% and -17.78%, respectively). Also, during the sample period some actively managed mutual funds faced positive returns [e.g. BPI Acções Portugal (6.05%), Banif Acções Portugal (1.98%) and IMGA Ações Portugal (0.85%)]. Although the results seem to demonstrate that outperformance is present for all funds, a decomposition of the analysis in an annual frequency for all the period available shows that for all funds (with except BBVA PPA Índice PSI20) underperformance is found at least once (see Table A3). Regarding the Sharpe and Sortino Ratio results, the evidence shows that BPI Acções Portugal is the investment fund with the best risk-adjusted return. Regarding the other results, they are in line with expected since the worst Sharpe and Sortino ratios come from the two funds (ETF and Index Funds) with the lowest performances in the sample.

Table 4: Absolute performance summary and Sharpe/Sortino ratios results

MEASURES	BAN	BBV	BPI	CAI	COM	IMG	NBP	SAN	PSI20 INDEX
Period: 01-Oct-2010 29-Oct-2015									
Return	1.98%	-20.17%	6.05%	-9.54%	-17.78%	0.85%	-3.80%	-0.07%	-27.38%
Sharpe Ratio	-0.07	-0.27	-0.03	-0.21	-0.24	-0.07	-0.14	-0.08	
Sortino Ratio	-0.10	-0.38	-0.04	-0.28	-0.34	-0.10	-0.19	-0.11	

Besides, regarding relative performance, as seen in Table 5 and suspected from the distributions presented in the previous results, it is observed a marginally higher percentage of outperformance observation in equity mutual funds. Moreover, it is observed that the outperformance and underperformance values are well distributed among the ETF and the equity mutual funds and that their average outperformance and underperformance values are mainly the same (in absolutes terms).

The index fund (BBVA PPA Índice PSI20) is the fund that had opposite results, having a higher percentage of underperformance observations (65.64%). It is also important to highlight that both BBVA PPA Índice PSI20 and the Comstage PSI20 reveal similar values of average outperformance but different values of average underperformance. This difference will be scrutinized in the TE_2

Table 5: Relative performance summary

MEASURES	BAN	BBV	BPI	CAI	COM	IMG	NBP	SAN
Period: 01-Oct-2010 29-Oct-2015								
Average Return	0.00024	0.00007	0.00027	0.00015	0.00010	0.00024	0.00020	0.00024
Average underperformance	-0.00401	-0.00110	-0.00344	-0.00434	-0.00220	-0.00424	-0.00621	-0.00442
N.º of obs. (underperformance)	598	854	614	624	647	625	621	623
% of underperformance	45.96%	65.64%	47.19%	47.96%	49.73%	48.04%	47.73%	47.89%
Average Outperformance	0.00386	0.00232	0.00359	0.00428	0.00237	0.00438	0.00605	0.00451
N.º of obs. (outperformance)	703	447	687	677	654	676	680	678
% of outperformance	54.04%	34.36%	52.81%	52.04%	50.27%	51.96%	52.27%	52.11%
Total obs.	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301

5.2.3.2. Tracking Errors

TE_1

The results of the average of absolute differences between the returns of the investment schemes and their benchmark are observable in Table 6. The first result to be emphasized comes from the lowest value of TE_1 from BBVA PPA Índice PSI20 [0.00152 percentage points (pp)], followed by Comstage PSI20 (0.00229 pp). BPI Portugal (0.0035 pp) and Banif Acções Portugal (0.0039 pp) also reveal a relatively low tracking error values among the actively managed equity mutual funds. Moreover, the result of the equity fund BPI Portugal has to be highlighted since this particular fund does not have the PSI 20 index as a clear benchmark on its prospectus information.

Table 6: Tracking error results

	BAN	BBV	BPI	CAI	COM	IMG	NBP	SAN
Period: 01-Oct-2010 29-Oct-2015								
TE_1	0.00393	0.00152	0.00352	0.0043	0.0022	0.0043	0.00613	0.0044
OBS.	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301
TE_2	0.00652	0.00446	0.00501	0.0067	0.0035	0.0074	0.01029	0.0071
OBS.	598	854	614	624	647	625	621	623
TE_3	0.00493	0.00478	0.00377	0.0050	0.0028	0.0057	0.00767	0.0055
OBS.	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301

Despite the results presented for the period, the biennial defragmentation also conducted (see Table A4) shows that overall results are not always verified biennially. As examples, in the first two years of the sample (2010-2012), Comstage PSI20 had a lower tracking error than BBVA PPA Índice PSI20 and Caixagest Acções Portugal displayed a more moderate tracking error than BPI Portugal for the last data interval (2016-2017). Finally, it is also important to mention that the average tracking error for Comstage PSI20 is less than the average tracking error of European ETFs computed by Shin and Soydemir (2010) for the 2004-2007 period.

TE_2

The outcome of the tracking error methodology applied to downside deviations is exhibited in Table 6. The results show a different perspective from TE_1 since Comstage PSI20 has a lower value than BBVA PPA Índice PSI20. This measure also shows that BPI Portugal is the equity mutual fund with the lowest tracking error regarding negative deviations, in contrast with NB Portugal Ações which has the highest value. In sum, concerning equity funds, the verified results are mainly in line with TE_1 values. Nevertheless, in the biennial analysis also conducted (for detail see Table A5), seasonality seems to have an effect on the results, having the index mutual fund and the ETF similar results in the biennial 2014-2015, although Comstage PSI20 still has the lowest values of tracking error.

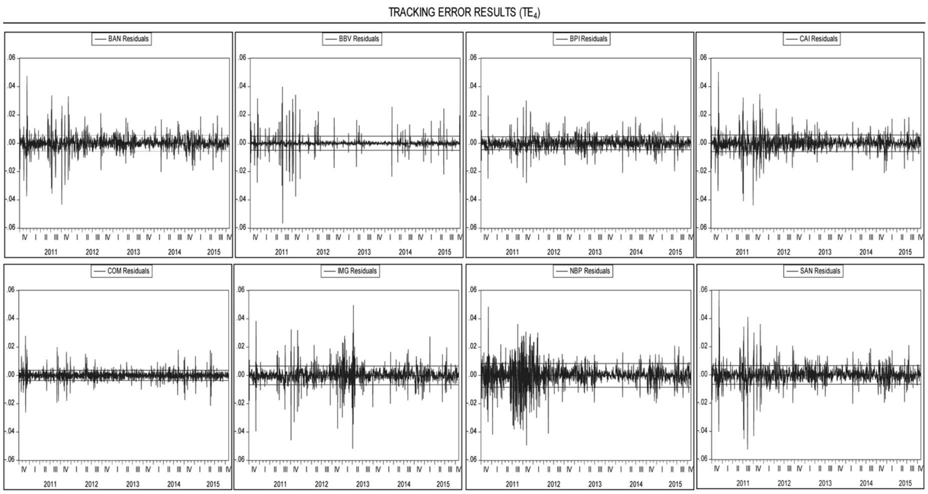
TE_3

Table 6 also summarizes the results of the third measure of tracking error which is the result of the standard deviation of the return differences between the investment schemes and their benchmark. Within this measure, the fund with lower tracking error is Comstage PSI20 (0.0028). The relative surprise is the fact that BBVA PPA Índice PSI20 comes in third with (0.00478) after BPI Portugal (0.00377). In the biennial decomposition for all years available of this tracking error measure (accessible in Table A6), it is found that the values of these two funds were only inverted for the biennial (2012-2013). The highest values of TE_3 were verified for NB Portugal Ações both in the period in analysis and in the biennial decomposition. Regarding Santander Acções Portugal, Caixagest Acções Portugal and IMGA Ações Portugal all these three funds show similar tracking error results (0.00554, 0.00509 and 0.00577) despite the fact that only IMGA Ações Portugal has the PSI20 Index as a clear benchmark.

TE_4

The single model was regressed for all the dependent variables in discussion and the residual of each regression is presented in Figure 3. The results show the residual variation among each investment scheme for the comparable period and from its breakdown is obvious the relatively low volatility and mean of the residual from BBVA PPA Índice PSI20 and Comstage PSI20 [for individual residual descriptive statistics detail see Table A7]. Regarding the equity mutual funds, BPI Portugal is the investment scheme that has the relatively lowest volatile residual in its regression. It is also important to mention that the high levels of residuals in actively managed funds are mainly seen in the year of 2011, which was a negative year for the PSI 20 index with a negative global variation of 27.60%. This result may be associated with the ability of investment fund to adjust their portfolio to the material loss faced by the financial sector related to the sovereign debt crisis. For the last years of the comparative period, even investment funds like NB Portugal Ações (which has been the fund with the highest performance differences with the benchmark) it was seen a decrease in volatility of the residual of its regression.

Figure 3: Residual graph for all the regressions



5.2.4. *ETF – Price vs. Net Asset Value and Deviation Persistence*

As expected, results presented in Table VII show that the linkage between the Price and the NAV is quite significant and close to one. Furthermore, in this regression, the high R-squared value (0.99), the significance of β at 1% level and its close to but less than one value suggests that Comstage PSI20 trades at a discount from its NAV. However, the result does not give a clear idea of the discount value, being then necessary to conduct a deviation analysis.

Table 7: Regression results

Variables	β	t-Statistic#β	R^2	Observations
$P_{t,i}$	0.999999*	15010.3958	0.99962	1673

Note: * denotes significance at 1%.

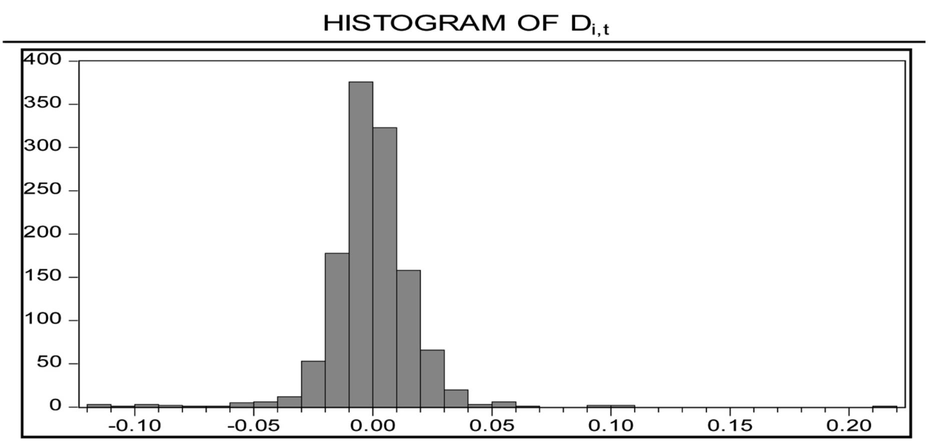
With that goal in mind, Price to NAV deviations were computed and the results are displayed in Table 8. From the results presented in the referred Table, it is possible to conclude that for all the sampling period Comstage PSI20 exhibits a slightly higher number of observations in which it is priced at a discount (854 = 51.04%) than at a premium (807 = 48.24%) though the absolute average premium (€0.01096; 0.167% of the average price) is moderately higher than the absolute average value of the discount (€0.01049; 0.174% of the average price). Notwithstanding, the finding presented have always to be understood in a context in which some of the prices used are originated from the price valuation conducted by Euronext. It is also important to mention the positive impact that the inclusion of more observation has in the series mean and standard deviation, suggesting that as the data range increases the average premium or discount would tend to decrease [For detail see Table A8]. This behavior may be justified by the increased popularity of the ETF (and consequent more trades and bid and ask orders) as an alternative investment schemes option for Portuguese investors within the period range.

Table 8: Performance and descriptive statistics summary

Mean	Median	Maximum	Minimum	Std. Dev.	Obs.	N.º Obs at Premium	Average Premium	N.º Obs at Discount	Average Discount
Period: 01-Oct-2010 31-Aug-2017									
-0.00007	-0.0003	0.2175	-0.1180	0.01729	1673	807	0.01096	854	-0.01049

Regarding the distribution of the difference between the Price of the ETF and its NAV, it can be seen in Figure 4 that is mainly settled around the mean having a few statistical outliers. However, the existence of deviations sets the need to study its persistence.

Figure 4: Histogram of the difference values between the Prices and the NAV



For that purpose, two regressions with the aim of evaluating the persistence of deviation analysis were conducted being the results presented in Table 9. As seen in the referred table, although both the dependent variables in regressions 1 (one lag period) and 2 (two lag period) are significant at 1% with positive values, the R-squared of both regression shows that the explanatory power of both regressions is small and close to zero. Nevertheless, the persistence of small deviations is a verified phenomenon in Comstage PSI20 for at least two days lag. Again, the results may be justified by the low turnover associated to the ETF and the relevant importance of price valuation of Euronext. However, it is important to mention that the average discount is just 0.00007 euros (0.001% of the average price) which, for example, can be favorably compared with the average discount of $0.014[9] (0.018% of average price difference) for SPDRs from Elton et al. (2002) and with Kayali (2007) discount of ₺0.008[10] (0.11% of average price).

Table 9: Regression results

	REGRESSION 1	REGRESSION 2
$\boldsymbol{\gamma_0}$	-0.00008	0.00003
t-Statistic#γ_0	-0.18232	0.06053
$\boldsymbol{\gamma_1}$	0.28344*	0.25116*
t-Statistic#γ_1	11.73379	9.53841
$\boldsymbol{\gamma_2}$	NA	0.09646*
t-Statistic#γ_2	NA	3.69158
R^2	0.08086	0.08526
Observations	1,567	1,474

Note: * denotes significance at 1%.

6. Conclusion

We applied different approaches to examine the empirical validation of Comstage PSI20 ETF performance as an alternative investment option to Portuguese Investors that aim to be exposed to the fluctuation of constituents of the Portuguese Stock Index (PSI 20 index). The results suggest that an investor that started an investment in the 30th of September 2010 and closed all positions on the 29th of October 2015 would achieve a closer to index performance if he had chosen to invest in the Index Fund (BBVA PPA Índice PSI20) rather than in the ETF or any other mutual fund. Moreover, for the same period, all the investment schemes outperformed the PSI 20. However, within the sample period, investment in these different securities would be associated with different average rates of under and outperformance, being the number of days of outperformance slightly higher than the underperformance

[9] Which corresponds to €0.0133504 [Exchange Rate for the 31/12/2002 from the ECB (2017)].

[10] Which corresponds to €0.0046592 [Exchange Rate for the 31/12/2007 from the ECB (2017)].

ones, with except of the BBVA PPA Índice PSI20, in which in 65% of the trading days the investor would face a lower return than the PSI 20 index variation.

Also, the results from the Jensen's model have shown a high relation (over 0.75) between mainly all the investment schemes performance and the PSI 20 index performance, making the equity mutual funds also a competitive opponent for ETFs and Index funds in terms of PSI 20 index exposure. These values corroborate the importance of including the four equity mutual funds in the study despite all of them not having the PSI20 as a clear benchmark in their prospectus. Comstage PSI 20 is the investment scheme with the highest relation between the benchmark and its returns (0.97), meaning that a daily return of 1% in the PSI 20 index increases in 0.97% the return of this ETF in the 2010-2015 studied period.

Since investors that choose an ETF as an investment option have the aim of tracking the benchmark return, several tracking error measures were calculated in order to have a clear investigation of this relevant ability. As expected, the lowest results of tracking error measures (i.e. the investment schemes with the highest ability to track the PSI 20 Index) were from Comstage PSI20 (ETF), BBVA PPA Índice PSI20 (Index Fund) and, as not so expected, from the equity mutual fund BPI Portugal since it has not the PSI 20 Index as a benchmark. The results suggest that BBVA PPA Índice PSI20 tracks better both positive and negative variations of the benchmark. However, regarding just downside deviations, Comstage PSI20 is found to be the best tracking investment scheme option for the examined period. Additionally, Comstage PSI20 is the best tracking investment scheme option if an investor intends to have a smooth tracking of the index (lowest value of the standard deviation of the difference between the return of the investment scheme and the PSI 20 index) and its results can be positively compared with the Shin and Soydemir (2010) study, meaning that a lower than average tracking error was verified. Within equity mutual funds, only the BPI Acções Portugal exhibited competitive tracking error values that could be comparable to the ones presented by the ETF and index mutual fund.

Solely for the ETF, the price efficiency and deviation persistence results showed that Comstage PSI20 exhibits a slightly higher number of days being traded at a discount (51.04%) than at a premium (48.24%), been verified only 12 trading day in which the price was the same as the NAV (price efficiency). Also, it was concluded that on average Comstage PSI20 faces a discount of €0.00007 between the Price and NAV, with minimum (discount) and maximum (premium) values of −€0.118 (-1.52% difference between the price and NAV) and €0.2175 (2.85% difference between the price and NAV), respectively. The results can be positively compared (since a lower discount was found) with the analysis of Elton et al. (2002) and Kayali (2007).

Persistence of deviations (premium and discounts) was also examined, being concluded the existence of this phenomenon for at least two trading days. However, the results need to be relativized by the low average value of deviations and by the low explanatory power of the examined regressions.

Our paper also highlighted some topics that may be relevant for further research. Future research may focus on the study of seasonality of the tracking errors for the investigated funds and the computing price efficiency of the ETF solely for traded values, avoiding the Euronext estimations that were not perceived in the current study. Also, regarding the ETF traded in the local exchange (Euronext Lisbon), a comparable examination including leverage ETFs may be conducted.

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ANNEX

Table A1: Descriptive statistics

NAME (ACRONYM)	MEAN	MEDIAN	MAXIMUM	MINIMUM	STD. DEV.	SKEWNESS	KURTOSIS	OBSERVATIONS
Period: 01-Oct-2010 31-Dec-2011								
BAN	-0.1005	0.0000	5.3151	-4.0629	1.2220	-0.0341	4.7771	323
BBV	-0.0780	0.0000	4.9266	-6.5749	1.3978	-0.3328	5.5585	323
BPI	-0.0916	0.0000	4.9546	-4.0880	1.2242	-0.1038	4.5550	323
CAI	-0.0927	0.0000	5.5550	-4.3040	1.2792	0.1091	4.6358	323
COM	-0.0813	0.0000	3.4276	-5.3398	1.3523	-0.3122	3.8432	323
IMG	-0.0961	0.0000	5.3395	-4.5411	1.2807	-0.0794	4.8285	323
NBP	-0.1103	0.0000	5.2779	-5.1322	1.2397	-0.1391	5.0037	323
SAN	-0.0910	0.0000	6.6368	-4.0682	1.3902	0.3227	5.9163	323
PSI20	-0.0873	-0.0573	3.2216	-5.2156	1.3608	-0.3034	3.8162	323
Period: 01-Jan-2012 31-Dec-2013								
BAN	0.0754	0.0927	4.0956	-5.2184	1.0775	-0.2542	4.7789	511
BBV	0.0558	0.0181	4.3516	-5.3151	1.1585	-0.1512	4.2811	511
BPI	0.0758	0.0848	4.6332	-5.8460	1.1109	-0.3039	5.4405	511
CAI	0.0514	0.0394	3.1223	-3.5430	0.9796	-0.2945	4.2949	511
COM	0.0557	0.0818	4.6914	-5.3366	1.1750	-0.2350	4.2512	511
IMG	0.0678	0.0530	4.6697	-5.5248	1.1328	-0.2395	5.2814	511
NBP	0.0732	0.0294	4.0229	-5.2359	1.0625	-0.2839	4.9422	511
SAN	0.0772	0.0428	4.5093	-5.7410	1.0963	-0.2893	5.4152	511
PSI20	0.0416	0.0266	4.3531	-5.3148	1.1762	-0.1610	4.1902	511

Period: 01-Jan-2014 31-Dec-2015								
BAN	0.0154	0.0462	4.8380	-5.8854	1.2682	-0.3557	4.6915	511
BBV	-0.0308	0.0000	4.7953	-5.9289	1.4424	-0.2615	3.9377	467
BPI	0.0138	0.0426	4.3842	-5.4034	1.2194	-0.3206	4.5864	511
CAI	0.0088	0.0322	4.4897	-5.5994	1.2271	-0.3693	4.8044	511
COM	-0.0219	0.0750	4.4405	-5.6161	1.4483	-0.3641	3.7116	511
IMG	0.0145	0.0036	4.5407	-5.4821	1.2827	-0.3224	4.5524	511
NBP	0.0053	0.0271	4.2717	-5.1266	1.2040	-0.2953	4.6520	511
SAN	-0.0006	0.0176	4.4492	-5.5288	1.2812	-0.3284	4.6866	511
PSI20	-0.0311	-0.0065	4.7119	-5.8028	1.4184	-0.3184	3.8634	511
Period: 01-Jan-2016 31-Aug-2017								
BAN	-0.0217	0.0187	3.1503	-6.1327	1.2233	-0.8620	6.1780	264
BBV	NA	NA	NA	NA	NA	NA	NA	0
BPI	0.0040	0.0000	3.1953	-6.0542	1.0697	-0.7736	7.1950	428
CAI	0.0132	0.0101	3.1647	-5.9462	1.0493	-0.7983	7.1863	428
COM	0.0000	0.0000	3.3270	-7.0642	1.1335	-0.8322	7.4440	428
IMG	0.0117	0.0021	3.3627	-6.4032	1.0779	-0.8455	7.4666	428
NBP	0.0023	0.0160	3.6662	-6.9296	1.1311	-0.8204	7.6159	428
SAN	-0.0008	0.0229	3.2344	-6.9905	1.1096	-0.8136	7.9180	428
PSI20	0.0211	0.0000	3.5680	-6.5879	1.0645	-0.7287	7.4911	428

Table A2: Regression results (01-Oct-2010 to 31-Aug-2017)

VARIABLES	BAN	BBV	BPI	CAI	COM	IMG	NBP	SAN
α	-0.00027	0.00005	0.00020	0.00013	-0.00008	0.00019	0.00010	0.00021
t-Statistic#α	-1.78685**	0.37599	1.92113**	1.00863	-1.06441	1.30202	0.57073	1.41956
β	0.97461	0.92908	0.83948	0.78264	0.95507	0.81036	0.67909	0.81799
t-Statistic#β	77.7967*	88.2812*	100.7108*	77.9738*	154.1708*	71.6205*	47.2244*	72.1111*
R^2	0.79019	0.85714	0.85135	0.77442	0.93066	0.74335	0.55738	0.74595
Observations	1,609	1,301	1773	1773	1773	1773	1773	1773

Note: * (**) denotes significance at 1% (10%).

Table A3: Absolute performance summary

	BAN	BBV	BPI	CAI	COM	IMG	NBP	SAN	PSI20 INDEX
Period: 01-Oct-2010 31-Dec-2010	-2.27%	1.33%	-0.80%	0.25%	1.60%	-0.83%	-2.77%	-1.09%	1.08%
Period: 01-Jan-2011 31-Dec-2011	-27.81%	-25.68%	-26.81%	-28.00%	-26.51%	-28.02%	-29.76%	-26.95%	-27.60%
Period: 01-Jan-2012 31-Dec-2012	14.40%	7.93%	14.01%	2.61%	7.88%	12.39%	15.16%	9.04%	2.93%
Period: 01-Jan-2013 31-Dec-2013	24.72%	19.09%	25.19%	23.67%	18.92%	21.73%	22.60%	31.94%	15.98%
Period: 1-Jan-2014 31-Dec-2014	-13.19%	-26.06%	-11.76%	-13.63%	-25.68%	-13.21%	-9.26%	-11.63%	-26.83%
Period: 01-Jan-2015 31-Dec-2015	19.58%	NA	17.05%	16.53%	13.99%	18.96%	9.11%	8.20%	10.71%
Period: 01-Jan-2016 31-Dec-2016	-6.05%	NA	-11.91%	-6.83%	-10.87%	-11.07%	-13.70%	-7.23%	-11.93%
Period: 01-Jan-2017 31-Aug-2017	NA	NA	12.69%	10.91%	9.15%	15.29%	13.83%	15.13%	10.20%

Table A4: Tracking error results (TE_1)

Tracking Error	BAN	BBV	BPI	CAI	COM	IMG	NBP	SAN
Period: 01-Oct-2010 31-Dec-2011								
TE_1	0.00544	0.00329	0.00371	0.00565	0.00285	0.00410	0.01208	0.00607
OBS.	323	323	323	323	323	323	323	323
Period: 01-Jan-2012 31-Dec-2013								
TE_1	0.00326	0.00070	0.00333	0.00420	0.00199	0.00498	0.00440	0.00380
OBS.	511	511	511	511	511	511	511	511
Period: 01-Jan-2014 31-Dec-2015								
TE_1	0.00354	0.00120	0.00349	0.00343	0.00216	0.00362	0.00385	0.00396
OBS.	511	467	511	511	511	511	511	511
Period: 01-Jan-2016 31-Aug-2017								
TE_1	0.00312	NA	0.00275	0.00238	0.00162	0.00274	0.00300	0.00310
OBS.	264	NA	428	428	428	428	428	428
Period: 01-Oct-2010 31-Aug-2017								
TE_1	0.00376	0.00152	0.00330	0.00381	0.00211	0.00389	0.00530	0.00409
OBS.	1,609	1,301	1,773	1,773	1,773	1,773	1,773	1,773

Table A5: Tracking error results (TE_2)

Tracking Error	BAN	BBV	BPI	CAI	COM	IMG	NBP	SAN
Period: 01-Oct-2010 31-Dec-2011								
TE_2	0.01025	0.00843	0.00593	0.00992	0.00465	0.00822	0.01764	0.01133
OBS.	150	168	167	160	164	167	156	154
Period: 01-Jan-2012 31-Dec-2013								
TE_2	0.00431	0.00177	0.00427	0.00550	0.00252	0.00846	0.00694	0.00486
OBS.	237	381	240	248	249	250	242	244
Period: 01-Jan-2014 31-Dec-2015								
TE_2	0.00501	0.00357	0.00500	0.00487	0.00334	0.00515	0.00512	0.00526
OBS.	226	305	221	232	256	226	242	247
Period: 01-Jan-2016 31-Aug-2017								
TE_2	0.00437	NA	0.00398	0.00342	0.00318	0.00397	0.00436	0.00417
OBS.	130	NA	217	216	211	205	204	204
Period: 01-Oct-2010 31-Aug-2017								
TE_2	0.00616	0.00446	0.00476	0.00603	0.00338	0.00672	0.00911	0.00649
OBS.	743	854	845	856	880	848	844	849

Table A6: Tracking error results (TE_3)

Tracking Error	BAN	BBV	BPI	CAI	COM	IMG	NBP	SAN
Period: 01-Oct-2010 31-Dec-2011								
TE_3	0.00779	0.00781	0.00500	0.00792	0.00384	0.00668	0.01120	0.00893
OBS.	323	323	323	323	323	323	323	323
Period: 01-Jan-2012 31-Dec-2013								
TE_3	0.00318	0.00254	0.00306	0.00369	0.00190	0.00650	0.00529	0.00351
OBS.	511	511	511	511	511	511	511	511
Period: 01-Jan-2014 31-Dec-2015								
TE_3	0.00554	0.00760	0.00380	0.00568	0.00314	0.00491	0.00824	0.00628
OBS.	511	467	511	511	511	511	511	511
Period: 01-Jan-2016 31-Aug-2017								
TE_3	0.00345	NA	0.00309	0.00288	0.00221	0.00298	0.00311	0.00304
OBS.	264	NA	428	428	428	428	428	428
Period: 01-Oct-2010 31-Aug-2017								
TE_3	0.00469	0.00487	0.00363	0.00469	0.00266	0.00523	0.00690	0.00504
OBS.	1,609	1,301	1,773	1,773	1,773	1,773	1,773	1,773

Table A7: Descriptive statistics of residuals

REGRESSION (IDENTIFIED BY THE DEPENDET VARIABLE)	MEAN	MEDIAN	MAXIMUM	MINIMUM	STD. DEV.	SKEWNESS	KURTOSIS	OBSERVATIONS
Period: 01-Oct-2010 29-Oct-2015								
BAN	4.97E-20	2.03E-05	0.0474	-0.0431	0.0057	-0.2024	16.80	1,301
BBV	2.35E-19	-9.33E-05	0.0397	-0.0565	0.0050	-0.6849	33.93	1,301
BPI	-5.60E-20	-5.40E-05	0.0336	-0.0279	0.0046	0.4239	11.50	1,301
CAI	-2.13E-19	8.37E-05	0.0502	-0.0436	0.0058	-0.0399	16.84	1,301
COM	-7.72E-20	-7.09E-05	0.0277	-0.0260	0.0036	0.1730	14.10	1,301
IMG	4.06E-19	-7.64E-05	0.0494	-0.0516	0.0066	-0.3741	15.83	1,301
NBP	-1.91E-19	2.16E-04	0.0484	-0.0492	0.0084	-0.6486	8.79	1,301
SAN	-1.35E-20	2.87E-05	0.0606	-0.0527	0.0066	-0.0184	19.51	1,301

Table A8: Performance and descriptive statistics summary

MEAN	MEDIAN	MAXIMUM	MINIMUM	STD. DEV.	OBS.		N.º Obs at Premium	Average Premium	N.º Obs at Discount	Average Discount
Period: 01-Oct-2010 29-Oct-2015										
-0.00030	-0.00070	0.21750	-0.11800	0.01889	1223		577	0.01229	641	-0.01165