Jumping over a low hurdle:
Personal pension fund performance

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Abstract

This paper provides a comprehensive analysis of the short- and the long-term performance of private pension funds and their Primary Prospectus Benchmarks (PPBs). The study covers 8,255 personal pension funds from across all 30 ABI investment sectors that operated in the UK in the 1980-2009 period. Of these, 4,531 pension funds are compared against their PPBs. We find convincing evidence that pension funds lack long-term performance targets. The existing PPBs are easy to outperform given that funds are allowed to diversify in assets not included in their PPBs, and the PPBs have a poor long-term performance against T-bills. We discuss policy implications of our findings.

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"Wealth Manager 1: Last year was easy for us wealth managers...

Wealth Manager 2: Yes. Equities looked risky so we put our clients' money on deposit in the bank meaning we got paid fees for doing nothing ….. but since then stock markets have powered ahead and interest rates on bank accounts have dwindled to almost zero, ….. so this year we're back to actively investing our clients' funds. One's got to bear in mind that cash in the bank now earns so little that once you factor in inflation the returns on it are negative…

Wealth Manager 1: Indeed, which makes it a handy benchmark to compare our investment performance against; One we can easily be seen to beat…"

Transcript from Alex Cartoon
The Daily Telegraph, Business Section, May 1, 2013

1. Introduction

The above transcript is taken from a daily U.K. cartoon, Alex, which basis its humour on portraying the selfish and cynical attitudes of fund managers in the City of London. The cartoon depicts the important issues faced by investors depositing their savings with wealth management companies, i.e., how is performance measured, are performance targets appropriately set, are savings really performing?

These questions are particularly important for pension investments. This is, in part, because the reforms undertaken by numerous governments to induce personal responsibility of individuals for old-age provision, combined with the steady move of the pension industry towards an asset-backed structure and defined contribution nature of the pension investments, make ordinary investors vulnerable to low income at retirement. The scale of vulnerability is further magnified by the fact that many pension contributors cannot be expected to have the basic financial knowledge necessary to actively monitor the performance of their pension investments (van Rooij et al., 2011). The additional difficulty is also imbedded in the long-term nature of pension savings. As long-term commitment to saving is difficult (Phelps and Pollak, 1968), so can commitment to long-term monitoring.

In the light of this, setting benchmarks that are challenging for fund managers and informative for contributors is important. The European Commission's steps towards treating benchmark manipulation as a market abuse offence and subject to

administrative fines are an example of recognition of the importance of the issue.[2] While the eyes are fixed on manipulations of LIBOR and EURIBOR, which is more serious and criminal, inappropriate benchmarking of pension investments may also cost individuals and governments vast amounts of money. While the EU is calling for greater scrutiny, institutional investors (including pension funds) are "calling for a shift away from benchmark-centricity, and in favour of a less constrained, more dynamic process that allowed managers greater freedom in portfolio construction" (IMA, 2013). Although, there may be some arguments for giving pension fund managers more flexibility, it is not clear that the existing benchmarks are a real constraint, or even a challenge.

The importance of choosing the right benchmark for comparative purposes has been well recognised in the finance literature (e.g., Jensen et al., 1972; Modigliani and Pogue, 1974; Blume and Friend, 1975; Roll, 1977; Roll and Ross, 1994; Ferson et al., 1999). However, the performance of benchmarks has not been paid much attention to even though it is well recognised that the choice of investment strategies and their consequent success may heavily depend on targets laid for asset managers. When there is no information about portfolio holdings of individual pension funds and performance targets imposed on managers, studying the performance of benchmarks and funds in relation to these benchmarks can provide a valuable lesson. It can inform on whether pension funds' investments are long-term orientated (as contributors would wish for), or whether they are focused on delivering good short-term performance (as a manager's career concern argument would suggest). This paper is the first one, to our knowledge, to discuss whether benchmarks used by pension funds are right and informative for contributors, and how pension funds perform in relation to these benchmarks. It is also first to study a wide range of pension funds' investment styles to provide a comprehensive picture of performance and investment practices. Studying a broad spectrum of investment styles is important if one wishes to understand retirement saving opportunities. It is common to perceive pension investments as a combination of more risky (equity) and less risky (bonds) assets of which composition in a pension portfolio changes with age of contributors. Therefore, the assessment of the performance of non-

[2] In September 2013, the European Commission passed proposals making the manipulation of benchmarks a market abuse offence subject to strict administrative fines (see MEMO/13/774).

equity funds is vital if one wishes to understand the state of the pension industry and contribute to a regulatory debate on improving its performance.

In total, we analyse 8,255 private pension funds across 30 different investment styles (classification according to the Association of British Insurers, ABI) over the 1980-2009 period.[3] For 4,531 of these funds we identified their Primary Prospectus Benchmarks (PPBs), i.e., benchmarks chosen by funds for advertisement purposes, in communication with existing contributors and to assess pension fund managers' performance.[4] This allows for comparison of fund and benchmark performance for a significant fraction of private funds offered to UK investors.

The choice of performance measures is fundamental for the analysis. The performance of funds and benchmarks is measured by the difference of funds/benchmark returns and of returns earned by T-bills, and by the Sharpe ratio (Roy, 1952; Sharpe 1966), respectively. The performance of funds in relation to their benchmarks is also assessed in nominal and risk adjusted terms. That is, we use the difference of returns earned by funds and benchmarks, and the Modigliani-Modigliani (M^2) measure (Modigliani and Modigliani, 1997).

There are several reasons to use these measures rather than asset pricing based evaluations (e.g., Jensen's alpha). First, we need a method of performance evaluation for both the funds and the PPBs. Calculating Jensen's alpha would require a clear specification of the market portfolio. However, given that many of the PPBs are traditionally used as proxies for the market portfolio (i.e., the FTSE index is a common performance benchmark of funds specialising in UK equities), it would notbe informative to assess their performance against themselves. Moreover, it may not be even sound to use the PPBs as the proxy for the market portfolio for funds. To illustrate the argument let us consider funds specialising in UK equity. These funds are benchmarked to the FTSE All Share index or its sub-indexes. According to the ABS classification, funds are classified as UK Equity when they invest at least 80% of their assets on the London Stock Exchange. This means that UK Equity funds can invest up to

[3] In the UK, occupational pension provision has a longer history than state pension. Individual cases of an early form of occupational pensions have been recorded in the 13th and 14th centuries, although the first funded occupational pension was set up in 1743 to provide for widows of the Church of Scotland ministers. Personal pension plans were set up by the 1986 Social Security Act and became available from July 1988. In 2001 the Welfare Reform and Pensions Act 1999 introduced stakeholder pension schemes.

[4] We write short-term and long-term in inverted commas, because some funds in our sample operate for a short period only. To simplify notation in the rest of the paper we refer to the performance based on annual averages as 'short-term' and on compounded returns as 'long-term'.

20% of their assets outside the London Stock Exchange and still be classified as UK Equity funds. Consequently, using the FTSE index as a proxy for the market portfolio would violate one of the fundamental properties of the market portfolio, i.e., funds' portfolios consist of assets not included in the FTSE index, and results in highly inaccurate estimates of performance (as documented by Comer et al., 2009, for US hybrid mutual funds).

Another argument against using asset price based performance valuation measures stems from the need to assess the short-term and the long-term performance of the funds and their PPBs. The distinction between the short-term and long-term performance is potentially very important, as it may allow assessment of suitability of benchmark choices, and therefore, investment strategies from the perspective of asset managers and of contributors. It is common in the finance literature to use log-returns as a convenient way of dealing with the fact that asset pricing models are constructed on (arithmetic) averages while we are interested in total (i.e., compounded) returns. Log-returns make switching between average and total returns easy. However, log-returns are not used in communication with contributors or in assessment of asset managers' performance. Therefore, to maintain the realism of the analysis, it is important to use arithmetic returns as the base for performance assessment. This, however, is not informative about the long-term performance. Even more, given that the arithmetic average is never below the geometric average of a given time series, using performance measures based on arithmetic averages may create a spurious effect of good performance if short- and not long-term investment strategies are in place. It is also important to keep in mind that long-term strategies may not be characterised by short-term gains (Campbell and Viceira, 2002; Cochrane 2013), so if pension funds are true long-term investors assessing their performance using the asset pricing based method with arithmetic returns may deliver an unfair and biased picture. Finally, it is important to distinguish between the long-term and the short-term performance to fully understand whether benchmarks create the right performance incentives. Even if fund managers' remuneration and promotion depends on short-term outperformance of benchmarks, and this is achieved, it does not automatically mean that funds are characterised by good long-term performance which, naturally, would be the desire of contributors.

Understanding of the fund-benchmark performance relationship of the UK personal pension funds has far reaching implications for the development and performance of the

personal pension industry in the UK and overseas. Given that investments of the British pension funds are subject to prudential rules, i.e., they are not constrained by tight investment restrictions (like, for example, those in many emerging markets), fund performance can be attributed to asset management practices rather than overzealous regulations. Therefore, studying the performance of the British personal pension funds helps understand the role of benchmarks as performance incentives. Understanding of such incentives is vital given a fast growing pace of adoption of define contribution pension schemes around the world, and the increasing reliance on benchmarks as the incentive and monitoring mechanisms.[5] Lessons learnt from the British experience are important for pension regulators in the UK, other developed and emerging markets.

We postulate that if the PPBs assigned to the pension funds are challenging, then pension funds' long-term performance measured against the T-bills (our proxy for the risk-free rate) should be better than when measured against the PPBs. This outperformance may not be observed, however, in the short run. If fund managers are focused on delivering good short-term (annual) performance, we should find some evidence that pension funds outperform their PPBs, but given that the desire to outperform the PPBs ties pension funds' short-term risk-return characteristics to those of the PPBs, pension funds may not be able to statistically outperform low volatility T-bills on an annual basis. That is, while the analysis of short-term performance informs on the ability of pension managers to meet PPB-set targets, it is the long-term performance analysis that can inform whether the PPBs are tough or easy benchmarks and whether pension investments deliver desired long-term performance.

We find that the pension funds of all investment styles outperform their PPBs in the long- and in the short-run, i.e., when returns are measured as the geometric and the arithmetic means, respectively. We argue that this superior performance results from expanding pension portfolios for assets not included in their PPBs. We also document that funds are not so good at outperforming T-bills in nominal and risk adjusted terms on an annual basis. Indeed, only funds specialising in emerging markets equities have statistically positive Sharpe ratios. This result is preserved when the analysis is restricted to 1980-2007. In the long-run, however, the picture is more optimistic. Here,

[5] The importance of using the right benchmark has been long debated in the literature (e.g., Lakonishok et al., 1992; Blake et al., 1999; Dor and Jagannathan 2005; Chan et al., 2009). Prospectus benchmarks have also been used by Sensoy (2009) in a study of mutual funds' performance. Non-benchmark evaluations have also been proposed to mitigate problems with inappropriate benchmarking (e.g., Grinblatt and Titman, 1993).

funds of all investment styles save for those specialising in UK equity have statistically significantly positive excess (geometric) returns and Sharpe ratios. These results are largely confirmed when the financial crisis period is excluded from the analysis. The biggest difference is detected for the UK Equity funds, who this time outperform T-bills and have statistically significant Sharpe ratios, and fixed income funds, who on average perform worse than T-bills in nominal and risk adjusted terms. We also show that PPBs are not challenging benchmarks. Their geometric and arithmetic returns compare poorly against equivalent returns of T-bills except for those of the PPBs used by funds specialising in emerging markets. Moreover, there is some evidence that the outperformance of these 'low-hurdle' benchmarks may result from funds investing in assets other than those used to construct their benchmarks rather than superior investment skills of managers.

These results have important implications for future research, pension contributors and policy design. In addition to providing the first rigorous assessment of the performance of the personal pension industry in the UK, the research directs our attention to the complexity of the assessment of performance and the importance of the choice of performance benchmarks. The research documents the potentially misleading role of the existing benchmarking practices for achieving good long-term performance. It seems that the existing benchmarks are far from being optimal long-term performance targets, and, in addition, are easy to beat even in the short-run. This brings to the fore the question of greater scrutiny of the process of opening new pension funds and monitoring their subsequent performance.

The rest of the paper is structured as follows. Section 2 summarises the literature and provides the theoretical base for the empirical analysis. Section 3 describes the dataset. Section 4 defines returns and performance measures used in Section 5, which presents and discusses the results of the regression analysis. Section 6 concludes and outlines a few directions for future research.

2. Brief literature review

Assessing how the pension industry evolves, develops and performs is important for both regulators and funds themselves. On one hand such assessment is crucial in

evaluating the existing regulatory regimes and investment practices to inform the directions and scale of future reforms. On the other hand, fund managers' remuneration and, potentially careers, may hinge on how funds perform and how the industry develops. All this is stimulated by the rapid process of the industry becoming asset-backed.

In contrast, the academic world has been more focused on assessing the performance of the mutual fund industry than of the pension fund industry. To some extent this can be explained by the fact that US based studies dominate the field, the US mutual fund industry is the biggest in the world ($13 trillion AUM in 2012; ICI, 2013), and, as a survey by Investment Company Institute shows, 94% of 52.3 million American households investing in mutual funds treat these savings as retirement financing (ICI, 2011).[6] Outside the US, however, the mutual fund industries are typically substantially smaller than the corresponding pension fund industries, and their share in retirement savings is not so vast. For instance, in the UK the funded pensions industry is twice as big as UK mutual funds with $1.9 trillion of AUM, against $0.85 trillion of the mutual funds (ICI 2012).

Moreover, being less regulated than the pension fund industry, the mutual fund industry offers rich material to assess the investment skills of fund managers (e.g. Henriksson, 1984; Coggin et al., 1993; Daniel et al., 1997; Bollen and Busse, 2005; Cohen et al., 2005; Cuthbertson et al., 2008; Fama and French, 2010), to test for potential departures from the EMH (Brown and Goetzmann, 1995; Elton et al., 1996, 2001, 2011; Carhart, 1997; Blake and Timmermann, 1998; Davis J.L., 2001; Bollen and Busse, 2005; Cuthbertson et al., 2008; Huij and Verbeek, 2009;), and to examine the practices of wooing investors (Cooper et al., 2005; Massa, 2003; Sensoy, 2009; Aydogdu and Wellman, 2011). These dynamics and the ease with which individual investors may terminate investment or switch between mutual funds, if unhappy with their performance, seem to make the research on mutual funds' capital flows and investment strategies appealing. In contrast, pension funds may appear less vibrant as there seems to be little 'switching' of contributors between funds and providers, providers are more regulated, etc. The more 'static' nature of the pension industry might also result from the selection bias of its participants. While investing in mutual funds

[6] Novy-Marx and Bauh (2011) estimate that the present value of employee pension liabilities in the US varies between $3.2 trillion and $4.43 trillion.

may require some financial savvy and a conscious decision on the part of a contributor, participation in pension saving programmes is often by default, or even compulsory, so it can be expected that the characteristics of participants and their ability to and interest in shifting funds from one fund to another may be very different.

So even though the pension industry is no smaller than the mutual fund industry, there seems to be much less research devoted to assessing its performance and development. There also seems small variability in the conclusions reached, i.e., empirical evidence consistently shows that pension funds' performance is rather poor (e.g., Ippolito and Turner, 1987; Lakonishok et al., 1992; Ambachtsheer et al., 1998; Blake et al., 1999 and Blake et al.; 2002), and pension funds' managers are not particularly skilled (Coggin et al., 1993; Browm et al., 1997; Blake et al., 1999; Thomas and Tonks, 2001).

It is interesting to note, however, that all the existing empirical assessment of the pension industry is conducted using the same statistical and econometric methods that are used for assessing mutual fund performance. This is surprising because the nature of investments of mutual and the pension industries should be very different with mutual funds being short-term orientated, and pension funds being expected to invest with long horizon objectives. Moreover, theoretical studies convincingly show that even within the mean-variance framework long-term and short-term optimal portfolios do not have to be the same, and, consequently, short-term performance of long-term optimal portfolios may be quite unflattering, even if their long-term performance is good. Campbell and Viceira (2002) summarise and further develop prior theoretical research on optimal allocation between low-risk and high risk-assets for long-term investors. However, their analysis is more suitable for retirement-planning households, rather than pension providers. While it makes sense that "households should be willing to invest heavily in risky financial assets in early adulthood, but should scale back their financial risk taking in late middle age" (Campbell and Viceira, 2002), this may not be a particularly constructive advice for asset allocation for pension providers who hold portfolios across households at various stages of saving life, or provide funds of particular profile (e.g., fixed income funds or emerging markets equity funds).

Cochrane (2014) provides a multi-period generalisation of the classical one-period mean-variance portfolio theory that is more applicable for institutional investors' optimal portfolio allocation than the framework provided by Campbell and Viceira

(2002). Given that pension funds can be perceived as investors without outside income, following from Cochrane (2014), their long-term mean-variance optimal allocation will be determined by the long-run mean-variance frontier and indexed perpetuity. In addition, if pension funds specialise in particular asset class, e.g., domestic equity, their long-term optimal allocation will be restricted to the market portfolio on the long-term mean-variance frontier, because the asset class specialisation will not allow pension funds reduce risk by investing in the indexed perpetuity. In this regard, pension funds will invest like an average investor. Therefore, whether we discuss one-period or multi-period optimal allocation of pension funds, our eye is still on the tangency point of the frontier, even if the one-period and the multi-period frontiers can be very different.

3. Optimal portfolios and performance of pension funds

The Intertemporal Portfolio Theory by Cochrane (2014) is fundamental for our understanding of how to assess performance of pension funds. An individual investor, even if she has outside income (e.g., from labour) and can hedge, still constructs her optimal asset allocation using the long-run mean-variance efficient payoff, which in turn is the allocation point of long-term investing pension funds (as investors without outside income. The investor can construct the long-term efficient portfolio herself, or outsource it to pension funds. However, for this to work, it is vital that pension funds are long-term investors. Hence, the fundamental questions are: (i) do pension funds invest in long-term optimal portfolios? (ii) do they perform well over the long-run? and (iii) are they given long-term incentives?

Without knowing exact asset allocation of pension funds it is impossible to construct and compare short-term and long-term frontiers. Yet, using simple examples we show that the performance analysis of the existing pension funds' portfolios can inform in the debate whether pension funds are likely to have short-term or long-term investment strategies.

3.1 Short-term performance of long-term investments

At retirement, contributors' wealth heavily depends on the total amount of money accumulated on retirement accounts. Therefore, let us assume that the compounded return of all periodical returns over the period of investment is what contributors care for. Let us also assume that there is a set of assets for which the mean-variance frontier is shown in Figure 1 (thin solid line).[7] To focus our attention let us assume that these are annual statistics. The market portfolio, M_A, corresponds to a given risk-free rate of return, R_{free} (or indexed perpetuity, if the frontier was determined by a multi-period decision process). Now, let us assume that for each asset we calculate its total compounded return, as we are interested in the total return. If we now annualise these total returns, to make them comparable with the annual (arithmetic) means used to derive the frontier, we obtain a geometric average return for each asset which can be used to plot another frontier (bold solid line in Figure 1). Even if the total return earned on a given portfolio is smaller than its compounded return (assuming that reinvesting is allowed), its arithmetic mean return is never smaller than the corresponding geometric mean return. Moreover, the difference between the average arithmetic mean return and the geometric mean return increases with the volatility of the returns. Therefore, the arithmetic mean frontier lies above the geometric mean frontier and the distance between them increases with risk, as Figure 1 shows. In other words, the geometric mean frontier is below the arithmetic one, and is flatter.[8] Consequently, the market portfolio of the geometric mean frontier, M_G, has higher risk than M_A, and its arithmetic mean return, M_{GA} is higher than the return of M_A. In other words, the total-return optimal allocation outperforms the annual-average optimal allocation in nominal terms but not in risk adjusted terms when performance analysis is based on arithmetic mean returns. Therefore, if pension funds are long-term investors with an objective to track a long-term optimal portfolio (such as M_G), assessing their performance using a (arithmetic) mean-variance optimal portfolio (such as M_A) as a benchmark will give a

[7] At this point it does not matter whether the frontier results from one-period or multi-period investment strategy. We take the mean-variance frontier as determined by (whichever) strategy and look at consequences of using compounded returns rather than mean ones.

[8] For instance, if the returns were normally distributed $R_G = R_A - 0.5\sigma^{2,}$ where R_G is the geometric mean, R_A is the arithmetic mean, and σ^2 is the variance.

biased and unjust picture. Performance should be assessed using the true benchmark and true investment horizon.

********** insert Figure 1 here **********

Private pension funds operating in the UK have clearly specified benchmarks (PPBs). It is not however clearly stated the time period over which the performance of the funds and their benchmarks is to be assessed over. PPBs are set as a reference point for contributors, therefore, they should be perceived as long-term targets. If such, the compounded returns should be used to measure the performance of funds in relation to their PPBs. However, PPBs are used in periodical reviews (quarterly, annual) of pension funds' and managers' performance, and therefore, are treated as a short-term performance benchmarks. Therefore, the performance analysis should also include arithmetic returns.

The analysis of the long-term performance, in addition to a conventional assessment of funds' ability to track their benchmarks on an annual bases, may shed some light on whether fund managers rest on tracking their PPBs in the short-run, or whether they try to be a bit more long orientated, and invest in portfolios that may be more optimal in the long-run. If pension managers just track their PPBs, and succeed in doing so, we can expect that the risk of the pension funds will be similar to that of their PPBs. If, however, the pension funds try to invest in long-term optimal portfolios, the risk of the pension funds may be higher than the risk of PPBs. Obviously, the fact that the risk of the pension funds is higher than the risk of the PPBs is not a definite proof of the pension funds executing long-term investment strategies.

Finally, the analysis of the short-term and long-term performance of the PPBs is required to fully understand their position as PPBs. In other words, a separate question of whether the PPBs are challenging to start with comes to afore.

3.2. How to outperform the benchmark?

So far, for simplicity of argument, we discussed pension funds as 'trackers' of their benchmarks. However, it would not be fair to assume up front that pension fund

managers cannot beat their PPBs.[9] In a perfect world, the outperformance of the PPBs would be achieved by high investment skills, e.g., good selection, timing, etc. For instance, if one assumes that a PPB is the market portfolio (determined by a given risk-free asset), than it is not possible to create a portfolio with the Sharpe Ratio higher than the Sharpe ratio of the market portfolio if short-selling is not allowed.[10] The outperforming the PPB could occur when it 'slips' off the efficient frontier. However, past research suggests that managers are not particularly good at timing and taking advantage of such events (e.g., Henriksson, 1984; Coggin et al., 1993; Daniel et al., 1997; Bollen and Busse, 2005; Cuthbertson et al., 2008). The lack of evidence of timing and selection skills may also result from the fact that the major indexes hardly depart from the efficient position, and when they do, transaction costs of portfolio rebalancing are so high that offset potential efficiency gains.

Is there, therefore, no 'cheap' way to beat a PPB? Potentially, there is, even if the PPB has characteristics of the market portfolio. This can happen when managers invest in a broader set of assets than those defining the PPB. Figure 2 presents a simple illustration of how mangers could outperform their PPBs when they are allowed to invest in assets excluded from their PPB. Let us denote the risk-free rate of return as R_{free}, and the solid line represents the frontier based on all assets included in the PPB. For simplicity of argument, let us assume that the PPB is the market portfolio as defined by the mean-variance optimisation argument (it does not matter whether the mean is arithmetic or geometric). If the Sharpe ratio is the measure of performance, following the PPB allocation is best the fund can do (ignoring transaction costs). However, if funds are allowed to invest outside the PPB, then enriching their portfolios by assets that have low correlation with the assets included in the PPB expands the frontier, as shown by the dotted line.[11]

********** insert Figure 2 here **********

[9] At this point we do not discuss whether pension funds outperform benchmarks because they choose successful strategies to beat PPBs or whether the choice of PPBs is endogenous to a chosen investment strategy.

[10] We do not consider short-selling because in the UK there is legal ambiguity as to whether pension funds are allowed to engage in short-selling. Hence, in practice funds either don't short-sell or if they do, it is to a very small degree. Our data show that on average the short positions are below 0.1% of funds' AUM.

[11] Given that it is rather unlikely that perfectly negative assets will be included to the existed portfolios, and there is a restriction on how much of these 'non-PPB' assets can be added (max 20% according to the ABI classification), it is unlikely that the risk of this new, 'extended', portfolio can be reduced to zero, and the efficient frontier becomes a straight line.

Obviously, M is the best allocation point as measured by the Sharpe ratio. However, even if the Sharpe ratio is highest at M, it may not be optimal for pension funds to try to replicate its asset composition. If pension funds' managers are expected to track the PPB, the best strategy may be to try to create a portfolio along the line PPB-P. It will deliver a higher return for the same level of risk with point P representing the portfolio with the same risk as the PPB and the highest achievable return. It is important to note that, if it is not known what additional assets are added to the PPB-tracking portfolio the efficiency loses that arise as a result of investing in P rather than M cannot be assessed. On paper, pension investments perform better in nominal and risk-adjusted terms than their PPBs whereas, in practice, they are not even achieving their efficient position given their investment constraint.

4. Data

We have collected data for 10,086 funds operated by 63 providers using the UK Life and Pension database by Morningstar Direct™. For each fund we collected information about the fund's inception date, provider, classification of its investment sector according to the ABI, and monthly returns. We collected the information for all funds that opened between from January 1980 till December 2009. According to Morningstar, less than 5% of funds are missing at any given time so this database covers almost the entire personal pensions market. Across these funds we identified 515 different Primary Prospectus Benchmark (PPB). Information necessary to calculate the performance statistics of the PPBs was collected from DataStream. To calculate meaningful statistics we requested that there were performance data for at least six months. This reduced the total number of funds to 8,255. When the same restriction was applied to the PPBs the sample shrunk further.

Among 515 benchmarks 389 were individual market indexes and 126 were composite benchmarks. Most commonly we could not reconstruct benchmarks because the weights of composite indexes were not provided, and/or their names were not recognised by DataStream. In total, we succeeded in calculating returns for 369 PPBs corresponding to 4,531 funds, and for these, monthly performance over the period of the corresponding fund's operation was calculated. Therefore, in the rest of the paper two

samples are analysed: PPB-unrestricted and PPB-restricted, which refer to 8,255 funds with 515 PPBs and 4,531 funds with 369 PPBs, respectively. We discuss the basic properties of the PPB-unrestricted sample to document consistency of our findings for the PPB-restricted sample. Before, the performance of the PPBs and of the funds is discussed, a few words about the structure of the samples is required.

Each fund can be assigned to one of the 30 investment sectors according to the ABI classification. To simplify the analysis we grouped these ABI sectors into six investment styles: Allocation (ALC), Fixed Income (FI), Emerging Markets Equity (EM-E), International Equity (I-E), UK Equity (UK-E), and other (Other). Funds are classified as ALC if they invest in a mix of asset classes (e.g., 60% in equity of any category and 40% in FI). Other category is created out of the following ABI sectors: commodity/energy, money market, global property, UK property, specialist, and protected/guaranteed funds. These sectors are put together because there are relatively few funds in each of these categories (all together they form only 8.6% of the sample), and to focus our attention on the main investment styles. Details of the grouping are provided in Appendix 1. The ABI sector classification is based on the, so-called, primary investment focus. For example, a fund classified as I-E may still invest up to 20% of its assets outside its primary classification group i.e., I-E funds can invest in the UK-E, FI, EM-E, etc.

Figure 3 shows the numbers of funds in each of the six investment styles (with EM-E, I-E and UK-E combined into Equity) that opened in the period 1980-2009. The statistics for the first 20 years, i.e., the period of 1980-1999 are presented on a five-year basis, i.e., up to 2000 each bar represents the total number of funds opened in each five-year window. The statistics of the last ten years, i.e., 2000-2009 are annual. Figure 3 shows a strong increase in the number of new funds offered to the public after 2000. It also shows that the Equity funds are most numerous. In spite of the sharp decline of stock markets in 2008, many funds started to operate during this and the following year. In particular, 918 new Equity funds started to operate in 2008. This is the highest number of funds opened in a single year in the whole history of the personal pension industry in the UK. Given that the financial crisis (high stock market fluctuations, decline in economic growth, etc.) extended beyond 2008, and the sample ends in 2009, we treat these last two years with some caution. The effects of 2008-09 may be more pronounced in our dataset than other stock market and economic turbulences because the

high proportion of funds opened during and immediately before the crisis started. It is also possible that the initial years of a fund's operation have different characteristics from the following, 'more mature', years. Therefore, in addition to the whole sample of funds operating in the period 1980-2009 we consider a sub-sample of funds that opened in the period 2008-2009 and a sample of funds that opened in the period 1980-2007. The 2008-2009 sub-sample consists of 1959 funds of which 962 are the Equity funds (this is before matching with PPBs).

********** insert Figure 3 here **********

It is worth noting that the sharp increase in the numbers of offered funds after 2000 is not associated with an increase in the numbers of providers. At the end of 2009 there were 63 pension providers in the personal pensions market which is a moderate increase from 58 in 2000. Almost half of these institutions started offering personal pension funds in the 1980s and by the early 1990s 45 out of the 63 were already active.

********** insert Table 1 here **********

Table 1 shows how many funds and fund-year observations there are for each of the six investment styles with the EM-E, I-E, and UK-E grouped together in a category called 'Equity' in the total sample (Panel A), the PPB-unrestricted sample (Panel B) and the PPB-restricted sample (Panel C). It is clear that the Equity funds are by far the largest group accounting for about half of the operating funds. Within this category the I-E and UK-E are most numerous accounting for 28.4% and 19.9% of funds respectively. Most importantly, the representation of each investment style is very similar between the total sample (Panel A), and the PPB-unrestricted sample (Panel B). The PPB-restricted sample (Panel C) has a greater proportion of Equity funds, and a reduced proportion of ALC and Other styles. This reflects the difficulty in reconstructing composite PPBs for these groups. Table 1 Panels D and E show the statistics for the 1980-2007 sub-sample.

In addition, monthly time series of UK T-bills for the period 1980-2009 have been collected from DataStream. The T-bills proxy for the risk-free asset.

5. Definition of returns and performance variables

5.1. Short-term and long-term returns

From a contributors' perspective it is important how much money has been earned over the period of contribution, especially since pension funds, in contrast with other common forms of investment, make earlier withdrawals costly.[12] Given the reinvested nature of the pension investments the compounded returns are calculated to measure long-term performance. However, given that the operational lives of the pension funds included in the sample differ significantly (some funds operate for over 20 years, some for two years only), the 'long-term' returns are calculated as the annualised geometric mean of monthly returns, and are referred to as annualised compounded returns (ACRs). The annualised standard deviation of the monthly returns is used as a corresponding measure of risk.

Unlike contributors, fund managers may be more interested in short-term performance given that their performance and remuneration are typically reviewed on a short-term basis. To account for it we also calculate annual returns (ARs) as compounded monthly returns over each calendar year. If a fund operated for less than six months in a given calendar year (i.e., opened in a period July-December), these first few months are not included into the analysis. First year returns of funds opened between January-June are annualised. The focus is on annual (not quarterly) returns, because annual reports carry more weight than quarterly reports, to avoid further annualisation, and to minimise issues with time-series properties in the panel analysis.[13] Risk of the ARs is calculated as the standard deviation of monthly returns in the corresponding calendar year.

[12] Blake (2003) claims that if a personal scheme was terminated after only one year, a contributor might lose as much as 90% of his/her contributions.

[13] There are strong time-series properties (e.g., long memory) in the higher frequency data (e.g., monthly, and even quarterly) which raised a question on stationarity. We use yearly data, and consequently, a yearly panel. This gives first order autocorrelation in the residuals i.e. we have effectively "shortened" the memory effect.

5.2. Performance measures

The first issue is to define the risk-free rate of return. We use a UK T-bill rate as a proxy for it. We realise that short-term interest rates are not risk-free for long-term investments (e.g., because of uncertainty of reinvestment rates), but truly long-term investment rates are not available to 'ordinary' individual UK investors. Average retirement savings last about 40 years, with a further 20 years of cashing them through retirement, yet the supply of 40 years' bonds to individual investors is practically close to zero. Moreover, unlike in many countries in Continental Europe it is very rare for British individual investors to purchase government bonds. Therefore, although not totally risk-free, we compare pension funds' and PPBs' performance with 'rolling-over' investments in UK T-bills. More precisely, the excess return over the T-bill, hereafter denoted as R-Tbill is defined using annual and compounded returns. This measure, does not control for risk of any type, and therefore can be criticised for its simplicity. However, given that many investors may not understand the importance of risk adjustment and it is 'bare' returns that they appreciate, we include this measure in the analysis. We also calculate the excess returns for PPBs, later denoted as PPB-Tbill.

The second measure is the difference between the fund return and that of its PPB, hereafter denoted as R-PPB. This measure is not risk adjusted either, but provides a relevant comparison with the benchmark of the fund's choice.

The third measure is the Sharpe ratio, denoted later as SR, which has widespread applications in fund industries (Goetzmann et al., 2007; Eling, 2008; Antolin, 2008, Hinz et al., 2010) and directly adjusts funds' and PPBs' returns for their volatility and the risk-free rate. Given that T-bills are not totally risk free we also defined the Sharpe ratio using standard deviation of R-Tbills and PPB-Tbill for the funds and the PPBs, respectively (e.g., Lo, 2002). The results were practically identical which is consistent with the fact that the volatility of the annual fund and PPB returns is much higher than the annual volatility of the T-bills. We do not present these results, but they can be obtained from the authors on request.

The last measure is the M^2 introduced by Modigliani and Modigliani (1997). It adjusts the fund's return to the benchmark's risk. Although the M^2 is not without criticism (Goetzmann et al., 2007) it serves well as the direct risk-adjusted comparison of the fund performance against the performance of its PPB.

The distributions of the M^2 and the two Sharpe ratios have been 0.5% winsorized at both tails in order to deal with outliers for observations where the denominator was close to zero (Wilcox, 2005).

We step aside from the traditional asset pricing based methods of portfolio valuation for several reasons. First, they are not suitable for geometric returns (i.e., when long-term performance is being assessed). Second, there are no obvious market portfolios which could be used to evaluate the performance of the PPBS (e.g., often they are main market indexes themselves), and funds (e.g., because of the multi-asset class nature of pension investment, and because of high likelihood of investing in assets excluded from their PPBs), and it is impossible to construct them as Kothari and Warner (2001) postulate, given that the holdings of funds are unknown. Finally, to have a direct comparison of the short-term and the long-term performance of the funds and the PPBs, it was necessary to use the same assessment criteria for their geometric and average returns.

6. Performance evaluation

We start the analysis of the PPBs' and funds' performance from a quick look at the basic performance statistics. Table 2 reports the mean, minimum and maximum returns, as well as the standard deviations for funds, PPBs and T-bills. Panel A shows the statistics for annualised compounded returns (ACRs) and Panel B shows the statistics for the annual returns (ARs).

First, the statistics are shown for the PPB-restricted sample of 4,531 funds and the corresponding PPBs over the whole period of 1980-2009. When the financial crisis' years of 2008-2009 are excluded, the sample size declines to 3,383 funds (as funds opened in 2008-2009 are excluded). For this sub-sample we present the statistics for two periods: before the crisis (1980-2007) and during the crisis (2008-2009). Finally, to complete the picture we show the statistics for the funds opened during the financial crisis. To remain consistent with the notation, the ACRs are still referred to as long-term although they are calculated for maximum two years.

********** insert Table 2 here **********

Two observations are to be made based on Table 2 statistics. First, for every sub-sample and every period of consideration returns earned by funds are higher by about 2% than the returns earned by their PPBs while their risk, as measured by the standard deviation, are very similar. Although, based on these statistics it is impossible to assess whether the funds statistically outperform, it seems that pension funds managers are quite good at tracking the assigned PPBs.

The second observation may be a bit less optimistic. The short- and the long-term returns earned by the PPBs are typically lower than returns earned by T-bills except for ACRs earned by the funds opened during the financial crisis. Given that the PPBs are much more risky than T-bills, this simple comparison indicates that PPBs may not be a good investment, and therefore a rather 'low-hurdle' benchmark to contest.

To further illustrate the risk-return characteristics of the sample, Figure 3 shows the ACRs versus their corresponding standard deviations for the funds and their PPBs, separated for individual investment styles for the four combinations of the sub-samples and the periods as presented in Table 2.[14]

********** insert Figure 4 here **********

The separation into the investment styles shows that the statistics reported in Table 2 are not driven by any particular style. With an exception of the 1980-2007 period it is common for the funds of all the investment styles to have the higher average return than their PPBs but very similar risk, i.e., the diamonds indicting the location of the funds' averages are practically vertically above, and occasionally to the left of, the dots of the corresponding PPBs' averages.[15] The crisis period is no exception. Whether the funds are created before 2008 or after 2007 (Figure 3C and D) impacts on their average returns and risk (the younger funds are on average less risky and more profitable than the old ones), but not on their relative position against the PPBs. This means that judging with a

[14] We do not present the corresponding ARs graphs to save space. They are twin-similar to the presented ones.

[15] T-tests for the hypothesis that the population of the standard deviations of the funds and of their PPBs have the same mean could not be rejected for the entire sample and for all ABI investment styles but the FI and the I-E funds. However, although, on average, the I-E and the FI funds were statistically significantly more risky than their PPBs, the differences themselves were very small: σ(I-E) = 103.28% while $\sigma(PPB_{I-E})$ = 101.78%, and σ(FI) = 37.52% while $\sigma(PPB_{FI})$ = 34.66%.

naked eye, funds may statistically outperform their benchmarks in absolute and relative terms, i.e., fund managers beat the 'market' at a quite comfortable margin.

In contrast, the exclusion of the 2008-2009 period (Figure 3B) shows a more familiar picture, that is the funds earn, on average, higher returns but they also risk more (except for the FI funds). To gain further insight into the performance of the funds and of the PPBs we assess the statistical significance of performance measures defined in Section 4.2.

6.1. PPB performance

We start from discussing performance of the PPBs to answer the question of whether the benchmarks are challenging, or in other words, do they offer contributors positive returns if pension funds simply mimic their allocation?

We start the analysis from a series of simple regressions, i.e., for each of the six investment styles nominal returns (PPB-Tbill) and Sharpe ratios (SR) are regressed against a constant.[16] Table 3 Panel A shows the results for the ACRs (cross-section regressions) and Panel B show the results for the ARs (panel regressions) when the returns are calculated over the 1980-2009, the 1980-2007 and the 2008-2009 periods. The 2008-2009 period is not divided into young and old benchmarks because all the PPBs have been constructed based on indexes that existed before 2008.

********** insert Table 3 here **********

The results of Table 3 are quite surprising. One could expect that if funds have any say on what benchmarks they choose, they would pick up easy ones, but having benchmarks that practically do not perform better than T-bills does not seem fair on contributors. The only PPBs that systematically, and statistically, outperform T-bills are those chosen by funds investing in emerging market equity. Their performance measures

[16] All the cross-section regressions presented in the paper are clustered by provider to control for heteroskedasticity and the Hoechle method (Hoechle, 2007), which calculates Driscoll-Kraay standard errors (Driscoll and Kraay, 1998) for unbalanced panels, is used in the fixed-effects panel regressions to control for heteroskedasticity, autocorrelation, and spatial correlation.

based on ACRs are statistically positive over the whole period and when the years of the financial crisis are excluded. Also the PPBs of the funds investing in international equities statistically significantly outperform T-bills in 1980-2007, but the statistical underperformance during 2008-2009 results in statistically insignificant performance over the whole period under consideration. In contrast, the PPBs of FI funds tend to statistically underperform T-bills except for the 2008-2009 period during which the T-bill rate was kept very low.

The lack of statistical significance reported in Table 3 Panel B can be expected given that the PPBs are typically more risky than T-bills. However, the statistically significant underperformance of the FI benchmarks may be of concern. The FI PPBs have relatively low risk (see Figure 3), and among all the investment styles can be expected to be closest to T-bills in their risk-return characteristics. Yet, they statistically significantly underperform. All this evidence suggests that the PPBs can hardly be classified as challenging.

6.2. Pension funds' performance

As for the PPB, we start the analysis of the funds' performance from running simple regressions for each of the six investment styles. This time we use all four performance measures: R-PPB and M^2 to compare the funds' performance against their PPBs', and R-Tbill and SR to compare it against T-bills. Table 4 Panels A and B show the results for the ACRs (cross-section regressions) and Panels C and D show the results for the ARs (panel regressions) over the 1980-2009 period. The results shown in Panels A and C are based on the PPB-restricted sample (i.e., 4531 funds), and Panels B and D show the results using the PPB-unrestricted sample (i.e., 8250 funds). Each panel shows the results for all the funds pooled together (ALL), and then for each investment style separately.

********** insert Table 4 here **********

First, it is clear that whether the PPB-unrestricted or the PPB-restricted samples are used the results are very similar when all the funds are pooled together (ALL), and when the sub-samples of the individual investment styles are analysed. The only exception is

the Other category for which the statistically significant outperformance of R-Tbills and of SR disappears once the PPB-unrestricted sample is used for the ACRs. They also have statistically significantly lower SR when the ARs are used. However, given that this group is a mix of very different kinds of funds, and the reduction of observations between the PPB-unrestricted and PPB-restricted samples is material (85% for AR and 70% for ACR), it is hard to interpret these results.

As postulated in Section 2.1, there are substantial differences between the estimates obtained for the ACRs and for the ARs. When the fund performance is measured by the ARs, on average, funds outperform their PPBs, i.e., R-PPB and M^2 are positive and statistically significantly different from zero at 1%. However, the constants estimated for R-Tbills and SR are statistically insignificant, although uniformly positive except for the EM-E funds which have statistically significantly positive SR (10% and 5% for the PPB-restricted and the PPB-unrestricted samples respectively), and outperform T-bills at 10% in the PPB-unrestricted sample. In contrast, the ACR regressions show that all investment styles, but UK-E, outperform both their PPBs and T-bills. The UK-E funds are the only investment style which does not statistically outperform T-bills in nominal and risk adjusted terms.

It is important to note that the lack of outperformance reported for the AR regressions for the R-Tbill and SR seems to be driven by the size of the estimated standard errors and not by the size of the coefficients. All the estimated coefficients are positive and similar to those estimated in the ACR regressions (although, slightly smaller as it geometric averages are never above arithmetic averages). For instance, the estimates of the R-Tbill coefficients for the ALL funds sample are 2.691 and 2.206 for the AR and for the ACR regressions respectively, yet the first coefficient is not statistically significant and the other one is at the 1% level. Clearly the difference is in the size of the standard errors. The lack of statistical significance of the average annual R-Tbills is driven by their high volatility, and given that the T-bill returns are quite similar across years, it is the volatility of R that results in the large standard errors and the lack of significance. At the compounded returns level, however, the volatility of R declines. The effect of compounding is strong enough to bring statistical significance to the estimated coefficient.

To explain this more formally, let us assume that a manager can create a portfolio, P, that earns a mean return of R_P, has the same risk as the PPB, i.e., $\sigma_P = \sigma_{PPB}$, and is

perfectly correlated with the PPB. But then, the difference R_P-R_{PPB} is statistically significantly different from zero for as long as $R_P \neq R_{PPB}$, because $\sigma_{P\text{-}PPB} = 0$. However, the comparison of R_P and R_{free} may not be statistically significant. More specifically, $\sigma_{R\text{-}Rfree} = \sigma_P \neq 0$, and the corresponding t-statistic, $\sqrt{N}(R-R_{free})/\sigma_P$, may not be greater than the corresponding critical value for the Student's distribution with 2N-2 degrees of freedom when the portfolio returns are highly volatile (N denotes the number of observations).

The assessment of the long-term performance is a slightly different story. The comparison of the long-term (compounded) returns is undertaken in a cross-section of funds. Here, if funds' investments are similar (and there is a substantial literature documenting herding among fund managers), there may be relatively low variability across funds and therefore, more statistical significance. To see that let us assume that all funds are created at the same time and benchmarked to the same PPB. Moreover, if all managers have the same objective in mind to create a portfolio that has the same risk as the PPB with a slightly higher return and vary a little in what assets they add to the basic portfolio that defines their fund's ABI investment style, then it is very likely that the variability of R_P-R_{PPB} across funds is small. This would result in high statistical significance of the results. Similarly, the same argument would apply to the comparison of R_P and the risk-free rate, i.e., for as long as there are substantial similarities across funds in their investment practices, statistical significance of the results can be expected.

Adjusting for risk to obtain Sharpe ratios and M^2 preserves the argument, especially if the funds and their PPBs have similar risk. That is, we observe statistical evidence that in the short-run funds are good at beating their PPBs but are not good at earning the risk-free rate, while in the long run there may be statistical evidence of both outperformance of the PPBs and R_{free}.

6.3. Investment skills or out of PPB diversification?

In Section 2.1 we postulated that outperformance of the PPBs could be achieved by skilful investment strategies within the asset class of the corresponding PPB and/or investing in a broader asset class that defined by the PPB. The risk-return characteristics of the funds and of the PPBs, as presented in Figure 3A, suggest that it is rather likely

that out of PPB diversification contributes to outperformance reported in Table 4 as it is rather unlikely that, on average, major indexes be at 2% below efficient frontiers, which gives funds an opportunity to lie about 2% vertically above their PPBs. However, Figures 3B, C and D suggest that the diversification argument may not be the whole story. When the 2008-2009 period is excluded from the calculations, the relative position of the funds and of their PPBs changes. The funds earn higher returns but also are more risky (Figure 3B). The 'vertical' position of funds and PPBs characterises the 2008-2009 period only (Figure 3C and D), except for the EM-E funds which, on average, are less risky and more profitable than their PPBs. The 2008-2009 period is characterised by dramatic changes to values and constituencies of indexes, so temporary departures of some PPBs from an efficient (in the sense of frontier) position could occur, however, it is rather unlikely that inefficiency would characterise the PPBs over a long period of time. Therefore, although years 2008-2009 are interesting to study, it is the 1980-2007 that can shed some explanatory light on the issue of out of PPB diversification.

To complete the analysis Tables 5, 6 and 7 present results of regressions analogous to those presented in Table 4, but for different periods (the format of Table 4 is preserved). In particular, Table 5 is of interest as it covers a relatively long period of time. Moreover, during that period, as Figure 3B shows, the funds have more 'theoretically' sound characteristics, i.e., higher returns but also higher risk in comparison with their PPBs (e.g., the difference between the average annualised standard deviation of the UK-E funds (50.45%) is statistically significantly different at 1% from the average annualised standard deviation of the PPBs (46.25%)). If funds invest in assets of their PPBs only, and these PPBs are efficient, then, funds would not be able to outperform the PPBs if the Sharpe ratio is used as the measure of performance, although in nominal terms, the funds could outperform their PPBs. If, on the other hand, the indexes are inefficient, then, assuming that fund managers take a full advantage of this inefficiency, the maximum outperformance would be determined by a vertical distance between the efficient portfolio and a corresponding PPB. Any outperformance greater than that, could be attributed to out of PPB diversification.

********** insert Table 5 here **********

********** insert Table 6 here **********

********** insert Table 7 here **********

Results presented in Table 5 confirm that we cannot eliminate the diversification argument. The funds statistically significantly outperform their PPBs in nominal and in risk adjusted terms (i.e., M^2) both in the short- and in the long-run. The EM-E funds are the only exception as their long-term performance is worse than that of the PPBs (although this result is not statistically significant). The level of outperformance is also high. For instance, the UK-E funds, on average, outperform their PPBs (i.e., FTSE All Shares in 86% of cases, and the remaining cases sub-indices of FTSE) by 3.05% in nominal terms and 2.52% in risk-adjusted terms. The difference is too high to be justified by potential inefficiency of the FTSE index. Even if the FTSE does not satisfy all the theoretical assumptions of the CAPM market portfolio, it is rather unlikely that it is on average about 3% below the efficient frontier on which the market portfolio should sit.[17]

To further test the out of benchmark diversification hypothesis we calculated returns of a hypothetical portfolio consisting of 80% of the FTSE All Share index and 20% of an emerging market index. We used several MSCI emerging market indices commonly used as PPBs for EM-E funds. More specifically, we used MSCI Emerging Market index, MSCI Emerging Markets–Latin America, MSCI Pacific except Japan index, as well as MSCI indices for individual countries (Brazil, China and India). We used several periods of performance assessment. First we looked at the 2000-2009 period, as the longest period for which all these indices are available. Next we looked at two sub-periods, 2005-2009 and 2008-2009 to give some feel for robustness of our findings. Using these returns we evaluated the performance of our 80-20 portfolio in relation to the FTSE All Share index. The results for the ACRs are presented in Table 8.

********** insert Table 8 here **********

It is clear that our 80-20 portfolio outperforms the FTSE All Share index in nominal and risk adjusted terms for all emerging markets indices used to construct the portfolio

[17] If the FTSE index was that inefficient, it would invalidate research done thought the last decades which uses FTSE as the proxy for market portfolio.

and all sub-periods. Moreover, the level of outperformance is substantial and comparable with the performance statistics shown in Figure 3 and reported Tables 4-7 for the UK-E funds versus their PPBs. This means that the simple investment strategy of keeping 20% of the portfolio in one of the emerging markets' indices and the remaining 80% on the London Stock Exchange, would allow funds to maintain their UK-E classification, use the FTSE All Share index as the PPB, and yet, comfortably "beat the market". Therefore, this leads us to the conclusion that it is very likely that the UK-E funds invest some fraction of their AUM in assets other than stocks listed on the LSE, and this diversification outside the main ABI specialisation classification allows them to formally outperform their PPBs.

The other results presented in Table 5 confirm that pension funds statistically outperform T-bills in the long run but not in the short-run (as shown in Table 4). However, this time the UK-E funds statistically outperform and the FI funds underperform T-bills.

The results presented in Tables 6 and 7 show the dramatic impact of the financial crisis on the returns earned by the pension funds. The high volatility of financial markets has wiped out all statistical significance from the short-term statistics (practically all coefficients of the AR regressions are statistically insignificant, Panels B). However, as in the previous regressions, taking compounded returns restores statistical significance (Panels A). There are two issues that require a comment. First, there are substantial differences in the performance of the funds created before 2008 (Table 6) and those created in years 2008-2009 (Table 7). The funds created before the financial crisis lost lots of money during in the period 2008-2009 even though they managed to statistically outperform their PPBs. The better performance of funds created in the 2008-2009 period than funds created prior to 2008 is driven by the fact that many of these funds were created when the LSE and other major international markets were bouncing back in 2009, and therefore these 'young' funds have not suffered from huge loses of the late 2007- 2008. Interestingly, on average, the UK-E funds stick out again. Those created prior to 2008 (Table 6) have the highest underperformance against T-bills (-8.7% per annum). Even those created during the crisis (Table 7) struggle to outperform T-bills (R-Tbill is statistically significantly different from zero at 10%, and SR is the lowest among all the investment styles).

7. Summary and Conclusions

This paper provides a first comprehensive and large scale analysis of the performance of private pension funds and their Primary Prospectus Benchmarks (PPBs). The study covers 8,255 personal pension funds from across all 30 ABI investment sectors that operated in the UK in the 1980-2009 period. We succeeded in reconstructing returns of PPBs for 4,531 pension funds, and use these returns to assess (i) how challenging the benchmarks are and (ii) how the funds perform in relation to these benchmarks. The performance measured by ordinary excess returns over UK T-bills, over PPBs, as well as the Sharpe ratio and the Modigliani-Modigliani measure (M^2) are calculated for average annual returns and annualised compounded returns.

The results reveal that in contrast with the previous research, pension funds may be performing better than previously reported. We document that on average pension funds outperform their PPBs in nominal and risk adjusted terms both on an annual basis (short-term) and in the long-run (compounded returns). We also find that on average pension funds outperform T-bills (in nominal and in risk adjusted terms) in the long-run. On average, on an annual basis pension funds' compounded returns are 1.822% higher than those of T-bills with funds specialising in emerging markets equity earning as much as 14.807% above the T-bill rate. This means that if annual fees are about 1%-1.8%, contributors may still be left with a bit more than an investment in T-bills would deliver, unless hidden charges wipe out even those little 'excesses'.[18]

The short-term performance analysis based on annual returns shows that on average pension funds outperform their PPBs but do not outperform T-bills, except for funds specialising in emerging markets equity for which we obtain statistically positive Sharpe ratios. This is an important result. It shows that the analysis of the performance of pension funds using average annual returns may be misleading and even unfair. This is because if in the short-run pension funds target to be at least as good as their PPBs, i.e., to some extent mimic risk-return characteristics of their assigned benchmarks, then the lack of statistical significance of the annual excess returns will result from high risk differentials between the PPBs and the T-bills. However, in the long-run, i.e., when

[18] There is a growing pressure on pension funds providing define contribution schemes to disclose their full costs ("UK pension providers set to be forced to disclose costs", Financial times, 24 February 2014)

compounded returns over the period of pension fund's operation are accounted for, these differences in risk get diluted and pension fund performance in comparison with T-bills may improve in statistical terms. Therefore, only a long-term performance analysis can show whether pension funds, as long-term investors, earn positive excess returns or not.

The long-term analysis is also essential for assessing how challenging the PPBs are. Given that UK pension funds can diversify outside their PPBs may help them with little effort to deliver superior outperformance of their benchmarks on an annual basis. This would not be an issue itself if the long-term performance of the PPBs was good. However, if the long-term performance of the PPBs is poor, then outperforming them in the long-run may still make the pension funds look poor in comparison with T-bills. Our analysis shows that the compounded returns of the PPBs, before and after risk adjustment, do not statistically outperform T-bills, across all investment styles but emerging market equity and, to a weaker extent, international equity. This suggests that the PPBs are not a real challenge in the long-run, as they are not in the short-run. This seems to indicate that the pension funds are not given satisfactory long-term investment targets. Finally, the weak performance of funds specialising in UK equities strengthen the argument for international diversification and reduction of home bias of investments.

So what are the implications of this research? First, regulators should pay greater attention to what and how performance targets are set and communicated to contributors. This research shows that the current PPBs are not challenging both in the short- and in the long-run. Second, more attention should be paid to the long-term performance. It seems that the existing way of setting performance targets does not stimulate the long-term performance and does not communicate it to contributors. The short-term outperformance of the assigned benchmarks does not secure reasonable long-term returns on investments. Therefore, it seems that it is not a "shift away from benchmark-centricity" as postulated by fund managers (IMA, 2013) is needed, but much tougher long-term targets of performance.

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Figure 1. Arithmetic mean and geometric mean frontiers.

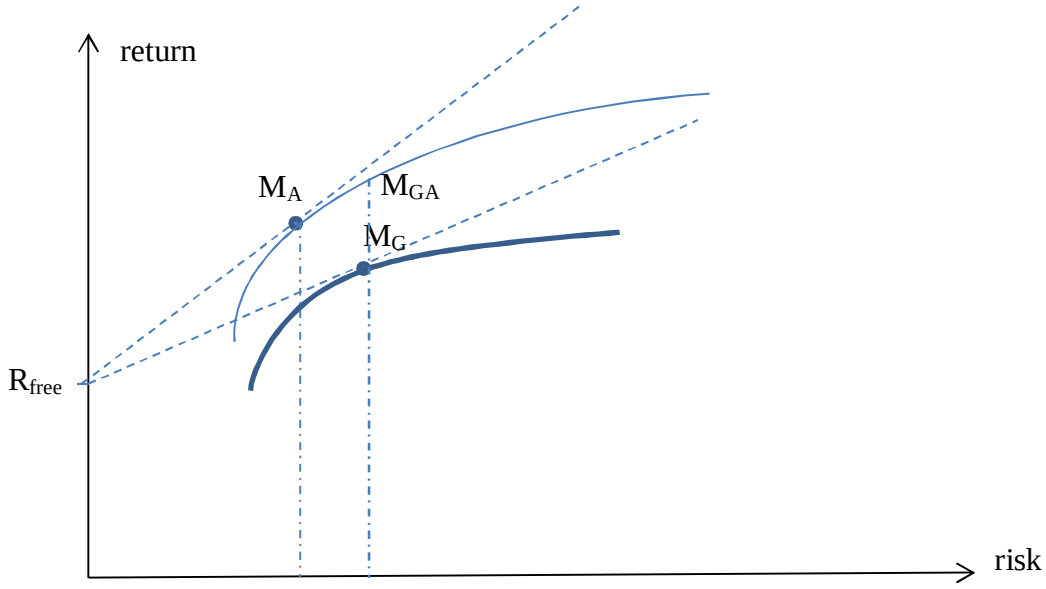


Figure 2. Expansion of a frontier when additional assets are included.

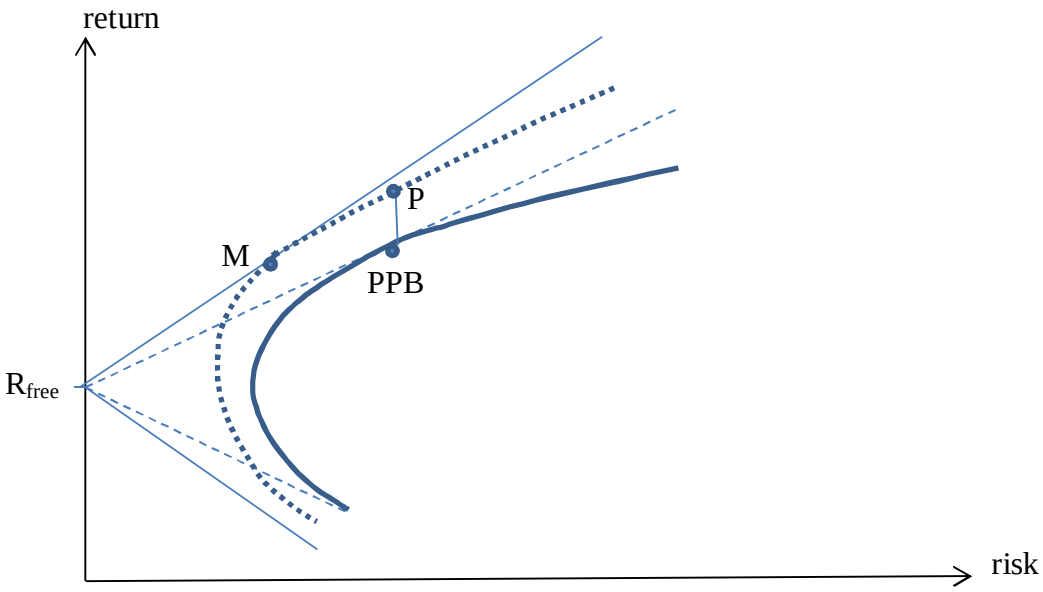


Figure 3. Number of funds opened in the period 1980-2009 per investment style.

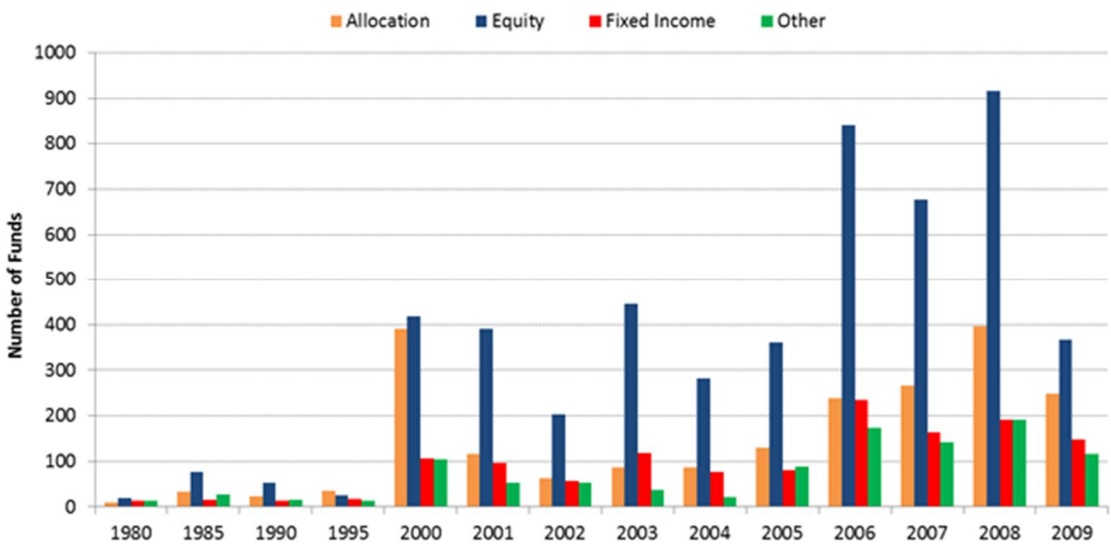
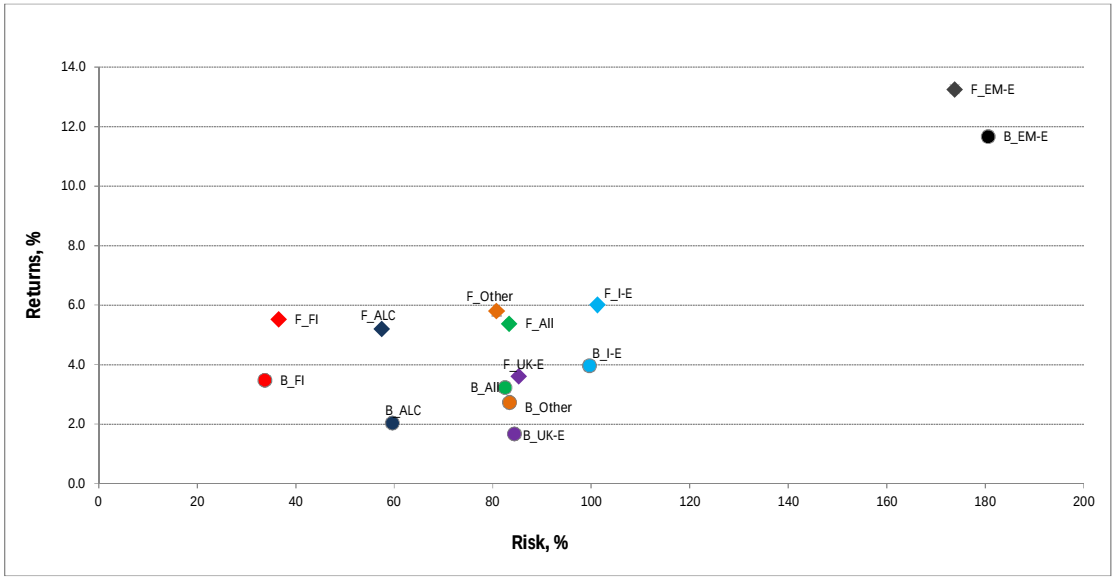
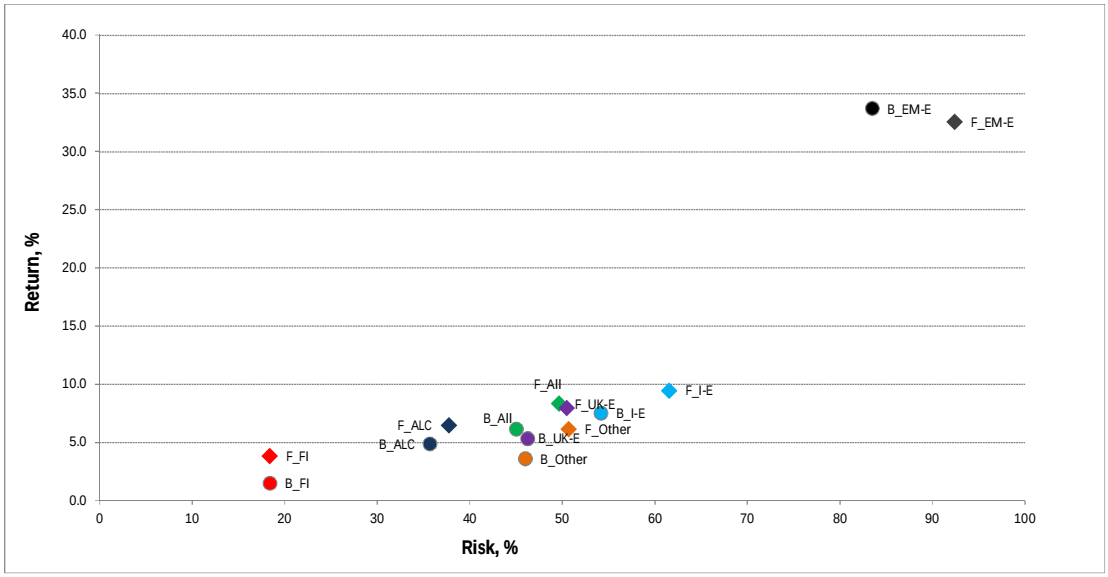


Figure 4. Average risk-return characteristics of funds (denoted by F_ and the abbreviation of the investment style name; diamond shapes) and their PPBs (denoted by B_ and the abbreviation of the investment style name; circle shapes) based on ACRs. Investment styles: ALC – allocation, FI – fixed income, EM-E – emerging markets equity, I-E – international equity, UK-E – UK equity, and Other – all other styles as defined in Appendix 1.

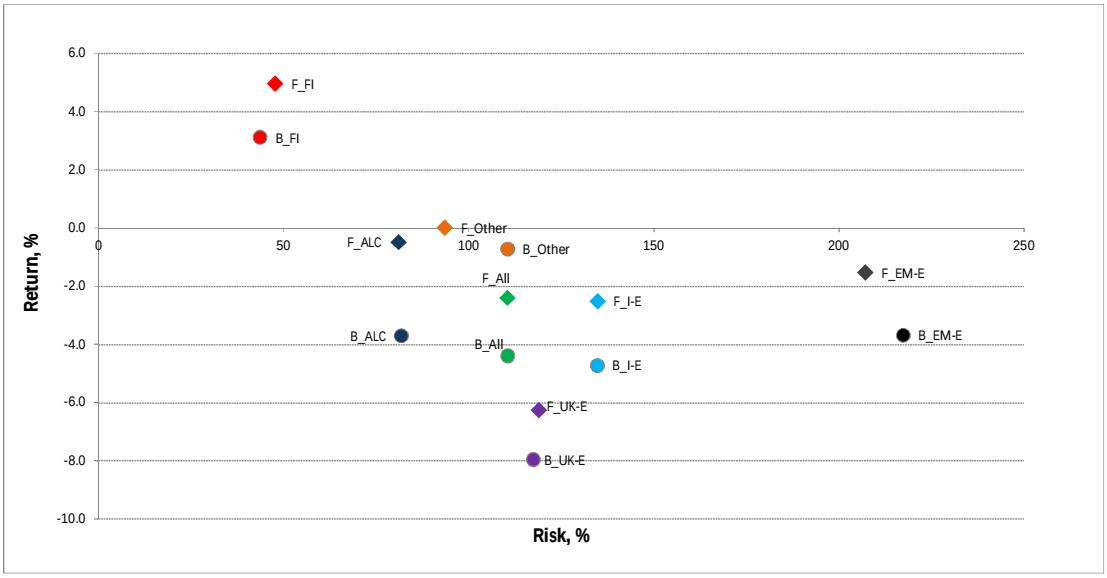
Panel A. Performance in 1980-2009



Panel B. Performance in 1980-2007



Panel C. Performance in 2008-2009 of the funds created in 1980-2007.



Panel D. Performance of the funds created in 2008-2009.

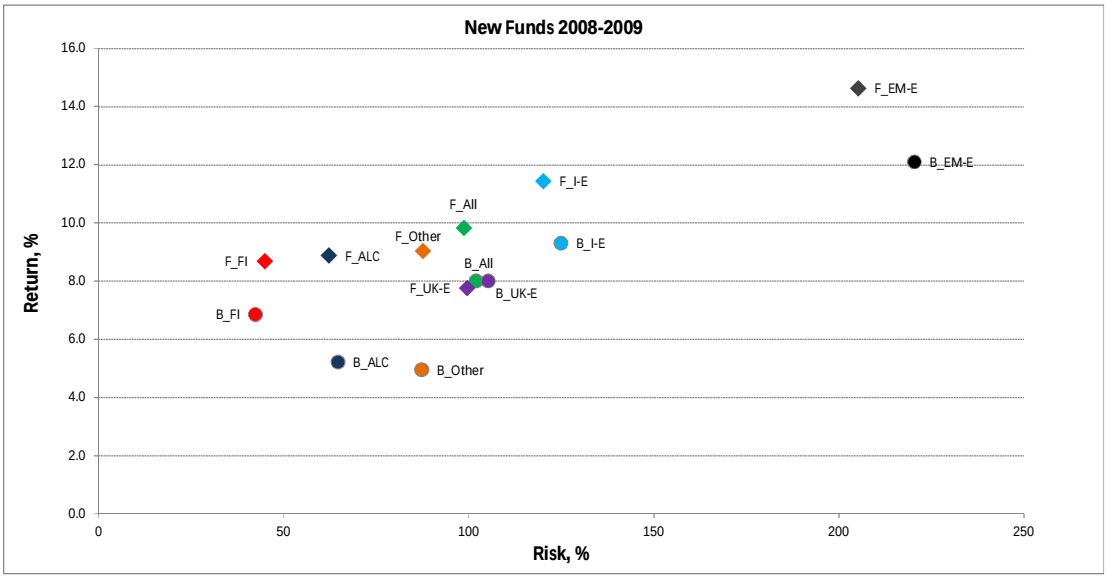


Table 1. Summary statistics for all funds (ALL) and in separation for individual investment styles (ALC-allocation; FI-fixed income; EM-E-emerging equity; I-E-international equity, UK-E - UK equity; Other-denotes all styles not included in the above styles). Panel A: shows statistics for all funds downloaded from the Morningstar Direct™. Panel B: PPB-Unrestricted sample shows the statistics for all the funds for which information on returns for at least six months was available. Panel C: PPB-restricted sample shows the statistics for all the funds for which information on their PPB returns was available. Panels D and E are equivalent to Panels B and C, respectively, but include funds opened between 1980-2007.

	Panel A: Initial sample		Panel B: PPB-Unrestricted sample		Panel C: PPB-Restricted sample		Panel D: PPB-Unrestricted sample 1980-2007		Panel E: PPB-Restricted Sample1980-2007	
Style	Funds	Obs.	Funds	Obs.	Funds	Obs.	Funds	Obs.	Funds	Obs.
ALL of which	10086	75638	8255	58852	4531	25292	8250	15593	4530	8536
ALC	2043	15021	1643	11487	337	1814	1639	3070	337	643
FI	1427	10844	1165	8567	630	3586	1165	2202	630	1179
Equity, of which	5135	36135	4342	29626	3230	18340	4341	8277	3229	6126
EM-E	259	1056	217	880	158	590	217	388	158	286
I-E	2864	21451	2397	17608	1708	10061	2396	4566	1707	3233
UK-E	2012	13628	1728	11138	1364	7689	1728	3323	1364	2607
Other	1481	13638	1105	9172	334	1552	1105	2044	334	588
ALL of which	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ALC	20.3%	19.9%	19.9%	19.5%	7.4%	7.2%	19.9%	19.7%	7.4%	7.5%
FI	14.1%	14.3%	14.1%	14.6%	13.9%	14.2%	14.1%	14.1%	13.9%	13.8%
Equity, of which	50.9%	47.8%	52.6%	50.3%	71.3%	72.5%	52.6%	53.1%	71.3%	71.8%
EM-E	2.6%	1.4%	2.6%	1.5%	3.5%	2.3%	2.6%	2.5%	3.5%	3.4%
I-E	28.4%	28.4%	29.0%	29.9%	37.7%	39.8%	29.0%	29.3%	37.7%	37.9%
UK-E	19.9%	18.0%	20.9%	18.9%	30.1%	30.4%	20.9%	21.3%	30.1%	30.5%
Other	14.7%	18.0%	13.4%	15.6%	7.4%	6.1%	13.4%	13.1%	7.4%	6.9%

Table 2. Summary statistics of the return and risk characteristics of pension funds' portfolios (Funds), their primary prospectus benchmarks (PPBs), and T-bills. ACR denote annualised compounded returns and AR denote yearly returns.

	Panel A: ACR					Panel B: AR				
Variable	Obs.	Mean	σ	Min	Max	Obs.	Mean	σ	Min	Max
Funds created in the 1980-2009 period; statistics for the 1980-2009 period										
Returns										
Funds	4531	5.38	9.97	-22.80	110.76	25292	5.00	24.73	-82.03	268.13
PPB	4531	3.22	10.40	-22.24	116.98	25292	2.71	22.81	-71.11	127.76
Tbill	4531	3.61	1.35	0.47	8.22	25292	4.61	2.45	0.66	18.30
Risk										
Funds	4531	83.35	27.32	0.63	486.95	25292	68.48	32.79	0.01	785.74
PPB	4531	82.54	29.51	0.06	623.00	25292	66.65	33.46	0.09	1763.56
Tbill	4531	1.85	0.63	0.03	3.94	25292	0.42	0.32	0.06	1.85
Funds created in the 1980-2009 period; statistics for the 1980-2007 period										
Returns										
Funds	3383	8.32	9.55	-32.63	76.95	16756	8.01	18.56	-59.69	268.13
PPB	3383	6.15	8.89	-36.94	89.05	16756	5.70	16.82	-71.11	127.76
Tbill	3383	5.33	0.67	4.56	8.62	16756	5.63	1.99	3.75	18.30
Risk										
Funds	3383	49.62	19.27	0.60	232.23	16756	53.66	26.54	0.01	785.74
PPB	3383	45.04	18.72	0.21	282.54	16756	50.34	26.39	0.09	1763.56
Tbill	3383	0.70	0.71	0.03	3.76	16756	0.31	0.28	0.06	1.85
Funds created in the 1980-2007 period; statistics for the 2008-2009 period										
Returns										
Funds	3383	-2.41	6.45	-31.00	20.14	6766	-2.10	32.10	-61.19	104.50
PPB	3383	-4.39	6.14	-29.62	21.28	6766	-4.13	31.13	-56.53	78.52
Tbill	3383	2.76	0.01	2.64	2.86	6766	2.76	2.08	0.66	4.90
Risk										
Funds	3383	110.45	27.89	0.01	380.41	6766	102.70	30.75	0.01	542.16
PPB	3383	110.54	30.11	2.20	437.08	6766	104.42	30.38	0.29	653.99
Tbill	3383	2.24	0.00	2.21	2.24	6766	0.65	0.30	0.35	0.96
Funds created in the 2008-2009 period; statistics for the 2008-2009 period										
Return										
Funds	1147	9.84	16.66	-18.79	110.76	1770	4.86	37.28	-82.03	110.76
PPB	1147	8.00	18.24	-21.15	116.98	1770	1.73	29.65	-57.88	78.52
Tbill	1147	1.71	0.82	0.47	2.76	1770	2.14	1.99	0.66	4.90
Risk										
Funds	1147	98.69	37.23	0.63	486.95	1770	96.75	37.19	0.01	762.45
PPB	1147	101.95	40.53	0.06	623.00	1770	99.94	35.29	0.29	653.99
Tbill	1147	1.48	0.83	0.03	2.24	1770	0.56	0.29	0.35	0.96

Table 3. Regressions on constant of PPB-T-bills and Sharpe ratios. ACR denote annualised compounded returns and AR denote yearly. P-values are shown in parenthesis. ***: 1% significance; **: 5% significance and *: 10% significance.

	Panel A: ACR						Panel B: AR					
	1980-2009		1980-2007		2008-2009		1980-2009		1980-2007		2008-2009	
	PPB-Tbill	SR	PPB--Tbill	SR	PPB--Tbill	SR	PPB-Tbill	SR	PPB--Tbill	SR	PPB--Tbill	SR
ALL	0.164	0.066	1.124**	0.041	-3.128***	-0.272	0.158	0.131	1.171	0.370	-1.829	-0.338
	(0.854)	(0.704)	(0.043)	(0.821)	(0.002)	(0.117)	(0.968)	(0.863)	(0.655)	(0.563)	(0.886)	(0.867)
Funds	4531	4531	3383	3383	4530	4530	4531	4531	3383	3383	4530	4530
Obs.							25292	25292	16756	16756	8536	8536
ALC	-1.308*	0.158	-0.280	0.039	-3.926***	-0.313	-0.898	0.199	0.352	0.436	-3.175	-0.232
	(0.088)	(0.637)	(0.492)	(0.858)	(0.000)	(0.288)	(0.820)	(0.832)	(0.911)	(0.591)	(0.784)	(0.921)
Funds	337	337	263	263	337	337	337	337	263	263	337	337
Obs.							1814	1814	1171	1171	643	643
FI	0.115	-0.369*	-3.680***	-2.868***	1.889***	0.377**	-1.800*	-1.662**	-3.475***	-2.503***	1.620	0.053
	(0.840)	(0.076)	(0.000)	(0.000)	(0.007)	(0.041)	(0.088)	(0.026)	(0.000)	(0.000)	(0.154)	(0.911)
Funds	630	630	465	465	630	630	630	630	465	465	630	630
Obs.							3586	3586	2407	2407	1179	1179
EM-E	9.637***	1.094***	27.971***	4.957***	1.954	0.222	14.993	2.062*	17.792***	3.021***	12.017	1.043
	(0.000)	(0.000)	(0.000)	(0.000)	(0.469)	(0.409)	(0.160)	(0.083)	(0.000)	(0.000)	(0.690)	(0.751)
Funds	158	158	91	91	158	158	158	158	91	91	158	158
Obs.							590	590	304	304	286	286
I-E	0.820	0.077	2.361***	0.510***	-3.241***	-0.406**	0.404	0.206	2.229	0.611	-3.450	-0.650
	(0.427)	(0.660)	(0.000)	(0.002)	(0.004)	(0.021)	(0.916)	(0.748)	(0.487)	(0.331)	(0.774)	(0.700)
Funds	1708	1708	1286	1286	1707	1707	1708	1708	1286	1286	1707	1707
Obs.							10061	10061	6828	6828	3233	3233
UK-E	-1.369	-0.241	0.253	0.292	-6.465***	-0.931***	-0.206	0.253	1.290	0.888	-3.120	-0.984
	(0.278)	(0.296)	(0.715)	(0.233)	(0.000)	(0.001)	(0.973)	(0.844)	(0.689)	(0.360)	(0.872)	(0.770)
Funds	1364	1364	1076	1076	1364	1364	1364	1364	1076	1076	1364	1364
Obs.							7689	7689	5082	5082	2607	2607
Other	0.167	1.501***	-1.318	0.196	0.021	1.691***	0.486	2.365***	0.397	2.180***	0.631	2.668
	(0.836)	(0.000)	(0.158)	(0.522)	(0.979)	(0.000)	(0.841)	(0.000)	(0.786)	(0.000)	(0.930)	(0.112)
Funds	334	334	202	202	334	334	334	334	202	202	334	334
Obs.							1552	1552	964	964	588	588

Table 4. Regressions on constant of PPB-restricted (Panels A and C) and PPB-unrestricted (Panels B and D) samples. Period 1980-2009. ACR denote annualised compounded returns and AR denote yearly. P-values are shown in parenthesis. ***: 1% significance; **: 5% significance and *: 10% significance.

	ACR						AR					
	Panel A				Panel B		Panel C				Panel D	
	R-Tbill	R-PPB	M^2	Sharpe	R-Tbill	Sharpe	R-Tbill	R-PPB	M^2	Sharpe	R-Tbill	Sharpe
ALL	2.206***	2.225***	2.665***	0.523***	1.822***	0.496***	2.719	2.691***	3.299***	0.711	2.116	0.110
	(0.005)	(0.000)	(0.000)	(0.002)	(0.005)	(0.004)	(0.548)	(0.000)	(0.000)	(0.426)	(0.549)	(0.889)
Funds	4531	4531	4531	4531	8255	8255	4531	4531	4531	4531	8255	8255
Obs.							25292	25292	25292	25292	58852	58852
ALC	1.745*	3.164***	3.662***	0.666**	1.946***	0.890***	1.975	3.083***	3.882***	1.072	1.672	0.884
	(0.051)	(0.000)	(0.000)	(0.027)	(0.005)	(0.002)	(0.669)	(0.000)	(0.001)	(0.380)	(0.634)	(0.367)
Funds	337	337	337	337	1643	1643	337	337	337	337	1643	1643
Obs.							1814	1814	1814	1814	11487	11487
FI	2.011***	2.104***	2.741***	0.894***	2.118***	0.933***	1.290	3.480***	3.546***	0.251	1.258	0.374
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.447)	(0.002)	(0.000)	(0.759)	(0.442)	(0.622)
Funds	630	630	630	630	1165	1165	630	630	630	630	1165	1165
Obs.							3586	3586	3586	3586	8567	8567
EM-E	11.098***	1.577**	2.769***	1.395***	14.807***	1.777***	17.832	1.872***	4.457**	2.635*	17.746*	2.642**
	(0.000)	(0.011)	(0.000)	(0.000)	(0.000)	(0.000)	(0.118)	(0.007)	(0.045)	(0.057)	(0.084)	(0.040)
Funds	158	158	158	158	217	217	158	158	158	158	217	217
Obs.							590	590	590	590	880	880
I-E	2.818***	2.056***	2.537***	0.488***	2.490***	0.435***	2.866	2.360***	2.918***	0.707	2.799	0.716
	(0.002)	(0.000)	(0.000)	(0.005)	(0.001)	(0.002)	(0.503)	(0.000)	(0.002)	(0.314)	(0.475)	(0.288)
Funds	1708	1708	1708	1708	2397	2397	1708	1708	1708	1708	2397	2397
Obs.							10061	10061	10061	10061	17608	17608
UK-E	0.393	2.068***	2.301***	0.192	0.112	0.131	2.353	2.813***	3.583***	1.034	2.362	1.012
	(0.647)	(0.000)	(0.000)	(0.285)	(0.889)	(0.423)	(0.709)	(0.000)	(0.000)	(0.432)	(0.682)	(0.406)
Funds	1364	1364	1364	1364	1728	1728	1364	1364	1364	1364	1728	1728
Obs.							7689	7689	7689	7689	11138	11138
Other	3.107***	3.314***	3.610***	0.798***	-0.001	-0.098	2.013	2.265**	2.667	-0.957	0.363	-3.607***
	(0.004)	(0.000)	(0.000)	(0.006)	(0.999)	(0.819)	(0.585)	(0.035)	(0.118)	(0.249)	(0.862)	(0.000)
Funds	334	334	334	334	1105	1105	334	334	334	334	1105	1105
Obs.							1552	1552	1552	1552	9172	9172

Table 5. Regressions on constant of PPB-restricted (Panels A and C) and PPB-unrestricted (Panels B and D) samples. Period 1980-2007. ACR denote annualised compounded returns and AR denote yearly. P-values are shown in parenthesis. ***: 1% significance; **: 5% significance and *: 10% significance.

	ACR						AR					
	Panel A				Panel B		Panel C				Panel D	
	R-Tbill	R-PPB	M^2	SR	R-Tbill	SR	R-Tbill	R-PPB	M^2	SR	R-Tbill	SR
ALL	3.247***	2.145***	1.848***	0.635***	2.221***	0.301*	3.637	2.502***	2.067***	0.893	2.696	0.109
	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.073)	(0.200)	(0.000)	(0.000)	(0.207)	(0.264)	(0.856)
Funds	3383	3383	3383	3383	6291	6291	3383	3383	3383	3383	6291	6291
Obs.							16756	16756	16756	16756	43259	43259
ALC	1.310*	1.595***	1.517***	0.358	1.354***	0.450**	2.801	2.603***	2.208***	1.252	2.343	1.036
	(0.061)	(0.001)	(0.000)	(0.245)	(0.001)	(0.012)	(0.412)	(0.000)	(0.001)	(0.218)	(0.389)	(0.196)
Funds	263	263	263	263	1179	1179	263	263	263	263	1179	1179
Obs.							1171	1171	1171	1171	8417	8417
FI	-1.476***	2.366***	2.300***	-1.280***	-1.068***	-0.983***	-0.147	3.581***	3.431***	-0.255	0.188	0.046
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.869)	(0.000)	(0.000)	(0.725)	(0.842)	(0.947)
Funds	465	465	465	465	913	913	465	465	465	465	913	913
Obs.							2407	2407	2407	2407	6365	6365
EM-E	26.690***	-0.746	-2.579*	4.425***	27.730***	4.369***	19.778***	1.653***	0.644	3.250***	18.193***	2.853***
	(0.000)	(0.464)	(0.051)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.239)	(0.000)	(0.000)	(0.000)
Funds	91	91	91	91	125	125	91	91	91	91	125	125
Obs.							304	304	304	304	492	492
I-E	4.338***	1.925***	1.642***	0.969***	3.692***	0.879***	4.193	1.894***	1.285***	0.951	3.813	0.902
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.234)	(0.000)	(0.000)	(0.152)	(0.272)	(0.174)
Funds	1286	1286	1286	1286	1862	1862	1286	1286	1286	1286	1862	1862
Obs.							6828	6828	6828	6828	13042	13042
UK-E	2.848***	2.599***	2.258***	0.963***	2.556***	0.860***	4.313	3.046***	2.522***	1.682	4.121	1.550
	(0.002)	(0.000)	(0.000)	(0.001)	(0.004)	(0.002)	(0.218)	(0.000)	(0.000)	(0.102)	(0.231)	(0.113)
Funds	1076	1076	1076	1076	1392	1392	1076	1076	1076	1076	1392	1392
Obs.							5082	5082	5082	5082	7815	7815
Other	1.251	2.636***	2.357***	-0.181	-0.666	-1.363***	1.499	1.396***	2.081***	-1.984***	0.676	-4.148***
	(0.217)	(0.000)	(0.000)	(0.598)	(0.197)	(0.000)	(0.350)	(0.004)	(0.003)	(0.001)	(0.557)	(0.000)
Funds	202	202	202	202	820	820	202	202	202	202	820	820
Obs.							964	964	964	964	7128	7128

Table 6. Regressions on constant of PPB-restricted (Panels A and C) and PPB-unrestricted (Panels B and D) samples of funds created in the 1980-2007 period. The performance is measured over the 2008-2009 period. ACR denote annualised compounded returns and AR denote yearly. P-values are shown in parenthesis. ***: 1% significance; **: 5% significance and *: 10% significance.

	ACR						AR					
	Panel A				Panel B		Panel C				Panel D	
	R-Tbill	R-PPB	M^2	SR	R-Tbill	SR	R-Tbill	R-PPB	M^2	SR	R-Tbill	SR
ALL	-4.864***	2.238***	2.372***	-0.681***	-4.667***	-0.770***	-0.842	2.774	5.028	-0.010	-1.104	-0.323
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.956)	(0.202)	(0.143)	(0.997)	(0.937)	(0.905)
Funds	3384	3384	3384	3384	6296	6296	3383	3383	3383	3383	6291	6291
Obs.							6766	6766	6766	6766	12592	12592
ALC	-3.107***	3.468***	3.587***	-0.560***	-4.392***	-0.840***	-0.454	3.875	6.383	0.467	-1.759	-0.124
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.973)	(0.134)	(0.119)	(0.878)	(0.897)	(0.968)
Funds	263	263	263	263	1183	1183	263	263	263	263	1179	1179
Obs.							526	526	526	526	2366	2366
FI	2.262***	1.927***	2.641***	0.744***	1.927***	0.627***	3.638	2.897	3.001	0.869	3.555	0.891
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.473)	(0.491)	(0.377)	(0.603)	(0.562)	(0.638)
Funds	465	465	465	465	913	913	465	465	465	465	913	913
Obs.							930	930	930	930	1826	1826
EM-E	-3.856***	2.381***	2.852***	-0.314***	-3.283***	-0.280***	10.238	2.738*	8.170	1.529	10.603	1.709
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.764)	(0.098)	(0.189)	(0.717)	(0.756)	(0.691)
Funds	91	91	91	91	125	125	91	91	91	91	125	125
Obs.							182	182	182	182	250	250
I-E	-5.042***	2.412***	2.492***	-0.713***	-5.014***	-0.714***	-1.767	2.762	5.309	-0.109	-1.728	-0.109
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.903)	(0.282)	(0.203)	(0.958)	(0.906)	(0.959)
Funds	1287	1287	1287	1287	1863	1863	1286	1286	1286	1286	1862	1862
Obs.							2572	2572	2572	2572	3726	3726
UK-E	-8.694***	2.000***	2.029***	-1.352***	-8.842***	-1.368***	-2.915	2.379	5.541*	-0.467	-3.089	-0.474
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.886)	(0.127)	(0.065)	(0.890)	(0.879)	(0.889)
Funds	1076	1076	1076	1076	1392	1392	1076	1076	1076	1076	1392	1392
Obs.							2152	2152	2152	2152	2784	2784
Other	-2.464***	1.447	1.017	-0.506	-4.741***	-1.411***	0.288	3.256	1.989	-0.276	-2.343	-2.500
	(0.004)	(0.311)	(0.482)	(0.115)	(0.000)	(0.000)	(0.980)	(0.314)	(0.687)	(0.909)	(0.810)	(0.487)
Funds	202	202	202	202	820	820	202	202	202	202	820	820
Obs.							404	404	404	404	1640	1640

Table 7. Regressions on constant of PPB-restricted (Panels A and C) and PPB-unrestricted (Panels B and D) samples of funds created in the 2008-2009 period. ACR denote annualised compounded returns and AR denote yearly. P-values are shown in parenthesis. ***: 1% significance; **: 5% significance and *: 10% significance.

	ACR						AR					
	Panel A				Panel B		Panel C				Panel D	
	R-Tbill	R-PPB	M^2	SR	R-Tbill	SR	R-Tbill	R-PPB	M^2	SR	R-Tbill	SR
ALL	9.327***	2.033**	3.333***	2.207***	9.127***	2.429***	7.650	4.163	8.349*	1.754	7.264	1.943
	(0.001)	(0.029)	(0.000)	(0.000)	(0.000)	(0.000)	(0.560)	(0.219)	(0.098)	(0.448)	(0.562)	(0.441)
Funds	1147	1147	1147	1147	1959	1959	1147	1147	1147	1147	1959	1959
Obs.							1770	1770	1770	1770	3001	3001
ALC	7.768***	3.629***	5.643***	2.995***	8.169***	3.097***	4.625	4.325	9.389	2.469	5.181	2.455
	(0.005)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.690)	(0.271)	(0.139)	(0.445)	(0.627)	(0.443)
Funds	74	74	74	74	460	460	74	74	74	74	460	460
Obs.							117	117	117	117	704	704
FI	7.377***	2.005**	3.400***	3.137***	9.213***	3.829***	6.408	4.675	6.689	2.656	8.231	3.430
	(0.000)	(0.038)	(0.008)	(0.000)	(0.000)	(0.000)	(0.339)	(0.387)	(0.204)	(0.268)	(0.351)	(0.250)
Funds	165	165	165	165	252	252	165	165	165	165	252	252
Obs.							249	249	249	249	376	376
EM-E	15.105***	2.530**	4.936***	1.808***	22.656***	2.617***	25.432	0.993	9.106	3.040	29.092	3.576
	(0.004)	(0.030)	(0.000)	(0.009)	(0.000)	(0.002)	(0.429)	(0.760)	(0.242)	(0.432)	(0.368)	(0.363)
Funds	67	67	67	67	92	92	67	67	67	67	92	92
Obs.							104	104	104	104	138	138
I-E	11.064***	2.214*	3.618***	1.984***	10.820***	1.932***	7.187	5.618	10.481*	1.500	7.137	1.491
	(0.001)	(0.055)	(0.001)	(0.001)	(0.001)	(0.001)	(0.549)	(0.154)	(0.079)	(0.423)	(0.561)	(0.440)
Funds	421	421	421	421	534	534	421	421	421	421	534	534
Obs.							661	661	661	661	840	840
UK-E	7.367*	0.219	1.429	1.739**	6.779*	1.620**	5.378	2.258	6.176*	0.876	5.001	0.889
	(0.058)	(0.898)	(0.292)	(0.026)	(0.082)	(0.039)	(0.724)	(0.113)	(0.089)	(0.710)	(0.749)	(0.720)
Funds	288	288	288	288	336	336	288	288	288	288	336	336
Obs.							455	455	455	455	539	539
Other	8.447***	4.299***	4.386***	2.538***	5.827***	1.934***	8.488	4.643	7.222	2.438	5.821	1.459
	(0.000)	(0.001)	(0.001)	(0.000)	(0.008)	(0.004)	(0.483)	(0.393)	(0.285)	(0.322)	(0.551)	(0.442)
Funds	132	132	132	132	285	285	132	132	132	132	285	285
Obs.							184	184	184	184	404	404

Table 8. Annualised nominal and risk adjusted performance on portfolios consisting of 80% FTSE All Shares Index and 20% MSCI index (P) and returns on the returns on the FTSE All Share index (FTSE) over three time periods; compounded returns, %.

	2000-2009		2005-2009		2008-2009	
MSCI index	P-FTSE	M^2	P-FTSE	M^2	P-FTSE	M^2
Emerging markets	1.891	2.153	2.730	2.610	1.731	2.417
EM Latin America	3.138	3.417	4.395	4.089	3.709	4.247
Brazil	3.755	4.117	5.643	5.044	3.678	4.446
Pacific except Japan	3.181	3.460	4.533	4.200	3.461	4.037
EM Asia	1.523	1.788	2.557	2.455	1.631	2.341
China	3.576	3.705	4.236	3.925	1.961	2.742
India	3.172	3.429	4.176	3.741	0.902	2.260

Appendix 1. Classification of ABI sectors into investment style categories.

Allocation	Equity			Fixed Income	Other
	Equity UK	Emerging markets	International markets		
Balanced (up to 85% Equity) Managed	UK All Companies	Global Emerging Markets Equities	Asia Pacific excl. Japan	Global Fixed Interest	Commodity/Energy
Cautious (up to 60% Equity) Managed	UK Smaller Companies		Asia Pacific incl. Japan	Global High Yield	Money Market
Defensive (up to 35% Equity) Managed	UK Equity Income		Europe excl. UK	Sterling Corporate Bond	Protected/Guaranteed Funds
Flexible (up to 100% Equity) Managed			Europe incl. UK	Sterling Fixed Interest	Global Property
			Global Equities	Sterling High Yield	UK Direct Property
			Japan Equities	Sterling Long Bond	Specialist
			North America	Sterling Other Fixed Interest	
				UK Index-Linked Gilts	
				UK Gilt	