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An Alternative Stock Index for Benchmarking Portuguese Investment Funds

Trabalho de Projecto

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Abstract

While the PSI 20 blue-chip index has been widely used as a benchmark for the Portuguese stock exchange, it may not be replicable by fund managers due to investment limits imposed in UCIT European regulation. This dissertation compares the relative performance of a set of Portuguese mutual funds against both the standard PSI 20 benchmark and a modified version which fully respects said limits.

Results show that the greater diversification imposed by the legal rules does not necessarily imply a sacrifice in terms of returns, and that no evidence was found of consistent, abnormal returns by active management, when evaluated by the modified benchmark.

Keywords

Benchmarking; Alpha; Portuguese stock market; Mutual fund performance; UCITS

Resumo

O índice PSI 20 é a referência mais habitual como barómetro da Euronext Lisboa. No entanto, os gestores de fundos portugueses que investem em acções nacionais podem não ter a possibilidade de replicar a carteira deste índice, devido às restrições ao investimento impostas pela regulação europeia para os mercados financeiros, nomeadamente as Directivas UCITS.

Neste projecto, vamos analisar até que ponto estas limitações podem ser impeditivas da performance dos fundos de investimento, criando um índice alternativo criado que respeita os referidos limites legais, e contrastando a performance dos fundos de acções nacionais quando medida pelos diferentes padrões.

Os resultados obtidos sugerem que a maior diversificação imposta pela legislação não tem necessariamente um impacto negativo sobre os retornos obtidos, e que a medição da performance dos gestores de activos com um índice sujeito às mesmas regras dos fundos não leva a conclusões mais favoráveis à gestão activa. Não se encontrou qualquer prova que os gestores de fundos, enquanto grupo, consigam obter consistentemente uma performance acima do retorno do mercado (ajustado pelo beta do fundo).

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1. Introduction

Should an investor trust an active fund manager with his savings, or is he better off just buying into an index fund (either the traditional mutual fund, or an Exchange Traded Fund)?

This is the perennial question faced by market participants, and the one many academic investigators have tried to find the answer for, even if they would rather pose the question along the lines of “Does the efficient market hypothesis hold, in one form or another, or is it possible for an active fund manager to exhibit persistent skill?”.

Most authors conclude that there is no evidence of value added by active fund managers, even though there is no unanimity, and it should be mentioned that most studies focus on the United States and United Kingdom markets.

In this context, we have a more specific question. Active managers in Portugal often excuse a poor performance vis-à-vis the market with the restrictions brought on by European directives regulating collective investment vehicles, namely limits on portfolio composition that admittedly prevent them from replicating the PSI 20 benchmark index. But is regulation, in this case, that much of a hindrance to performance? If the answer is yes, then it would be evidence that the regulatory approach might be hurting fund investor's returns, which would definitely deserve some attention from supervisor authorities. On the other hand, if the answer is no, then we would conclude that market participants who seek to invest in the Portuguese market might be better off with passive investment vehicles - index funds, ETF and derivatives that replicate the index evolution.

This study is thus a contribution to understanding how severely fund managers are constrained by regulation, specifically where it concerns limits on investment positions. We seek to answer specific questions:

- What are the legal diplomas that regulate mutual funds? And which rules would apply to a portfolio that could constitute a stock market benchmark?
- What input can we draw from published work in the scientific community?
- Does an index, built in compliance to the above mentioned rules, show significantly worse performance than the original market benchmark?
- How different is measured fund performance, if this new index is employed as the market benchmark?

We find that our custom built market representative index does indeed comply with investment restrictions without lagging the PSI 20 index, and furthermore we do not observe any improvement in measured fund performance when the new index is used as banchmark.

The structure is as follows: some background information on the Portuguese market, the legal framework and the resulting rules for index composition will first be presented on chapter 2. Then, in chapter 3, we will make a short review of academic literature on benchmarking and performance evaluation.

The next step is the presentation of the performance measures (for example, Jensen's Alpha, the Treynor Ratio, etc.) and of the dataset.

The new index and the evaluation of the mutual funds under analysis will be detailed in the Results section (chapter 5), after which concluding remarks will be made, as well limitations of the present study and directions for future research.

2. Background

In this section, we will review the legal constraints to portfolio composition imposed by European regulations, and provide further information on the Portuguese stock market and the PSI 20 benchmark index.

2.1. The Portuguese Stock Market

The Portuguese equity market (referring to its main exchange, Euronext Lisbon; there is also the OPEX market, which is smaller, has much less visibility and is noted mainly for derivatives trade), when compared to North-American or even larger European exchanges. During the analysis period, little more than fifty companies were listed on the exchange (from 55 by the end of 2004 to 53 by September 2011).

The PSI 20 is regarded as the benchmark for the Portuguese market. The 31st of December of 1992 was chosen as starting date for the series, with a starting value of 3.000 points, and was designed specifically to serve as a market benchmark, and underlying derivative products.

It comprises the 20 largest and most traded stocks on the Euronext Lisbon, adjusted by their free-float. These criteria are measured by value turnover and trading velocity, respectively. To be eligible for selection, listed stocks should obey a series of criteria, namely having their headquarters in Portugal (or using the Euronext Lisbon as their main listing), and maintaining adequate liquidity (for example, having a significant free float, and without any predictable negative impacts on this measure).

As per the current rules, an annual review of constituent selection and weightings is performed in March, with quarterly fast entry of new listings with high scores in the selection criteria (they must be at 15th or higher in the new ranking).

Like many capitalization weighted indexes, it imposes limits on the maximum weight any one stock can have on the index. A cap on value is defined, and positions greater than this limit have their weight reduced down to the maximum admissible value, and as a result all other positions are increased proportionally. If any position is increased over the limit, the process is repeated. It was only on October 2001 that a 20% maximum weight cap was introduced. Since July 2007, this cap was reduced to 15%.

More details can be found in NYSE Euronext (March 2011).

Mutual funds investing solely on the Euronext Lisbon make up approximately 10% of total assets invested in Portuguese mutual funds (excluding real estate), as of August 2011. In the last seven years, the value of assets under management went through a veritable roller coaster. From around 330 million Euros in July 2004, the “bull” period that lasted until the summer of 2007 saw combined portfolio holdings balloon to over 900 million Euros, but with the financial crisis triggered by the subprime collapse in the

United States, the industry was hit by falling asset values and redemption requests, and by August 2011 asset values under management had fallen to under 200 million Euros¹.

The *Comissão do Mercado de Valores Mobiliários* (CMVM) is the supervisor for Portuguese transferrable securities market. Through the emission of Regulations (*Regulamentos*), it can supplement the legislative work of the Portuguese government and the European Union. One such Regulation with major impact on mutual funds is Regulation 15/2003 (republished by Regulation 7/2007), which sets detailed rules on mutual fund operations.

The fund dataset for this study includes all the mutual funds classified by the *Associação Portuguesa de Fundos de Investimento, Pensões e Patrimónios* (APFIPP) as Portuguese stock funds, and obeying article 7 of Regulation 15/2003, which states that a fund may only be classified as a stock fund if it invests at least 2/3 of its portfolio in stocks, directly or indirectly.

On chapter 4, the dataset will be presented in greater detail.

2.2. Legislation

In the context of the continuous effort to enhance the European Single Market, ensuring the free movement of capital (and financial services) was one of the priorities of the European Commission.

The heterogeneous legislation of different member countries constituted an obstacle to greater integration. Among the several proposals, the European Council approved Directive 85/611/EEC of 20 December 1985, on Undertakings for Collective Investment in Transferable Securities (UCITS). It sought to “facilitate the removal of the restrictions on the free circulation of the units of collective investment undertakings in the Community” and thus bring about a European capital market, while at the same time ensuring more effective and uniform protection for investors. The expectation was that financial firms could market their products in all member states, once they were compliant with UCITS regulation. It should be noted that Portugal, along with Greece, was given extra time to implement this legislation: until 1992 (with the possibility of a further two year period), while most member states were expected to complete the needed legislative changes by 1989.

However, it was necessary to wait until 1994, when the *Decreto - Lei n° 276/94*, of 2 of November, finally transposed to Portuguese law the Council Directive. Of particular interest to this paper is its article 43. It established that a mutual fund cannot hold a position in any one listed company greater than 5% of the fund’s Asset Value (AV).

¹ Source: APFIPP - Associação Portuguesa de Fundos de Investimento, Pensões e Patrimónios

This limit (art. 43, 1) could be increased to 10%, as long as all positions greater than 5% of the fund's AV did not sum over 40% of that same AV (art. 42, 2).

By this time, the experience in the different European countries had shown that UCITS was not living up to expectations. It was too limited in the range of admissible investments, and differences in regulation between countries persisted, namely in regards to information disclosure and marketing practices. A first attempt in the mid-1990s was unsuccessful (what came to be known as UCITS II), due to the inability to reach a consensus at the European Council level. Already in the 21st Century, a major overhaul finally came in the shape of a set of Council Directives, 2001/107/EC and 2001/108/EC of the European Parliament and of the Council of 21 January 2002, which constituted UCITS III, introducing simplified prospectuses, regulating management companies and extending the range of eligible assets.

UCITS III was transposed to Portuguese law by the *Decreto – Lei n° 252/2003*, of 17 of October. The limits on investment were now stated in Article 50, 1, that somewhat simplified the previous wording, stating that the maximum position limit is raised to 10%, but the combined total of all positions greater than 5% of the fund's AV still cannot be greater than 40%. In practical terms, there is little change. This law also added limits on qualified positions (article 59). A mutual fund cannot hold more than 10% of a listed company's shares without voting rights, which is not a major factor in terms of this study.

It should be noted that Article 55 recognizes that mutual funds can exceed these limits due to corporate events or even price variations, so a 6 month period is given to correct the situation.

The latest version was published by the *Decreto - Lei n° 71/2010*, of 18 of June, however there was no change to investment limits.

As a final note, it should be mentioned that UCITS IV was already approved in 2009 (by Directive 2009/65/CE), but has not yet been transposed to the Portuguese legal framework.

The limits on portfolio composition of mutual funds that invest in stocks and are UCITS compliant can thus be condensed in two propositions. First, a “hard” limit: position sizes cannot exceed 10%. Second, a “soft” limit: the sum of all positions over the 5% threshold cannot exceed 40%.

3. Literature Review

3.1. On the choice of benchmarks

Academic literature suggests that the evaluation of mutual fund performance can be highly susceptible to the choice of benchmark. How effective are commonly used index benchmarks?

Soucik and Allen (undated) apply a wide range of benchmarks in a study involving Australian mutual funds. Of particular interest to this work, they found that common market indexes like Australia's All Ordinaries Index and a custom-built Value Weighted Index exhibited large upward bias, when compared to simple buy-and-hold, random selection portfolios (which are, by definition, expected to have zero alpha).

Bolognesi and Zuccheri (2008) mention a bias of market capitalization weighted indexes which is very relevant in this context: Since market representativity is equaled to market value, stocks or sectors that are "in fashion", and with rising valuations, also make up an increasingly greater part of the index, over time. The 1998 tech bubble is a good example, when the Information Technology industry peaked at nearly 40% of the Standard & Poor's 500 index, in 2000. It was reduced to approximately half in 2007. Incidentally, Sharma et al. (2006) confirmed that portfolio managers tended to herd into tech stocks in the period leading up to the crash (1998-2000).

In a study of S&P 500 index funds, Frino & Gallagher (2001) remind us that while index calculations depart from market values, they are theoretical, in the sense that the index does not face the market frictions suffered by funds, and thus it is impossible for funds to replicate the benchmark index without cost. Index funds in the sample did beat actively managed funds however, and thus appear to be the better alternative.

Kosowski (2006) conducted a comprehensive study on US equity funds, comparing the performance in recession and expansion periods. Using time-varying alphas and betas, this research found economically and statistically significant higher alphas during recession periods than during expansion periods. Kosowski *et al* (2006) had already tested the skill of high-performing fund managers. Using a bootstrap methodology to avoid the problems of non-normality of fund returns, it was possible to compare the number of high performance funds with the number of outliers one can expect to arise from pure luck. Evidence was found that the top-performers do exhibit "true skill", in the sense that their positive abnormal returns persist in time in a way that is statically unlikely to happen by chance.

Grinblatt & Titman (1989) contrast results obtained with Jensen's Alpha and a measure developed in Treynor & Mazuy (1966). They conclude that the choice of benchmark can heavily influence measured performance, although the measures used are generally consistent among themselves when the same benchmark is applied.

Naturally, the academic community has developed improved measuring tools to gauge fund performance more accurately, more recent works expanding upon earlier, simpler models.

Several studies concluded that firms with small market capitalizations and/or low book value-to-market ratios tended to produce superior returns in the long run. See, for example, Chan, Hamao, and Lakonishok (1991), or Fama and French (1992). The results obtained with these models that use several explanatory variables suggest that there is little managerial ability to generate what otherwise could be interpreted as abnormal returns, when we account for the size and book-to-market effects, which incidentally are used as criteria in the construction of the Russell family of indexes, a commonly used benchmark for managers. See Russell (2011). Duque and Almas (2008) found some evidence of the book-to-market effect for the Euronext markets (Paris, Brussels, Amsterdam and Lisbon).

Carhart (1997) built upon the results of Fama and French (1992), and added a momentum factor, which essentially consists of buying the previous year's top funds and selling the worst performers. With this model, which has since been used in other works (like Soucik and Allen (undated)), he performed a study on a large sample of north-american mutual funds, and found no evidence of unexplained abnormal returns, which might have indicated skilled management. He did find persistently underperforming fund managers, however.

Wermers (2003) also finds some short-term persistence in mutual fund performance, part of which is attributable to a momentum factor propelling "winners" and with the managers of "losing" funds unwilling to cut their losses and invest in high momentum stocks. But the most interesting part of this research is to find significant correlation between stock returns and the inflow of money to funds, suggesting that investor's money chases the winning funds and it contributes to raise stock prices, augmenting the previous effect.

Considering the valid criticisms of subjectivity introduced by the choice of benchmark, it was only natural that academic researchers attempted to avoid this problem altogether. Grinblatt & Titman (1993) proposed a measure based on the direct analysis of the fund holdings, the individual stocks, without using a benchmark from which to draw relative performance. They encountered some evidence of persistent performance, but found it unlikely to survive fund expenses. Machado-Santos e Armada (1997) applied the same methodology to a set of Portuguese mutual funds.

Daniel *et al* (1997) developed an alternative evaluation model which also circumvented the need to specify a market benchmark. The rationale is to generate random portfolios with characteristics that match the holdings of the funds under evaluation. More specifically, they evaluated timing and selectivity by fund managers. They concluded that funds in general did not exhibit a timing ability, but some funds showed selection skills. Fong *et al* (2008) fine tuned the model by Daniel *et al* (1997), by performing more frequent updates and, most interestingly, by weighting their characteristics-based

benchmark according to the composition of a commonly referenced index, effectively assigning zero alpha to a capitalization weighted average index, according to the authors. It seems an intriguing bridge between sophisticated academic benchmarking practices and simpler, broadly used market indexes, representatives of the market.

Also using a technique of mimicking the holdings of fund portfolios, Kothari & Warner (2001) report that traditionally used measures of performance can fail in capturing economically significant abnormal returns. The researchers emphasize that this is likely to happen if the fund's style differs from the chosen benchmark, which is not much of a risk in the present study.

3.2. On the existence of abnormal performance in Portuguese mutual funds.

Most academic studies, including the ones quoted above, conclude that there is no evidence of the added value of active management, especially after fees and expenses are taken into account. See Daniel *et al* (1997) for additional examples. But given the relatively little interest of the Portuguese stock exchange, even in the European context, there are not many recent studies on mutual fund performance

For example, Machado-Santos e Armada (1997), mentioned above, found some evidence of mutual fund outperformance but, interestingly, only in sub-periods where the market experienced negative returns.

Cortez, Paxson & Armada (1999) found only weak evidence of persistent performance in the Portuguese mutual fund industry, for the period 1994-1998. While they rejected persistence in performance for the industry as a whole, they found some individual managers exhibited consistently out- or underperformance.

While not a published, peer-reviewed paper, Barros (2009) deserves a mention. While testing for the possibility of herding by Portuguese fund managers at times of index composition changes, he author found that the portfolios did not deviate significantly from the PSI 20 index, which isn't very surprising, considering the reduced number of both electable stocks, and of funds themselves. We expected to obtain similarly low tracking errors, relative to the PSI 20 index.

3.3. The Capital Asset Pricing Model

We will review mutual fund performance using the Capital Asset Pricing Model (CAPM) as our basic theoretical framework. It will allow us to generate expected returns for the funds in our dataset, and using a set of indicators (namely, Jensen's Alpha and the Treynor ratio), to determine whether any fund manager exhibits abnormal returns, by either exceeding or failing to achieve expected returns, and the dimension of such returns.

The classical CAPM was presented by Sharpe (1964) and Lintner (1965), based on the Markowitz (1959) mean variance model. The essential formula of this model is familiar to any finance student:

$$E(R_i) = R_f + [E(R_M) - R_f]\beta_{iM}, \quad i = 1, \dots, N$$

Underlying the model is the supposition that all investable assets are part of a market portfolio, which is mean-variance efficient. How far can this concept hold, if we limit the investable universe to stocks traded on a particular market (and a small number of other assets, like short-term debt), which is the mandate of a fund manager focusing on the Portuguese stock market? Can indexes like the S&P 500 or the PSI 20 be considered under this definition, reliable benchmarks?

Roll (1978) made what would become one of the most widely quoted criticisms of CAPM-based models. He argued that performance results could be dramatically affected by the benchmark chosen, and that benchmarks that were not mean-variance efficient would not allow trustworthy inferences. Following the same logic, Chen and Knez (1996) demonstrate that in theory it is possible to create an infinite set of admissible benchmarks, which provide a multitude of different ranking orders for funds under study.

Nagorniak (1982) worked along the lines of Roll's critique, and compared the results, in terms of traditional CAPM measures, of the S&P 500 and a so-called Complete Index, which comprised a greater range of assets, and concluded that the use of a simple index average, a single source of risk, could lead to misleading results.

Fama & French (2004) presents a summary on the evolution of the Sharpe-Lintner CAPM, as well as a comprehensive review of the empirical work focused on the model's shortcomings. Even though many practical implementations are flawed, they defend that CAPM remains a theoretical hallmark.

3.4. Summary

This summary of the extensive existing literature on this subject suffices to show that traditional CAPM based measures are no longer the state of the art, when it comes to determining the existence of persistent managerial skill. However, the aim of this paper is not to disprove or confirm the CAPM. We are more interested in ascertaining the direction and the dimension of the difference induced by the use of a distinct benchmark, than the explanatory power of the single-factor CAPM model *per se*.

While the use of models that account for different sources of performance has for some time been widespread in academic studies, they prove difficult to replicate in a study focusing solely on the Portuguese stock market, due to the small universe of listed companies, and the scarcity of available data. It should also be mentioned that one of

the reasons for the popularity of measures like Jensen's alpha, and the Sharpe and Treynor ratio, was their intuitive interpretation, which made them undoubtedly attractive, a factor which is still true today.

As for the existence of managerial skill, that fund managers cannot outperform the market can currently be considered a stylized fact. While some counter-examples were presented (and certainly many more could be found), even these only go so far as concluding that abnormal performance could exist for short time periods, or in specific circumstances.

4. Methodology and Data

4.1. Index Composition

What constitutes a “good” market index? As discussed above, the market portfolio called for by the CAPM is an object of dispute, but most market participants seem oblivious to the discussion altogether; simple capitalization-weighted averages are most often used as market benchmarks outside academic studies, and also as proxies for passive investment strategies (more traditional index-replicating mutual funds, or Exchange Traded Funds).

Bolognesi & Zuccheri (2008) set forth a list of desirable characteristics:

- 1) Being objective and transparent
- 2) Representative of the asset class (range of eligible instruments)
- 3) Replicable (all assets should be readily tradable and have adequate liquidity)
- 4) Computable from available public information

Keeping in mind these guidelines, it was necessary to design rules to re-balance the weights of the index components in conformity with the legal limits mentioned above. Furthermore, we used the Sharpe Ratio to optimize the weightings on the index. This measure was calculated for all the stocks that composed the index going back one year, and the Solver algorithm was used to maximize the combined Sharpe Index of the selection.

To minimize the limitations of this tool, the process was made on two steps. First, a simple VBA program was created, which iteratively modified the weights within the PSI 20 composition, until the conditions were met. They are still the 20 most liquid and most traded stocks in the Euronext Lisbon market, so the companies that comprise the index are the same. Figure 4.1 describes this process.

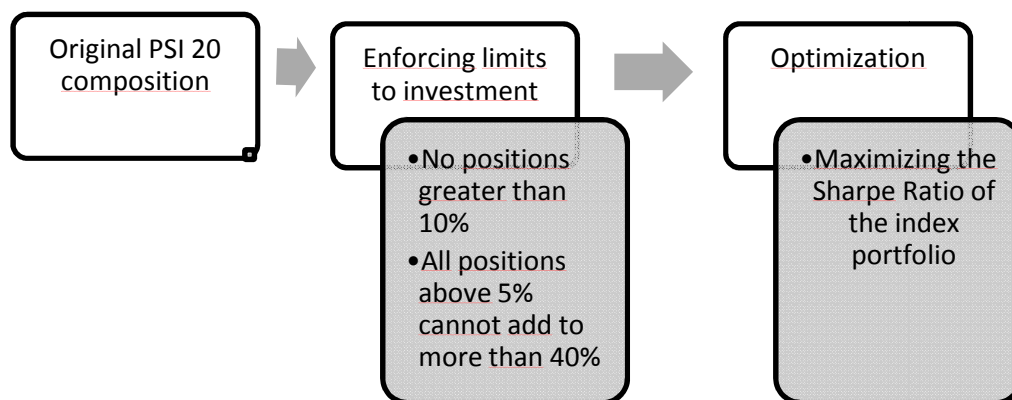


Figure 4-1: Index Generation

Departing from total market weights, calculated using free-float adjusted number of shares and closing market prices on the day of the revision, the following steps are performed:

1. All positions greater than 5% of Asset Value (AV) are reduced in incremental steps, with the excess weight redistributed to positions smaller than 5%, until the sum of all positions greater than 5% is under or at 40%.
2. If, after the first rule is satisfied, any position is greater than 10%, it will be reduced to 10%.
3. Step 1 is repeated, if necessary, until the sum of all positions greater than 5% is under or at 40%.

There is a tendency for position sizes to cluster at around 5%, with the larger blue chips like EDP near the 10% maximum boundary.

Then, we run the algorithm, seeking to maximize the Sharpe Ratio of the index selection.

The adoption of these rules should lead to an index composition with less concentration on the largest capitalizations, moving closer to an equal-weight scheme.

This reflects some of the criticisms against the use of the PSI-20 blue chip index as a benchmark for harmonized mutual funds focused on the Portuguese stock market and operating under Portuguese law: the fund manager is unable to match the weight of the index largest capitalizations, and a strong level of diversification is imposed upon him, so even if, by hypothesis, he had effective stock picking skills, the portfolio manager is prevented, to some extent, of acting on them. At the limit, a fund manager can overweight what he might consider the four most promising stocks, up the maximum of 10%.

Recall that in mathematical terms, PSI 20 limits the weight of larger companies through the introduction of a capping factor. Since market capitalization is the product of stock price, times the number of shares (free float adjusted), times the capping factor, capping is equivalent to reducing the number of shares entering the market portfolio. For

uncapped stocks, the value is simply 1, but it will be lower for capped stocks. For example, in the composition as of May 2011, a cap factor of approximately 0,6 was applied to bring EDP in line with the maximum 15% weight allowed within the PSI 20 index.

Since, with this particular mechanism, one cannot have cap factors greater than one (meaning that it is not possible to include in the index a number of shares greater than those that are available to investors on the market), trying to enforce both a lower maximum limit for individual stocks, and the 40% of NAV limit on large positions (ie, greater than 5%), did sometimes result in very small portfolios: as the larger companies cap factor is decreased, the weight of others companies is increased, and some of these will surpass the 5% threshold themselves, meaning they also must be reduced, with market capitalization getting progressively smaller.

Thus, instead of working with total number of shares and free-float factors, we directly determined the desired weights, which are then multiplied by stock prices to obtain daily capitalization for our alternative index. We used prices adjusted for capital actions at this stage (*Datastream* datatype “P”), to avoid distortions caused by corporate events, such as stock splits. This practice does mean, however, that this index will have fixed weights, that is, it is no longer a dynamic capitalization weighted over time average of the stock values.

It should be noted that these legal limits to investments are a greater limitation on a passively managed index with a reduced number of stocks, as presented here, than a mutual fund portfolio, whose manager can subjectively decide which stocks to overweight, can invest in a variable number of companies, and can also invest in other types of assets: number 7 of the CMVM Regulation 15/2003, as republished by CMVM Regulation 7/2007, only demands that equity mutual funds have 2/3 of their asset value invested in stock, and any fund will at least maintain some liquidity in money market assets, which will not count towards the above mentioned limits (unless the issuer is the same as the stocks with greater weight). So, naturally, a fund manager doesn't face significant difficulties in obeying the limits.

4.2. Index Mathematics

In the index calculations proper, we generally followed the formulation of S&P (February 2009), with the necessary adaptations required by the fact that actual quantities, free-float factors and capping factors are not being used, thereby avoiding a multitude of divisor adjustments which would generally be required in face of several corporate events, like stock-splits, rights emission, and others.

Given that weights are the only index input other than stock prices, it was possible to use capital action-adjusted quotes to avoid index distortions.

This type of index is modification of a *LasPeyres* index, with the main difference being the Divisor, which sets the initial base value.

$$Index_t = \frac{\sum_{i=1}^{20} (P_{i,t} * W_{i,t})}{D_t}$$

With

P_t = stock i price in day t

W_t = stock i weighting in day t

D_t = index divisor in day t

The initial divisor being defined as

$$D_0 = \frac{Market\ Capitalization_{t_0}}{Base}$$

With

$Market\ Capitalization_{t_0}$ = the product of prices and component's weights at the start of the series (July 1st, 2004).

$Base$ = the initial desired value of the index. To facilitate comparisons, the chosen value was the same as the PSI 20 at the start of the period: 7337,50 points.

We performed annual revisions, except for material changes in the PSI 20 itself (for example, there was a shift from bi-annual revisions in January and July, to annual revisions after March 2008).

After each revision, the divisor was recalculated to avoid disruption in the series. We only want to allow index variation that results from price action, so considering $t+1$ the day where the new composition is effective, we must ensure that the index level obtained with the "old" composition in day t remains the same with the new composition at day t prices, that is,

$$\frac{\sum_{i=1}^{20} P_t * W_t}{Divisor_{Old}} = Index\ Level_t = \frac{\sum_{j=1}^{20} P_t * W_{t+1}}{Divisor_{New}}$$

With $i= 1,...,20$ being the set of stocks belonging to the index before the revision, and $i= 1,...,20$ being the new index components

Given this equality, the Goal Seek tool available in MS Excel was used to determine the "new" divisor value which would fulfill this condition. Since stock prices are adjusted for capital actions, and neither the PSI 20, nor our ASI 20, are total return indexes, no other adjustments to the divisor were made. 7 revisions were made in total, with the corresponding number of divisor changes.

4.3. Measures of performance

4.3.1. Sharpe Ratio

This measure, proposed by Sharpe (1994), aims to evaluate the excess return (over the benchmark portfolio) obtained by the portfolio manager, for unit of risk taken. Risk is measured by the standard deviation of the fund's return. Since it considers the total risk incurred by the fund, and returns above the riskless rate, it is not dependent on the choice of market benchmark.

Applied to all selected stocks, it will be used as decision criteria in determining weightings of the index constituents. The Sharpe measure is not scalar, that is, the value itself has little interpretation, and is more an instrument to rank different funds.

Considering the financial instability of recent years, one can come across negative long term returns, which in turn lead to negative Sharpe Ratios. The measure must be interpreted with some care in such a situation. Due to the way it is formulated, for any two funds with equal, negative returns (relative to the risk-free benchmark), the fund with increased risk will have a higher (in the sense of less negative) Sharpe Ratio, yet clearly the quality of management was inferior, since it took on more risk to produce the same returns. Sharpe (1994) simply states that funds with negative value should be held short, but for funds in this situation (ie, both have negative Sharpe ratios), it is sometimes possible that higher absolute value equates with better performance.

Sharpe (1994) pointed out that the *Ex Post* version is to be preferred in measuring historical returns. The difference is mostly conceptual.

$$S_h = \sqrt{\frac{\bar{D}}{\sigma_D}}$$

Where \bar{D} is the average value of the fund's differential return in relation to the riskless rate, and σ_D is the standard deviation of that difference.

However, since we are increasingly observing funds with negative long-term absolute returns, the simpler, more common *Ex Ante* formulation will be used instead:

$$S_h = \frac{\bar{d}}{\sigma_d}$$

Where

\bar{d} = average of the excess returns relative to the riskless rate during the period, and

σ_d = standard deviation of \bar{d} .

4.3.2. Jensen's Alpha

Jensen (1967) developed one of the more widely measures of portfolio manager's performance. His alpha (α) measures a portfolio manager's forecasting ability, in the sense that he is able to deliver greater than expected returns by choosing stocks which are somehow undervalued, considering the systematic risk incurred.

Assuming the usual hypotheses of the CAPM model hold, the expected return can be written as:

$$E(\tilde{R}_i) = R_f + [E(\tilde{R}_M) - R_f]\beta_{iM}$$

With

$E(\tilde{R}_i)$ = the expected one-period return of portfolio i

R_f = the riskless rate

β_{iM} = the beta of portfolio i relative to the market benchmark

$E(\tilde{R}_M)$ = the expected one period return of the market benchmark

This equation of any i security (or portfolio) can be restated as a forecast, if we consider that the actual reached returns on time t will be equal to the expected returns plus an error term (e_t):

$$R_i = R_f + [R_M - R_f]\beta_{iM} + e_t$$

This equation can be re-written to have, in the left hand side of the equation, the excess return relative to riskless rate:

$$R_i - R_f = [R_M - R_f]\beta_{iM} + e_t$$

In case of a security, e_t has an expected value of zero. However, in the case of a managed portfolio, we must consider the possibility that the manager is a superior forecaster, and his investment choices consistently result in $e_{it} > 0$. Jensen (1967) proposes this can be achieved by not restricting this equation to intercept at the origin:

$$R_i - R_f = \alpha_{it} + [R_M - R_f]\beta_{iM} + u_t$$

In this formulation, it is assumed that α_t encompasses the abnormal returns generated in time t by the decisions of the portfolio manager, while u_t is expected to be a "white

noise”, with $E(u_t)=0$. However, since it is difficult to determine what are conscious decisions of the portfolio manager and what are random events, Jensen (1967) suggests we estimate the value of the alpha measure by linear regression using the least squares method, paying close attention to the quality of fit and error measures. For example, Dewachter *et al* (2004) use the same CAPM single-factor model, but use more robust estimators, since OLS estimators can be less reliable in the presence of outliers.

4.3.3. Treynor ratio

Another measure in the CAPM framework, it was developed in Treynor (1965). It relates excess returns over the riskless rate with the systematic risk incurred by the manager, which is measured by the fund’s beta. It is also referred to as the *reward-to-volatility* ratio. The rationale is that the best manager is the one who can maximize excess returns per unit of systematic risk, since according to mean-variance portfolio theory unsystematic risk can be diversified away.

Unlike Jensen’s alpha, the actual value of the Treynor Ratio gives us little information; it is best seen as an instrument to sort the performance of portfolios in terms of reward per unit of market risk: the higher the Treynor ratio, the better the performance, under this viewpoint.

The Treynor ratio is thus defined as:

$$T = \frac{\bar{d}}{\beta_p}$$

Where

\bar{d} = average of excess fund returns over the riskless rate

β_p = fund beta

4.3.4. Information Ratio

Although the Sharpe Index is a widely used measure, it is of limited use to this study from the viewpoint of performance evaluation, since it relates risk premium to total risk incurred, without taking account the investment style of the fund.

For this reason, we will also present the Information Ratio. The development of this ratio is usually credited to Treynor & Black (1973). The main advantage is that it relates

abnormal returns relative to a market benchmark (instead of just the risk-free rate), in terms of the volatility of those returns (the tracking error). In other words, it relates the active return (deviation from market returns) with the risk resulting from this active management.

We define the Information Ratio as

$$IR = \frac{R_p - \beta R_m}{\sigma_e}$$

With

R_p = portfolio return

βR_m = market return adjusted by the portfolio's beta

σ_e = tracking error, the standard deviation of the difference between portfolio returns and beta-adjusted market return

4.4. Choice of the risk-free interest rate

For the risk-free proxy, two options presented itself. The first one emphasizes minimizing risk, in all dimensions, by choosing a very short-term money market instrument from a top-quality issuer. The other option would be to choose an asset (or composite index of assets) whose recommended investment period is similar to the assets under evaluation, which could be 5 to 10 years top-rated sovereign bonds, an option taken in recent studies.

The majority of studies use a short term reference, the United States Treasury Treasury bill, between 3 and 12 months, and naturally German sovereign debt of corresponding maturity was another option. However, recent events, namely the financial crisis involving some of the Euro countries, but also the possibility that the credit worthiness of the United States of America might increasingly be called into question, at least to the point that it may be considered riskier than other OCDE countries, makes the definition of what constitutes a good proxy for the riskless rate a complicated endeavor. In the end, the 3-month Euribor rate was used, as a compromise.

It should be mentioned that Soucik and Allen (undated) found little sensitivity to different interest rates, in a study of Australian funds, involving a large set of benchmarks, which suggests the inferences we take should not be overly affected by this particular variable.

4.5. Data

Index composition data was obtained from several sources, namely the Euronext Lisbon Factbooks and several NYSE Euronext Index Announcements². An acknowledgment must be made to Mr. António Barros (Barros, 2009), who kindly supplied additional NEIA notices that were no longer available. The analysis period spans seven years, from July of 2004 until July of 2011.

Stock prices and interest rates were collected from *Datastream*, including prices adjusted for capital events, used for index calculation. Prices without adjustment, number of shares and *free-float* adjustment factors were also collected and used to calculate PSI 20 component weights, when this information was not available.

A total of eight mutual funds were included in this analysis. These are all the mutual funds currently in activity both classified by the *Associação Portuguesa de Fundos de Investimento, Pensões e Patrimónios* (APFIPP) as Portuguese stock funds, and obeying the requirement of article 7 of Regulation 15/2003 to be considered equity funds, which states an obligation to invest at least two thirds of the portfolio, directly or indirectly, in stocks.

Appendix Table 0-1 shows relevant information about the investment vehicles. It is interesting to note the growth of the Santander fund in terms of market share (in the class); this fund actually achieved a positive Sharpe Ratio during the period under analysis, and as we will see, showed the best risk-adjusted return in all measures. The BPI fund, which ranked third in most measures, also managed to more than double its weight in total asset values under management. On the other end of the spectrum, the greatest decreases in share of value under management were observed in the Caixagest and Millennium funds. While this is not too surprising in the first case, given the poor absolute and relative performance, the latter is a bit more surprising, since it generally was the second best fund, as we will see in chapter 5.

Information on returns and risk is presented in Table 0-2 (Appendix). While risk measured by the standard deviation was similar, returns were not. This is easily perceptible in Figure 4-2, which plots fund average excess returns over the riskless rate, against volatility measured by the annualized standard deviation of monthly returns (the Sharpe Ratio components).

² Partially available at www.euronext.com

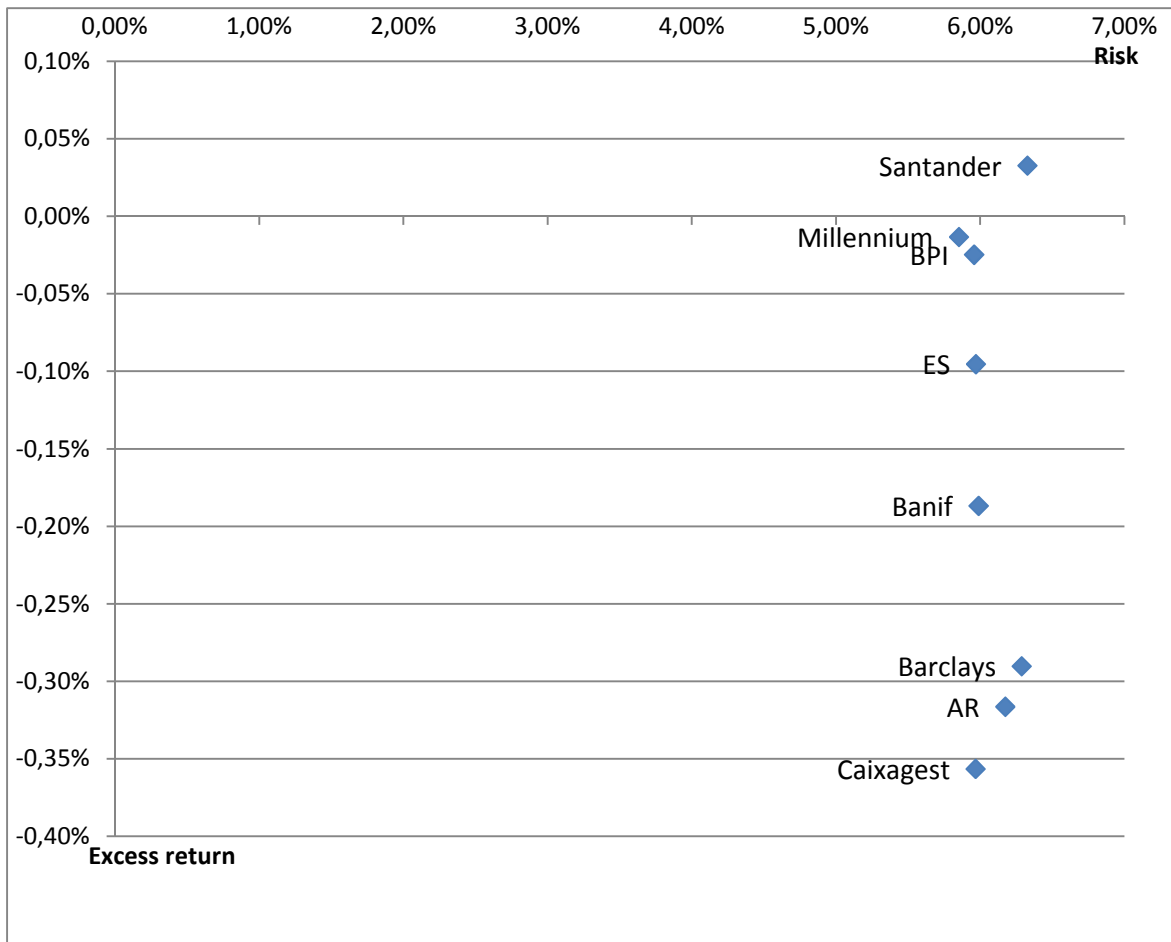


Figure 4-3: Risk Premium?

The number of funds is not too distant from published studies on the Portuguese market. According to APFIPP data, there was only one case of a mutual fund classified a national stock fund in the beginning of our analysis period that did not survive until 2011. The *Postal Acções* fund, managed by Caixagest, changed its investment policy from Portugal to the European Union, Switzerland and Norway, in March 2007. So survivorship bias should not have a major impact in our conclusions.

We used end-of-month share (*Unidade de participação*) value for the mutual funds, net of costs, obtained from Lipper.

5. Results

Before moving to the performance results, a description of the Alternative Stock Index time series (from now on referred to ASI 20) is in order.

In a broad overview, the ASI 20 outperformed the PSI 20 over the entire 7 year period under analysis, while demonstrating a (very slightly) lower volatility of continuously compounded returns:

Table 5-1: Comparison of Index Characteristics

| Index | PSI 20 | ASI 20 |
|-------------------------------------|---------|---------|
| Variance of daily returns | 0,00014 | 0,00014 |
| Standard deviation of daily returns | 1,19% | 1,17% |
| Annualized Standard Deviation | 18,83% | 18,54% |
| Return over total period | 2,73% | 11,63% |
| Annualized Returns | 0,39% | 1,58% |

Graphic 5-1 (Appendix) plots a comparison of the index levels for both series. As we can see, there is a strong similarity between the results.

This should be confirmed through a mean-difference test on related samples, using the SPSS statistical package. First, we tested for normality of both series of monthly returns, to determine if a parametric test could be used. We retained our null-hypothesis of normality at the 5% significance level, so we were confident in applying a t-test. The results indicate that the mean difference in returns was not significantly different from zero with a 5% significance level, or in other words, that the mean return of the PSI 20 is not statistically different from the ASI 20, suggesting that the difference in performance that arises over the study period might be due to chance.

While both indexes tracked each other closely during the run up and the following crash, with the financial crisis of 2008, the ASI 20 far outpaced the PSI 20 during the following recovery. Considering the nature of the index changes, a reasonable possibility was that smaller capitalization stocks (whose weight suffered the largest increase in the ASI 20 relative to the PSI 20) had a superior performance when compared to the blue-chips (which suffered the greatest weight reduction).

Looking at the composition after the revision in March 2009, we find that the four largest capitalizations (EDP, Galp, Portugal Telecom, EDP Renováveis) represented about 57% of the PSI 20, but only around 30% of the ASI 20. At the same time, the four smallest capitalizations on the PSI 20 constituent list (Altri, Sonae Indústria, Teixeira Duarte, Sonaecom) amounted to only 1,96% of this index, while representing 12,40% of the ASI 20. In this same period, taking a simple arithmetic average of stock prices, we find that these small caps increased their price in 66%, while the blue chips only advanced 25%. The use of fixed weightings should not be a factor; in fact, it may even

have lessened the impact of the outperformance by the small caps, by preventing an increase in their combined share of the ASI 20.

Moving on to the performance analysis, Table 5-2 presents betas relative to both benchmarks. The differences were fairly minor, although the Barclays, Alves Ribeiro (the ones with the highest Beta relative to the PSI 20) and the Espírito Santo funds were the only managers who saw their systematic risk measure decrease (by a small amount) with the ASI 20, signaling less sensitivity of fund returns to market returns relative to market volatility, under this benchmark.

Table 5-2: Betas

| Index | PSI 20 | ASI 20 |
|------------|--------|--------|
| BPI | 1,017 | 1,018 |
| Banif | 1,020 | 1,029 |
| Barclays | 1,059 | 1,051 |
| Caixagest | 1,012 | 1,013 |
| ES | 1,016 | 1,012 |
| Millennium | 0,997 | 1,003 |
| AR | 1,036 | 1,024 |
| Santander | 1,081 | 1,090 |

To determine the existence and the sign of alpha, several linear regressions were performed, using the beta-adjusted market risk premium as the explanatory variable and each fund's risk premium as the dependant variable, with an intercept term which would be the fund's alpha. The regressions were performed using the Eviews econometric package.

First, the analysis was performed with the PSI 20 as benchmark, with the results presented in Table 5-3. The average alpha value was slightly positive but near 0%, with individual funds ranging from 0,20% to -0,17%. More importantly, no alpha was statistically different from 0: with very low t-test scores, the null hypothesis of no statistical significance of the alpha could not be rejected.

Table 5-3: Jensen's Alpha with PSI 20 benchmark

| PSI 20 | Alpha | p-value | R-squared |
|------------|--------|---------|-----------|
| Santander | 0,20% | 0,26 | 0,92 |
| Millennium | 0,17% | 0,39 | 0,91 |
| BPI | 0,16% | 0,41 | 0,91 |
| ES | 0,09% | 0,66 | 0,91 |
| Barclays | 0,00% | 0,99 | 0,91 |
| Banif | -0,10% | 0,67 | 0,89 |
| AR | -0,13% | 0,58 | 0,88 |
| Caixagest | -0,17% | 0,40 | 0,90 |
| Average | 0,03% | | |

The regressions seem fairly robust. The coefficients of determination were around 90%, so the regression lines were a good fit to our data points. There were no traces of autocorrelation of the error terms (Durbin-Watson statistic provided as a default output by Eviews), but in some regressions there were signs of heteroscedasticity (detected through White's Heteroscedasticity Test), which is not rare event in financial time series. In the presence of heteroscedasticity, the Ordinary Least Squares method may not provide us the minimum variance estimators, and could produce, in theory, unreliable results. Since this can be considered a large sample, the regression was re-estimated using White's Heteroscedasticity-Consistent Variances and Standard errors (the new regression output is on the summary table), without any material differences in our conclusions.

The alpha values for the ASI 20, presented in Table 5-4, were in fact very similar, but the average alpha did shift to negative. The null hypothesis fails to be rejected in all cases, so no evidence of added value by fund managers was found.

Table 5-4: Jensen's Alpha with ASI 20 benchmark

| ASI 20 | Alpha | p-value | R-squared |
|------------|--------|---------|-----------|
| Santander | 0,11% | 0,60 | 0,90 |
| Millennium | 0,06% | 0,77 | 0,90 |
| BPI | 0,05% | 0,82 | 0,89 |
| ES | -0,02% | 0,93 | 0,88 |
| Banif | -0,11% | 0,60 | 0,90 |
| Brclays | -0,21% | 0,43 | 0,85 |
| AR | -0,24% | 0,38 | 0,84 |
| Caixagest | -0,28% | 0,22 | 0,88 |
| Average | -0,08% | | |

The statistical results were very similar, with a slightly lower R^2 , but still with good explanatory power. Again, no suspicion of autocorrelation, but some evidence of

heteroscedasticity in more cases, which was minimized with White’s adjustment, and again with no visible impact on the inferences drawn.

As for the Treynor Ratio (Table 5-5), the small difference in fund betas relative to the different benchmarks meant that results were very similar. In fact, the difference is, for all practical purposes, insignificant. Since the numerator (excess returns relative to the riskless rate) is unchanged, any difference comes from the denominator (Beta in relation to the benchmarks). As seen in Table 5-2, we didn’t measure a very pronounced increase in systematic risk.

Table 5-5: Treynor Ratio

| Index | PSI 20 | ASI 20 |
|------------|-----------|-----------|
| Santander | 0,000304 | 0,000302 |
| Millennium | -0,000132 | -0,000132 |
| BPI | -0,000242 | -0,000241 |
| ES | -0,000937 | -0,000941 |
| Banif | -0,001830 | -0,001814 |
| Barclays | -0,002739 | -0,002760 |
| AR | -0,003052 | -0,003087 |
| Caixagest | -0,003522 | -0,003519 |
| Average | -0,00152 | -0,00152 |

Finally, the Information Ratio. When compared to the PSI 20 (Table 5-6), results showed some symmetry: four funds achieved a positive IR, one (Banif) scored near 0, and three funds obtained negative IR, due to the negative average of deviations from PSI 20 returns.

When the ASI 20 was used, all the funds in the sample scored a lower Information Ratio, since without exception they experienced lower returns relative to this index and a larger tracking error. Although the sample is small, the generalized increase in tracking error could suggest that fund managers try to not deviate too much from the PSI 20, even within the legal constraints. It is to be expected, since fund managers are usually evaluated in relative terms, and the PSI 20 is the most common benchmark. Still, this provides some support to the proponents of passive investment strategies, since more expensive “active” funds managers are not that active, and are not adding much value to compensate for their costs.

Table 5-6: Information Ratio

| Index | PSI 20 | ASI 20 |
|------------|--------|--------|
| Santander | 0,11 | 0,05 |
| Millennium | 0,10 | 0,03 |
| BPI | 0,09 | 0,02 |
| ES | 0,05 | -0,01 |
| Banif | 0,00 | -0,06 |
| Barclays | -0,05 | -0,09 |
| AR | -0,06 | -0,10 |
| Caixagest | -0,09 | -0,14 |
| Average | 0,02 | -0,04 |

We can see the different measures employed are consistent among themselves, and only the Santander fund managed to present positive results across all measures with our new benchmark. Next chapter we will draw inferences from these results.

6. Conclusions

The objective of this study was to create an alternative benchmark to the PSI 20 for the Portuguese stock market, fully respecting restrictions on position limits that fund managers face. The custom built index, designated ASI 20, is much less concentrated on the larger blue-chips than the original.

A 7 year data series was obtained, and at least for the period under analysis, the main conclusion is the ASI 20 did not underperform the PSI 20 in a statistically significant way. It did achieve a slightly better risk-adjusted return over the full period, driven by the outperformance of smaller capitalization stocks, which may not persist over time, but the fundamental point is that the compliance with the applicable rules did not implicate underperforming the PSI 20 index, thus negating the common objection put forth by fund managers, that the PSI 20 is not a fair benchmark.

Contrasting the performance of all available mutual funds during this period against both benchmarks, we find that fund managers do not come out any better when measured by the improved benchmark we introduce. No statistical evidence exists of abnormal returns when measured with Jensen's Alpha, with non-significant alphas, that nevertheless pointed to fund underperformance, and little change in terms of reward-to-volatility. There was only one case where positive results were observed across all the measures used, so the efficient markets hypothesis is not meaningfully challenged by these results, for the group of managers as a whole.

One of the limitations of this study is that we relied on Microsoft Excel for optimization of the index portfolio with the Sharpe Ratio as criteria. A more powerful algorithm could yield other compositions. Another limitation is the relatively short study period. For example, it could be interesting to specifically test performance during recessions, as some studies have found outperformance under such circumstances. At this time, we have only one such period, so that is not a feasible test.

As for future work, the obvious step would then be to increase the scope of the current study, by generating a longer data series, which in turn could enable a deeper analysis.

It would also be interesting to study the feasibility of incorporating into the index composition rules factors such as book-to-market ratios or momentum, as it is already done in some market indexes, even though the small universe of investable equity would be a challenge.

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A. Appendix

Table A-1: Portuguese Equity Mutual Funds

| Fund | Management Entity | Abbreviation | Global Cost Rate ¹ | Net Asset Value ² (July 2004) | Market share (July 2004) | Net Asset Value ² (July 2011) | Market share (July 2011) |
|--|---|--------------|-------------------------------|--|--------------------------|--|--------------------------|
| FUNDO DE INVESTIMENTO MOBILIÁRIO ABERTO SANTANDER ACÇÕES PORTUGAL | Santander Asset Management - Sociedade Gestora Fundos Investimento Mobiliário, SA | Santander | 2,01% | 72,05 | 23,13% | 77,23 | 35,14% |
| MILLENNIUM ACÇÕES PORTUGAL - FUNDO DE INVESTIMENTO ABERTO DE ACÇÕES NACIONAIS | Millennium BCP Gestão de Activos - Sociedade Gestora de Fundos de Investimento, SA | Millennium | 2,03% | 87,68 | 28,14% | 49,80 | 22,66% |
| CAIXAGEST ACÇÕES PORTUGAL - FUNDO DE INVESTIMENTO MOBILIÁRIO ABERTO DE ACÇÕES | Caixagest - Técnicas de Gestão de Fundos, SA | Caixagest | 2,02% | 81,49 | 26,16% | 36,40 | 16,56% |
| BPI PORTUGAL - FUNDO DE INVESTIMENTO ABERTO DE ACÇÕES | BPI Gestão de Activos - Sociedade Gestora de Fundos de Investimento Mobiliário, SA | BPI | 1,29% | 16,14 | 5,18% | 28,35 | 12,90% |
| ESPÍRITO SANTO PORTUGAL ACÇÕES - FUNDO DE INVESTIMENTO ABERTO DE ACÇÕES NACIONAIS | ESAF - Espírito Santo Fundos de Investimento Mobiliário, SA | ES | 2,29% | 26,02 | 8,35% | 11,45 | 5,21% |
| ALVES RIBEIRO - MÉDIAS EMPRESAS PORTUGAL - FUNDO DE INVESTIMENTO MOBILIÁRIO ABERTO DE ACÇÕES | Invest Gestão de Activos - Sociedade Gestora de Fundos de Investimento Mobiliário, SA | AR | 0,91% | 8,71 | 2,80% | 6,03 | 2,74% |
| FUNDO DE INVESTIMENTO MOBILIÁRIO ABERTO BARCLAYS PREMIER ACÇÕES PORTUGAL | Barclays Wealth Managers Portugal - SGFIM, SA | Barclays | 2,05% | 12,51 | 4,02% | 5,84 | 2,65% |
| BANIF ACÇÕES PORTUGAL - FUNDO DE INVESTIMENTO MOBILIÁRIO ABERTO DE ACÇÕES NACIONAIS | Banif Gestão de Activos - Sociedade Gestora de Fundos de Investimento Mobiliário, SA | Banif | 2,05% | 6,95 | 2,23% | 4,72 | 2,15% |
| Total | | | 311,56 | | 219,81 € | | |

Note1: total fees applied to the fund relative to average Net Asset Value, over a 1-year period

Note 2: values in millions of euros

Table A-2: Mutual Fund Performance

| Fund | AR | Banif | Barclays | BPI | Caixagest | ES | Millennium | Santander | Average |
|---|---------|---------|----------|---------|-----------|---------|------------|-----------|---------|
| Total return | 15,72% | 2,26% | -6,32% | -11,82% | 9,86% | 16,66% | -8,49% | 20,49% | 38,36% |
| Annualized return | 2,11% | 0,32% | -0,93% | -1,78% | 1,35% | 2,23% | -1,26% | 2,70% | 0,59% |
| Anualized Standard Deviation of Monthly Returns | 21,29% | 20,64% | 21,67% | 20,55% | 20,55% | 20,60% | 20,18% | 21,82% | 20,90% |
| Sharpe Ratio | -0,0512 | -0,0312 | -0,0461 | -0,0041 | -0,0597 | -0,0159 | -0,0023 | 0,0052 | |

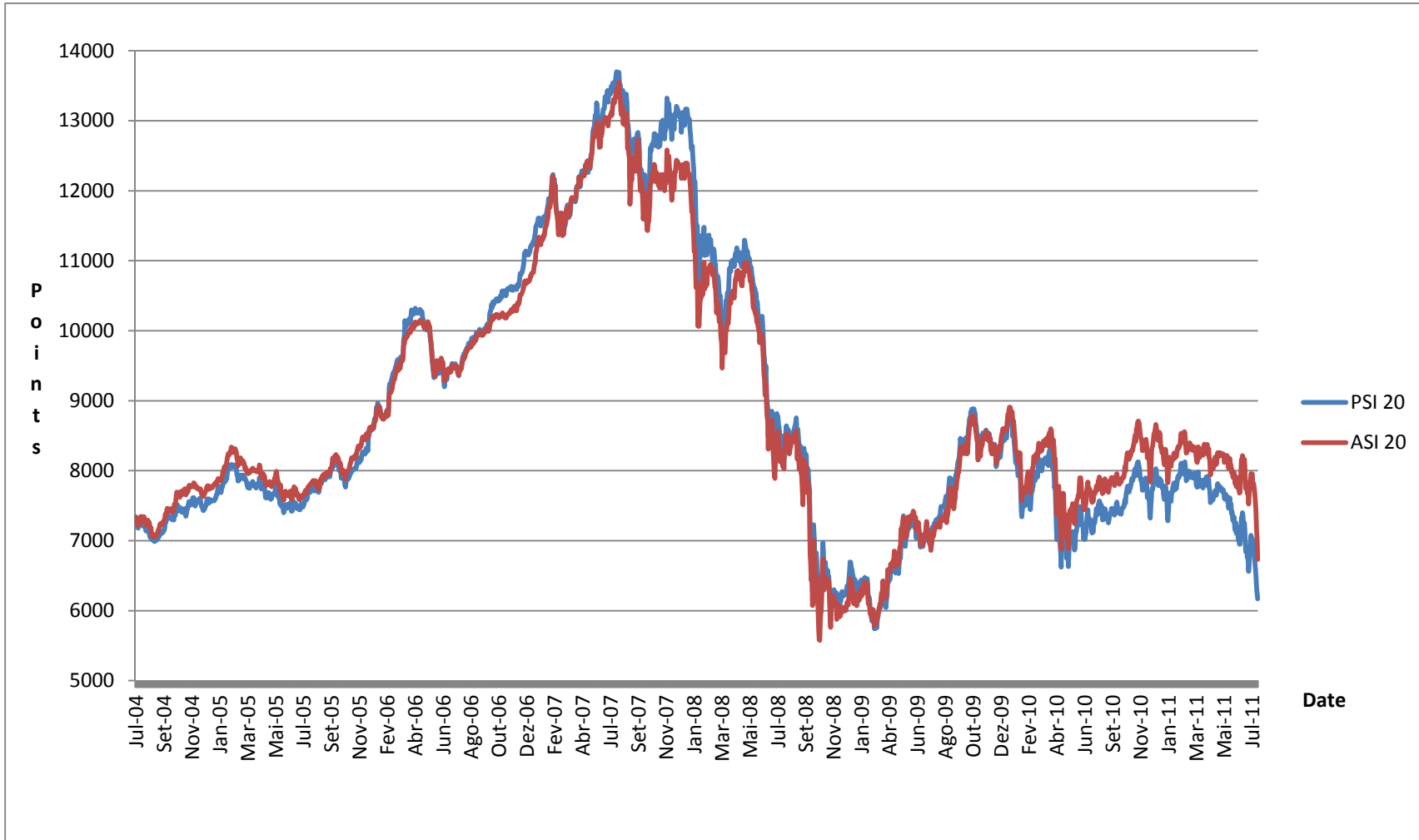


Figure A-1: Comparison Over Time