Jumping over a low hurdle:
Personal pension fund performance

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Abstract

This paper provides a comprehensive analysis of the annual and of the long-term performance of personal pension funds relative to their Primary Prospectus Benchmarks (PPBs) and T-bills. The study covers 9,659 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 challenging 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. We discuss policy implications of our findings.

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Keywords: pension funds, portfolio performance, asset management, diversification, benchmark selection, Sharpe ratio

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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 bases 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 a defined contribution nature of pension investments, make ordinary investors vulnerable to low income at retirement. The 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). Additional difficulty is also embedded in the long-term nature of pension savings. As long-term commitment to saving can be 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 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; Kryzanowski and Rahman, 2008). However, suitability of existing benchmarks has not received much attention even though it is well recognised that the choice of investment strategies and their consequent

success may heavily depend on targets set 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 regulators, policymakers and contributors would wish for), or whether they are focused on delivering good short-term performance (as a manager's career concern argument would suggest).

To the best of our knowledge, this paper, using data from the UK personal pension industry, is the first one to discuss whether benchmarks used by personal pension funds are appropriate and informative for contributors, and how personal pension funds perform in relation to these benchmarks. It is also the first to provide an assessment of a wide range of personal pension funds' investment styles.

The UK personal pension funds form one of the biggest and oldest personal pension industries in the world with over £300bn of AUM (IMA, 2012).[3] Understanding of the fund-benchmark performance relationship of the UK personal pension funds can have 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 important given the fast pace of adoption of defined contribution pension schemes around the world, and the increasing reliance on benchmarks as the incentive and monitoring mechanisms.[4]

In total, we analyse 9,659 personal pension funds across 30 different investment styles (classification according to the Association of British Insurers, ABI) over the 1980-2009 period. For 4,531 of these funds we identified their Primary Prospectus

[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] For a discussion of the importance of using the right benchmark see Lakonishok et al. (1992), Blake et al. (1999), Dor et al. (2003), Chan et al. (2009). Prospectus benchmarks have also been used by Sensoy (2009) in a study of mutual fund performance. Non-benchmark evaluations have also been proposed to mitigate problems with inappropriate benchmarking (e.g., Grinblatt and Titman 1993).

Benchmarks (PPBs), i.e., benchmarks chosen by funds for advertisement purposes, in communication with existing contributors and to assess pension fund managers' performance. This allows for comparison of fund and benchmark performance for a significant fraction of personal pension funds offered to UK investors.

There is only a handful of studies devoted to the performance of pension funds *per se*.[5] The vast majority of the literature on fund performance is focused on mutual funds.[6] In particular, the US mutual fund industry is studied in great detail, which is understandable given the size of the US mutual fund industry ($13 trillion AUM in 2012; ICI 2013) and the fact that 94% of 52.3 million American households investing in mutual funds treat these savings as retirement financing (ICI, 2011). Outside the US, mutual funds are not so important in servicing the pension market.[7] Yet, there are very few studies that address the pension industry issues, and even fewer that recognise that methods used to investigate performance of mutual funds are not necessarily apt to assess the performance of pension funds.

This is surprising because the nature of investments of mutual and pension industries should be very different with pension funds being much more long-term orientated than mutual funds. Consequently, given that the short-term and long-term optimal portfolios may be very different (Cochrane 2014), and short-term performance of long-term optimal portfolios may be quite unflattering, even if the long-term performance is good (Campbell and Viceira 2002), the assessment of pension funds' performance using the same techniques as are used for mutual funds may give a biased and unfair picture. Pension fund performance should be assessed on a long-term basis.

Assessing long-term performance is also important because pension funds' contributors cannot pocket short-term benefits from funds and move on to another fund or out of pension funds. As discussed in the next section pre-retirement withdrawals are discouraged and switching across providers of pension funds can be costly.

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[5] E.g., Ippolito and Turner (1987), Lakonishok et al. (1992), Coggin et al. (1993), Browm et al. (1997), Ambachtsheer et al. (1998), Blake et al. (1999, 2002), Thomas and Tonks (2001), Blake (2003), Novy-Marx and Bauh (2011)..

[6] E.g., investment skills of fund managers are studied by 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); tests for potential departures from the EMH are investigated by 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); practices of wooing investors are studied by Cooper et al. (2005), Massa (2003), Sensoy (2009), Aydogdu and Wellman (2011).

[7] For instance, in 2010 the UK funded pensions accounted for $1.9 trillion of AUM, i.e., they were twice as big as mutual funds which by the end of 2010 had only $0.85 trillion of AUM (ICI 2012).

To measure long-term performance we use compounded returns calculated over the pension funds' operation life. In addition we calculate annual returns. Using (annualised) compounded and annual returns we calculate several 'traditional' measures of performance used by pension funds in communication with contributors, i.e., excess returns in relation to UK T-bills and to assigned PPBs, and Sharpe ratio (Roy 1952; Sharpe 1966), as well as the Modigliani-Modigliani (M^2) measure (Modigliani and Modigliani, 1997) to account for risk of the PPBs, Sharpe ratios adjusted for skewness and kurtosis (Peizer and White 2006) to account for non-normal distributional properties of returns, and the Sortino ratio (Sortino and van der Meer 1991) to account for downside risk. We focus on these measures because (i) we wish to analyse compounded as well as average returns, (ii) we need measures that will be suitable and comparable across different asset classes and, finally, (iii) we wish to assess performance of both the funds and the PPBs.

Our findings indicate that PPBs are not challenging nor particularly informative benchmarks. We find robust evidence that the pension funds of all investment styles outperform their PPBs both in the long- and short-run but we argue that this superior performance results from expanding pension portfolios to include assets not included in their PPBs. Our results also suggest that pension funds tie themselves to their PPBs' risk profile which means that (i) they may earn lower returns than they could given asset classes they invest in, and (ii) they are not so good at outperforming T-bills in nominal and risk adjusted terms on an annual basis.

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 on an annual basis. This raises the question whether there should be greater scrutiny of the process of opening new pension funds and monitoring their subsequent performance. The results also highlight the cyclical nature of investment styles and benefits of international diversification.

The rest of the paper is structured as follows. Section 2 provides a discussion of three distinct features of the pension industry that create a base for our research

questions and empirical analysis. Section 3 describes the dataset. Section 4 defines variables used in Section 5, which presents the results of the regression analysis. Section 6 discusses the finding and Section 7 concludes and outlines a few directions for future research.

2. Features of personal pensions and research questions

We start from outlining three critical background features of the UK personal pension fund industry that are central to our analysis and then identify the primary consequent questions that form the core of the investigation.

The first relates to the relevant time frame for assessment. As discussed in the previous section it is common to look at and assess the performance of pension funds as if they were mutual funds, i.e., the existing studies of the UK pension funds are concerned with their 'average' performance (e.g., Blake et al. 1990, Thomas and Tonks 2001). However, there are fundamental differences between the regulation and the nature of pension fund savings in comparison with those of mutual funds which raise questions as to whether this is the most informative approach for pension funds. Withdrawals and switching across providers of mutual fund investments are much more flexible than they are in the case of pension savings. In the case of pension fund savings, tax benefits heavily discourage any pre-retirement withdrawals. More importantly, switching across saving plans (even within the same provider) is known to be costly. Blake (2003) estimates that if a personal scheme was terminated after only one year, a contributor might lose as much as 90% of his/her contributions. Wood et al. (2012) report that the average marginal cost of a straightforward transfer end-to-end is about £105 (or about $160) but they also note that "all providers stressed that the figures they gave us were the minimum values, for the most straightforward transfers, and only represent a small fraction of the providers' actual transfer costs". In the assessment of the pre-2009 pension funds charging practices Vaze and Roker (2011) claim that "typically between 2 and 6 per cent of the value transferred is paid to the pension company and adviser to meet the cost of switching and marketing". According to The Independent "(w)hile legal, the practice employed by UK pension funds has been exposed as being among the worst in Europe with Britons frequently paying up to four

times the amount paid by their neighbours in Holland and Denmark".[8] Vaze and Roker (2011) report that in 2009 alone financial advisers that filed returns to the Financial Services Authority had earned around £1.6 billion in commission paid from selling investment products like pensions. It is hard to say how much of this amount is earned as transfer and switching fees but one can suspect that it is quite high. A review conducted by the Financial Service Authority (FSA, 2008) revealed strong irregularities in practices and advice on pension transfers and switches. In particular, they "assessed around a quarter of firms as providing unsuitable advice in a third or more of the cases sampled". They also found that in the 79% of unsuitable cases the switch involved extra product costs.

Given that pension fund contributors face substantial costs of transfers and switches, pocketing short-term benefits and moving on to another fund or out of pension funds in search for better performance is hampered. So, whilst it makes perfect sense that mutual fund performance is measured on an annual, quarterly or monthly basis, it is not at all clear that this is appropriate for pension funds. The costly and restrictive nature of switching across pension funds suggests that contributors may need to pay more attention to total (long-term) returns and not just average (short-term) returns. At the time of retirement, it is the total amount of money that matters, not whether, for example, pension funds had a good average return for a short period.

Unlike contributors, regulators and governments, however, pension fund managers may be more interested in short-term performance. Their career and promotion prospects, as well as remuneration are typically reviewed on a quarterly or annual basis, so naturally achieving good quarterly/annual performance may be more important for them than constructing portfolios that will deliver good long-term returns. Therefore, looking at the quarterly/annual performance also conveys some relevant information.

The second important background feature is that pension funds have flexibility in assessing and reporting their performance. At the time of a pension fund's inception a PPB is chosen by its provider as an indicator of the investment style and strategy of the fund. The PPB will also be used as the reference point for future performance evaluation and is also used as an indicator of the investment style and strategy of the fund for marketing purposes. There are three relevant points about these benchmarks. One is

[8] "Reveal: The scandal of how pension providers rake in the money", The Independent, 12 December 2010.

that a benchmark is assigned by a provider. Second, the benchmarks do not define the ultimate asset class for the fund's investments. This means that funds are allowed to invest a fraction of their money outside the benchmark. Third, the period of assessment is not uniformly specified. It can differ across funds and time.

The PPB defines a so-called primary investment focus which classifies funds into a range of ABI investment sectors (see Appendix 1 for a list of ABI sectors and our grouping of them). However, a fund can invest up to 20% of its money outside its ABI sector classification, and, therefore, outside its PPB and retain its ABI sector status. For instance, a fund can be classified as specialising in UK equity and have the FTSE All Share Index as its PPB, yet it may invest up to 20% of its assets outside its primary classification group i.e., in any non-UK listed equity, fixed income domestic and foreign securities, and other assets allowable as pension fund investments. This means that if pension funds take advantage of this asset allocation flexibility and create portfolios containing assets from outside the benchmark, outperforming the benchmark may be an 'easy hurdle'.

Finally, the third critical background feature that is important for this study is that the clear separation of investment styles creates an opportunity to study performance characteristics of a range of investment styles. It is common in the literature to focus on performance characteristics of domestic equity mutual funds. A similar practice has been applied to pension funds. Some studies of occupational pension funds consider performance of portfolios diversified across various groups of assets, but there is no discussion in the literature of the performance of particular investment styles and it is therefore unknown whether the results reported in the past literature are investment style specific, or whether they can be generalised across different investment styles. The data set used for this paper allows investigation of this issue.

Given these particular features of the UK personal pension fund market the following three themes are developed.

First, we assess the annual and the long-term performance of pension funds. We are interested in observing whether there are any differences in performance resulting from using different time horizons in the performance assessment. Consistent with the argument of Campbell and Viceira (2002), the short-term performance of a long-term optimal investment strategy may look quite poor, so the question arises whether the performance of pension funds looks better when assessed in the long-run than it does on an annual basis?

Second, our interest goes beyond funds specialising in domestic equity and we address the question of the performance of a range of investment styles. On one hand 'beating the market' is hard regardless of what assets define 'the market', on the other hand, it can be expected that different investment styles deliver different returns. Therefore, it is important to gain some understanding of whether and what differences there are in the performance of different investment styles. In particular, does taking higher risk and investing in equity funds deliver higher returns than investing in lower risk funds specialising in fixed income assets?

Finally, it is important to shed some light on the role of the benchmarks. Theoretically, it is impossible to beat the market portfolio, but in practice, given that the performance is measured against indexes, it could be possible to outperform these indexes if they were inefficient (Kryzanowski and Rahman 2008). This would, however, require considerable skills, as detecting these, inefficiencies and being able to take advantage of them is not straightforward. However, if the benchmarks are inefficient by construction, it does raise the question of their purpose.

3. Data

We have collected data for 10,086 funds operated by 63 providers registered in the UK 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 have collected the information for all funds that opened between January 1980 and 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 have identified 515 different Primary Prospectus Benchmarks (PPB). To assess performance of the PPBs total return statistics on market indexes constituting PPBs were collected from DataStream as Morningstar do not provide information on the benchmark returns. To calculate meaningful statistics we requested that there were performance data for at least six months. This reduced the total number of funds to 9,659. When the same restriction was applied to the PPBs the sample shrunk further.

Among the 515 benchmarks, 389 were individual market indexes and 126 were composite benchmarks. Most commonly we could not reconstruct PPBs because the

weights of composite indexes were not provided, and/or their names were not recognised by DataStream or identified through web search. In total, we succeeded in calculating monthly returns for 369 PPBs corresponding to 4,531 funds. All overseas index returns were converted into pound sterling returns to make them comparable with the fund returns. End of month exchange rates were used. Therefore, in the rest of the paper two samples are analysed: PPB-unrestricted and PPB-restricted, which refer to 9,659 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 are discussed, a few words about the structure of the samples are 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 30 ABI investment 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 were put together because there were relatively few funds in each of these categories in the PPB-unrestricted sample and even less after the PPB-sample was constructed. For instance, it was possible to calculate PPB returns for only 32 money market funds out of the population of 326 of the funds in the money market category, and none for 361 real estate category funds. Details of the grouping are provided in Appendix 1.

Figure 1 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 1 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 alone. 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 the last two years (i.e.,

2008-2009) with some caution. The effects of the financial crisis may be more pronounced in our dataset than other stock market and economic turbulences because of the high proportion of funds opened during and immediately before the crisis started. Moreover, for the sizable proportion of funds included in the sample that opened in the 2008-2009 period the annual returns and the compounded returns are calculated over a period of 12 months, so they are identical. 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 1980-2007 PPB-unrestricted sub-sample consists of 7,838 funds of which 4,047 are equity funds. The corresponding statistics for the PPB-restricted sample are 3,575 and 2,554 respectively.

********** insert Figure 1 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 two groups. Table 1 Panels D and E show the statistics for the 1980-2007 PPB-unrestricted and the PPB-restricted samples respectively.

In addition, monthly time series of 1-month UK T-bills for the period 1980-2009 have been collected from DataStream. These proxy for the risk-free rate.

4. Definition of returns and performance variables

4.1. Returns

To assess the long-term performance of the pension funds the compounded returns are calculated over the whole period of fund's operation within the 1980-2009 period and within the 1980-2007 period. To complete the picture the compounded returns over 2008-2009 are also calculated but because for a high proportion of funds there is only one annual observation in that period, the 2008-2009 statistics are treated with caution.

Given that the operational lives of the pension funds differ significantly (some funds operate for over 20 years, some for two years only), these total returns are annualised and the annualised compounded returns (ACRs) are used in the analysis of long-term returns. The annualised standard deviation of the monthly returns is used as a corresponding measure of risk. To check robustness of our results the (arithmetic) average over the funds' operational life (and sub-periods) is also calculated. We refer to these annualised arithmetic average returns as AARs.

Yearly returns are calculated as compounded monthly returns over each calendar year (YRs) and log-returns for each calendar year (YLRs). If a fund operated for less than six months in a given calendar year (i.e., opened between July and December), these first few months are not used to calculate YRs and YLRs. First year returns of funds opened between January and 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, most importantly, to minimise issues with time-series

properties in the panel analysis.[9] Risk of the yearly returns is calculated as the annualised standard deviation of monthly returns in the corresponding calendar year.

By construction, the samples of yearly returns (YRs and YLRs) are panels, while the samples of the ACRs and AARs are cross-sections. Therefore, consistent with our intentions, the panel data and the cross-section regressions address different questions. One asks whether pension funds on average outperform T-bills and their PPBs, and the other one asks whether long-term returns of pension investments are statistically different from those earned by reinvesting in T-bills or delivered by the PPBs. The corresponding returns on the T-bills and on the PPBs are also calculated as ACRs, AARs, YRs and YLRs.

4.2. Performance measures

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 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 1-month T-bills, i.e., the 1-month UK T-bill rate is the proxy for the risk-free rate. The convenience of using a monthly rate is also dictated by the fact that pension fund performance statistics are available on a monthly basis, too.

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, the measure is included in the analysis. We also calculate the excess returns for PPBs, later denoted as PPB-Tbill, as well as the difference between the fund return and that of its PPB, hereafter denoted as R-PPB.

[9] 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, yearly panels. This gives first order autocorrelation in the residuals i.e. we have effectively "shortened" the memory effect.

To adjust for risk the Sharpe ratio (Roy, 1952; Sharpe, 1966), denoted later as Sharpe, is calculated. The ratio is of particular interest because it is commonly used by the fund industries (Ingersoll et al. 2007; Eling, 2008; Antolin, 2008, Hinz et al. 2010).[10]

We also use the M^2 measure introduced by Modigliani and Modigliani (1997) for the direct risk-adjusted comparison of the fund performance against the performance of its PPB. Although the M^2 is not without criticism (Ingersoll et al. 2007) it is a convenient statistic to look at as it gives the difference between the fund and its PPBs returns subject to the fund having the same risk as the PPB.

Given that stock market returns are not normally distributed, to confirm robustness of our findings, we also use the Sharpe ratio adjusted for skewness and kurtosis (Pazier and White 2006), denoted as SharpeAdj.[11] In addition, to gain a better insight into the importance of downside risk of investments, the Sortino ratio (Sortino 1991) is provided. We use two definitions of a 'target', the T-bills and the PPBs, and the corresponding Sortino ratios are denoted Sortino_{TB} and Sortino_{PPB} respectively. It can be expected that pension portfolios have relatively low volatility, hence the Sharpe ratio is more suitable for performance assessment. However, given that our sample includes periods of high volatility and, in particular, the 2008 financial crisis has had a dramatic impact on returns earned by the pension industry, the Sortino ratio is interesting to look at.

The distributions of the M^2 measures, Sharpe ratios, adjusted Sharpe ratios and Sortino 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 focus on the above defined performance measures and step aside from the traditional asset pricing based methods of portfolio valuation for several reasons. First, asset pricing models are not suitable for the analysis of long-term returns as asset pricing models (CAPM, APT, etc.) require time series of returns. Calculations of compounded returns deliver only one observation per fund. Second, asset pricing based

[10] Given that T-bills are not totally risk free we also defined the Sharpe ratio using the 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.

[11] 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. Even if it is unlikely that the Sharpe ratios can be distorted by short-selling, we use the SharpeAdj to control for effects of non-normal distribution of returns.

models are concerned with arithmetic averages as these represent expected values. Geometric averaging (i.e., annualised compounded returns) does not fit into this notation. Third, probably most importantly, 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 of the funds (e.g., because of the multi-asset class nature of pension investment, and because of the high likelihood of funds holding assets not included in their PPBs). Given that the holdings of funds are unknown, it is impossible to construct convincing proxies for the market portfolios as Kothari and Warner (2001) postulate. Finally, to have a direct comparison of the annual and the long-term performance of the funds and of the PPBs, it is necessary to use the same assessment criteria for their annual and long-term returns.

5. Performance evaluation

The analysis of the performance is based on panel (using YRs, YLRs) and cross-section (using ACRs, AARs) regressions where the performance measures defined in Section 4.2 are regressed on a constant, i.e., the regressions are of the form

$$\text{performance measure} = \alpha + \varepsilon,$$

with the panel regressions having additional fund and year fixed effects. The 'performance measure' refers to one of the seven performance measures defined in Section 4.2, and ε denotes an error term. To deal with heteroskedasticity, autocorrelation and spatial correlation, and the unbalanced nature of the panel data the Hoechle method (Hoechle 2007) with Driscoll-Kraay standard errors (Driscoll and Kraay 1998) for unbalanced panels was applied to obtain robust and unbiased estimators (it was sufficient to use one lag in the specification of the autocorrelation term). The reported estimates are averages across all the funds. The (OLS) cross-section regressions were clustered by provider to control for heteroskedasticity.

The core analysis is based on the PPB-restricted sample of 4,531 funds for which the performance of their PPBs could be calculated. However, where possible the regressions were also run for the PPB-unrestricted sample of 9,659 funds to ensure that

the results are not sub-sample specific. Moreover, each sample was divided into six investment-style sub-samples (as defined in Section 4), and the whole period of investigation (i.e., 1980-2009) was divided in two sub-periods, 1980-2007 and 2008-2009. We look at each investment style separately to shed some light on potential benefits of investing in them. The period of the data availability was split into the 1980-2007 and the 2008-2009 sub-periods to ensure that the results are not driven by the performance of the disproportionately high number of crisis-born funds, and to shed some light on the performance of the funds at the start of the financial crisis. To address the latter, the sample was additionally split into two subsamples: funds that started to operate prior to the financial crisis and funds that started to operate in 2008 and 2009.

Given that many of these combinations of the sample divisions produced very similar results to save space we present only a selection of them. The remaining regressions can be obtained from the authors on request.

5.1. Performance based on average returns

We start from discussing the panel regression results obtained for the yearly returns (YRs) as those are commonly used in the literature and in communication with contributors. Table 2 shows the estimated average performance for the1980-2009 (Panels A and B) and the 1980-2007 (Panels C and D) periods. The performance measures based on the PPB-restricted sample of 4,531 funds are presented in Panels A and C, and based on the PPB-unrestricted sample of 9,659 funds are shown in Panels B and D.

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

Tables 2 documents that, on average, over the whole period of 1980-2009 the pension funds outperformed their PPBs by 2.57% in nominal and 2.97% in risk adjusted terms on an annual bases. Looking at individual investment styles, all R-PPB and M^2 are positive and all of them are statistically significantly different from zero at 1% and 5% except those obtained for the Other category. The risk adjusted performance (M^2)

is typically slightly higher than the nominal difference (R-PPB) for all the investment styles but FI. The funds specialising in domestic equity outperform their benchmarks (in the vast majority of cases, the FTSE index) by 2.73% in nominal terms and 3.15% after adjusting for risk. The FI funds have the highest level of nominal outperformance among the six investment styles. However, the EM-E funds perform best in risk adjusted terms by beating their PPBs by 5.18% on an annual basis. Even the FI funds, earn 3.08% per annum more than their PPBs.

The statistical outperformance of the PPBs is confirmed when the financial crisis is excluded from the analysis for all the investment styles but EM-E for which no statistical significance of the averages is obtained (Panel C). There are, however, some differences in the size of the outperformance. The exclusion of the crisis years seems to be associated with lower M^2s for all the investment styles by FI. The nominal outperformance is slightly higher for the FI and the UK-E funds, but lower for the other investment styles. All-in-all, the EM-E funds' performance seems most affected by the exclusion of the crisis years with M^2 and R-PPB dropping from 5.18% (statistically significant at 5%) and 2.56% (statistically significant at 1%) respectively for 1980-2009 to -0.36% and 0.86% (both statistically insignificantly different from zero) respectively for 1980-2007.

The picture changes radically when the pension funds' returns are compared against the T-bills. Here, only the EM-E funds consistently outperform the T-bills in nominal and risk-adjusted terms. This result is preserved when the PPB unrestricted samples are used in the regressions, i.e., when the sample of 9,659 funds for the whole period (Panel B) and the sample of 7,405 funds for the 1980-2007 period (Panel D) are used. The EM-E funds outperform T-bills in nominal terms by 19.29% per annum in the PPB-restricted sample and by 17.04% in the PPB-unrestricted sample (both statistically significant at1%) when the financial crisis' years are excluded from the calculations. The inclusion of the crisis years lowers the level of outperformance to 18.62% for the PPB-restricted sample and 16.71% for the PPB-unrestricted sample (statistical significance of 10% and 5% is obtained for these estimates respectively).

5% statistical significance is also obtained for the Sharpe ratios of the I-E and UK-E funds over the 1980-2007 period, but this result is diluted in the PPB-unrestricted sample. The Other category is the only group of funds for which the statistically significant underperformance is obtained for the Sharpe ratios for the PPB-unrestricted

samples (Panels B and D) and the PPB-restricted before the financial crisis (Panel C). However, given the high mix of this group, it is difficult to interpret this result.

To get some understanding of the impact of the financial crisis Table 3 presents the estimated performance statistics for 2008-2009. Panel A presents the results obtained for the sample of funds that started to operate before the financial crisis.[12] Panel B shows the results for the funds that started to operate during the financial crisis.

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

Table 3 Panel A shows a pattern similar to that observed in Table 2, i.e., the statistical significance is observed for the R-PPR and M^2 but not for the T-bills and Sharpe. It documents that, on average, the funds incepted during the financial crisis (Panels C and D) performed better than the older funds (Panels A and B). These 'older' funds were still successful in outperforming their benchmarks (except for the FI funds) but were not so good at outperforming the T-bills.

In contrast, the newly created funds were exceptionally good at outperforming the T-bills both in nominal and risk adjusted terms. They were also successful in outperforming their benchmarks. The UK-E funds seem to have the least impressive performance (lowest coefficients and statistical significance).

In sum, the average performance of funds, when it comes to beating their PPBs seems quite good. Whatever investment style and period are taken, there is no sign of statistically significant underperformance. Indeed, even if 2008-2009 were tough years for investors, the funds managed to outperform their benchmarks. Can this be taken as a sign that contributors have nothing to worry about? How does this result marry with the evidence of the lack of outperformance of the T-bills? To address these questions we first look at the compounded returns before we look at the performance of the PBBs.

Given the similarity of the results obtained for the PPB-unrestricted and the PPB-restricted samples, to save space, only the results obtained for the PPB-restricted sample are presented in the rest of the paper.

[12] The small difference in the numbers of observations between Tables 2 and 3 results from the fact that a few funds created in the second half of 2007 are excluded from the performance analysis of 1980-2007 but enter the regressions for the 2008-2009 period.

5.2 Performance based on compounded returns

Tables 4 and 5 keep the format of Tables 2 and 3 respectively, but show the results obtained for the annualised compounded returns, ACRs. More precisely, Table 4 shows the performance statistics for the 1980-2009 and the 1980-2007 periods. Table 5 presents the performance over 2008-2009 of the funds created before (Panel A) and during (Panel B) the financial crisis. In addition to the performance measures shown in Tables 2 and 3, the Sharpe ratio adjusted for skewness and kurtosis, SharpeAdj, and two Sortino ratios, $Sortino_{TB}$ and $Sortino_{PPB}$ are presented to illustrate robustness of the findings.

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

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

In contrast with the results obtained for YRs, the averages estimated for all the performance measures over the 1980-2009 and the 1980-2007 periods show that the funds are quite successful in outperforming T-bills, too. Now, all the estimates obtained for R-Tbill and Sharpe are statistically significantly positive except those of the UK-E funds when the performance is measured over 1980-2009. When the financial crisis is excluded the three groups of funds specialising in equity outperform T-bills in nominal and risk adjusted terms. The EM-E funds have earned above the T-bills as much as 26.70% per annum, the I-E have earned 4.48% per annum and the UK-E funds have earned 3.34% per annum. When the risk is taken into account the equity funds still perform better than the other investment categories having the Sharpe ratios of 1.46, 0.33 and 0.33 (all significant at 1%).

The picture is slightly different for the FI funds which underperformed T-bills in nominal (-1.53%) and risk adjusted terms (-0.39%). Given that the ALC funds can be seen as a combination of equity and fixed-income assets, their relatively weak performance is probably a consequence of the poor performance of fix-income investments.

When the financial crisis years are added to the performance calculations (Table 4 Panel A) the performance of the equity finds declines with the EM-E and the I-E funds earning 10.81% p.a. and 2.79% p.a. respectively more than the T-bills. The UK-E funds are the only investment style that has not (statistically significantly) outperform the T-bills. In contrast, the performance of the FI funds improves. Now, the FI funds outperform the T-bills by 2.03% p.a. in nominal terms and have statistically significantly Sharpe of 0.27.

Using ACRs preserves the results of Table 2 for the comparison of the funds and their PPBs, i.e., funds outperform their PPBs in nominal and risk-adjusted terms except for the EM-E funds over the 1980-2007 period.

The performance statistics estimated for the financial crisis period (Table 5) are highly statistically significant which contrasts with the results presented for the YRs in Table 3. It is clear that 'old' funds were harder hit by the turbulent markets than the 'young' ones. In particular, the equity funds created in 2008-2009 performed well on recovering stock markets (their R-Tbill and Sharpe estimates are positive and statistically significant) while the 'old' funds highly statistically underperformed T-bills which may be behind the lack of statistical significance of the UK-E funds in Table 4 Panel A. The London Stock Exchange lost 8.2% between 1 January 2008 and 31 December 2009.

The ability to beat the PPBs is also different for the two cohorts: the 'old' funds outperform the PPBs in nominal terms but underperform them after risk adjustment. The 'young' funds outperform the PPBs in risk adjusted terms, but not in nominal terms.

Given that non-normally distributed samples can deliver biased Sharpe ratios each panel of Tables 4 and 5 shows the average estimates of SharpeAdj, Sortino_{TB} and Sortino_{PPB}. The SharpeAdj statistics are comparable to the Sharpe ratios estimated for the whole period (Table 4 Panel A) and for the funds created during the financial crisis (Table 5 Panel B). However, considerable differences in sign and statistical significance are observed when the financial crisis is excluded from the calculations (Table 4 panel A) and for the 'old' funds during the financial crisis. While the period of the financial crisis can, to some extent, be expected to have 'non-normal' properties, it is interesting that when the financial crisis years are excluded funds seem to have considerable asymmetries in their returns structures with the equity funds being negatively and fixed income funds being positively biased.

The Sortino ratios further highlight differences between the FI and the equity funds, as well as differences in relativity of performance. More precisely, the outperformance of the PPBs does not always mean making money. For instance, the negative $Sortino_{TB}$ and the positive $Sortino_{PPB}$ ratios estimated for the equity funds (Table 5 Panel A) suggest that the probability of losing money was considerable for funds that had substantial equity holdings when the stock markets crashed. Even if the funds did not lose as much money as their PPBs, in comparison with the positive yields of the T-bills, they did not performed well.

In summary, there are substantial differences between performance measured using the ACRs and using the YRs. On one hand, the coefficients for the YR-based regressions are larger than those estimated for the ACRs. On the other hand, there is more statistical significance, especially in comparison with the T-bills in the ACR-based regressions. This higher statistical significance may, however, disclose statistically significant losses as much as gains. While it can be expected that the size of the estimates differ with the length of the period of the calculations, the differences in statistical significance of the estimates may seem less intuitive. In the next sections we explore in more detail potential explanations for our findings.

6. How to make sense out of it?

6.1. Why it may be hard to beat T-Bills on an annual basis?

The analysis of the YR-based performance measures shows that the funds do not outperform T-bills (Table 2), while the ACR-based measures (Table 4) document that they do. It may seem a bit puzzling why the funds outperform the PPBs but fail to outperform the T-bills, even though the coefficients estimated for the R-Tbills are frequently comparable with those estimated for R-PPB. Clearly, the difference is in the size of the standard errors. If the funds succeed in tracking their PPBs, R-PPBs may have a smaller variance than R-Tbills. Indeed, the more volatile the PPBs are in comparison with the T-bills, the higher the volatility of the R-Tbills will be which may affect statistical significance of the performance statistics based on the T-bills in the panel regressions.

Moreover, many of the estimates for R-Tbills presented in Table 4 are smaller than the equivalent statistics presented in Table 2, yet this time they are highly statistically significant. Again, the difference seems to be in the size of the standard errors. It is important to keep in mind that the ACRs based regressions look 'directly' at the variability of the performance measures across the funds, i.e., the 'within-fund' variability is suppressed by compounding. Therefore, it does not really matter how volatile R-Tbills were for each fund, because the statistical significance of the averages presented in Table 4 tells us that the variability across the funds was low.

To make these points more formally, let us assume that a manager can create a portfolio, P, that earns a mean return R_P, has the same risk as the PPB, i.e., $\sigma_P = \sigma_{PPB}$, and is perfectly correlated with the PPB. 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 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 attempt to create portfolios that (i) have risk similar to the risk of their PPBs and (ii) have higher average returns, while there is a little variation 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 may be small. This would result in high statistical significance of the results.

6.2. Arithmetic and geometric returns

It could also be puzzling that the performance statistics estimated for the YR-based measures are not always bigger than those for the ACR-based measures. Surely, the ACR based R-Tbills or R-PPR should not exceed their arithmetic means. It is important to stress that the comparison between Tables 2 and 4, and Tables 3 and 5 is not a straightforward comparison between geometric and arithmetic returns. Tables 2 and 3 show the average (after controlling for fund and year specific effects) performance statistics, while Tables 4 and 5 show the results of cross-sectional regressions. In other words, the YR-based measures are not arithmetic mean equivalents of the ACR-based measures.

By definition, it is impossible to construct a panel of total compounded returns. Therefore, to show that the findings documented in Tables 2-5 result from distinguishing between returns calculated over the whole period of operation and returns calculated for shorter time intervals we have repeated the analysis using the performance measures based on the AARs and YLRs.

The AARs similarly to ACRs inform about the funds' performance over the whole operational life safe that the AARs are the arithmetic averages while the ACRs are the geometric averages (both annualised). Following from that it can be expected that the estimates obtained for the AAR-based measures should be higher than those estimated for the ACR-based measures.

To further test robustness of our findings and correctness of the argument that the period of return calculations matters, we repeated the panel analysis using log-returns, YLRs. By construction log-returns are easily convertible into total returns and this might create an expectation that using long returns in a panel regression answers the question about the total return (after de-logging the results). This is, however, not the case as the nature of the panel regressions preserves the focus on the 'within-fund' variability and impacts on statistical significance of the findings.

To save space we present the results for the 1980-2009 and the 1980-2007 periods as these are most important from the long-term perspective. Tables 6 and 7 present the regression results estimated for the AAR-based and the YLR-based measures respectively. The estimates of R-PPB, M^2, R-Tbill for the YLR-based regressions have been multiplied by 100 to make them comparable with those presented in the other tables.

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

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

It is clear that Tables 6 and 7 repeat closely the pattern of statistical significance of Tables 4 and 2 respectively (save for the fact that Table 7 shows the results for AdjSharpe and the Sortino ratios and does not show the PPB-unrestricted sample results). The YLR-based regressions, like the equivalent YR-based regressions, show that the funds are quite successful in outperforming their PPBs but not so good at outperforming the T-bills. The AAR-based regressions, like the ACR-based counterparts, show that the funds outperform both their PPBs and the T-bills. These results strengthen the argument presented in Section 6.1 that the statistical significance is related to the way the returns are calculated, i.e., whether the regressions are used to assess performance over a particular period of time or its sub-periods.

The comparison of Tables 4 and 6 also shows that, consistent with our expectations, using arithmetic averaging inflates the performance statistics as the AAR-based performance statistics of Table 6 exceed the ACR-based statistics of Table 4.

At this point one could still wonder how it is possible that so much outperformance is found. The next section sheds some light on the issue.

6.3. How to beat the benchmark?

The regression results presented so far show consistently that pension funds outperform their PPBs. The level of outperformance is statistically and economically significant. For instance, the UK-E funds have the ACR 1.98% higher than their PPBs (i.e., FTSE All Shares in 86% of cases, and the remaining cases sub-indices of FTSE) over the period 1980-2009 (Table 4). This outperformance increases to 2.84% when the financial crisis years are excluded from the analysis. The differences are too high to be potentially attributed to inefficiencies of the FTSE index. A similar argument applies to all the other investment styles: it cannot be expected that all the other benchmarks

are inefficient enough to explain the high levels of the outperformance. How is it then possible that the funds outperform their PPBs?

A possible explanation of this ability to outperform the PPBs is that the PPBs are inefficient given the true asset spectrum invested in by pension funds. Figure 2 presents a simple illustration of how managers could outperform their PPBs when they invest in a broader asset class than used to calculate 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. If the Sharpe ratio is the measure of performance, replicating the PPB allocation is the best a fund can do (ignoring transaction costs). However, if funds are allowed to invest outside their PPBs, then enriching their portfolios by assets that have low correlation with the assets included in their PPB expands the frontier, as shown by the dotted line.[13]

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

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 fund managers are expected to track their PPB, the best strategy may be to try to create a portfolio along the line P-PPB. 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 losses 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 may not even be achieving their efficient position given their investment constraint.

[13] Given that it is rather unlikely that perfectly negative assets will be added to the existing 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.

To illustrate that the above argument can explain the scale of the outperformance we look more closely at the UK-E funds as this group has the highest level of PPB homogeneity. We calculate 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 indexes commonly used as PPBs for EM-E funds. More specifically, we used MSCI Emerging Market index, MSCI Emerging Markets–Latin America index, MSCI Pacific except Japan index, as well as MSCI indexes 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 indexes 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 the 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 the 80-20 portfolio outperformed the FTSE All Share index in nominal and risk adjusted terms for all the emerging markets indexes used to construct the portfolio and all the sub-periods. Moreover, the level of outperformance is substantial and comparable with the performance statistics reported in Table 4 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' indexes 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 possible that the UK-E funds outperformance of their PPBs may be a consequence of some fraction of their AUM being invested in assets other than stocks listed on the LSE. This diversification outside the main ABI specialisation classification allows the funds to outperform their PPBs. There is formally nothing to complain about, as such diversification benefits contributors but it is hard to consider the current PPBs a real investment challenge.

To further illustrate the risk-return characteristics of the sample, Figure 3 shows the annualised ACRs versus their corresponding standard deviations for the funds and their PPBs. It shows the averages for all the funds (ALL) and the six individual investment styles for the four combinations of the sub-samples and the periods as presented in Tables 4-5.[14]

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

The graphical representation of the statistics hidden behind the differences presented in Tables 4 and 5 helps to visualise the extent to which funds' returns are positioned vertically above the returns earned by the PPBs on the risk-return plain. This suggests that the explanation for the UK-E funds provided above, that funds diversify their portfolios beyond assets defining their PPBs, is quite plausible for all the investment styles. It is interesting that the outperformance of the PPBs is so strongly visible for the funds that were created during the financial crisis. These funds have very few observations, yet, they are already structured in such a way that, on average, they outperform their benchmarks.

Figure 3 also indicates that relying on the PPB-related performance measures may create a spurious feeling of safety. The period used in the study stretches between 1980-2009 but, as Figure 1 illustrates, the majority of the funds have been created between 2000-2009, with more than a half being created between 2005 and 2009, i.e., when equity markets grew sharply before the financial crisis and then sharply declined during the financial crisis. In general, the 2000-2009 period has not been easy for equity investors. The collapse of the markets after the burst of the dot-com boom resulted in substantial losses and the shift to 'safer' fixed income investments have resulted in low returns on bonds.

Given that funds, despite being more volatile, struggle to statistically outperform T-bills on an annual basis and that the funds outperform the PPB suggests that it might be expected that the PPBs do not outperform the T-bills either. However, it is not clear

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

what the performance of the PPBs based on compounded returns is. Table 9 suggest that it is not particularly good. To minimise multiple counting of PPBs, which could occur when several funds with the same PPB were opened in a same calendar month, the regressions are run under the restriction that if several funds were incepted with the same PPB at the same calendar month, that PPB enters the regressions only once. This procedure reduced the number of observations by half with the strongest impact on the UK-E PPBs whose representation declined from 1,364 to 303 entries. Moreover, given that all the benchmarks were created before 2008, there are no 'old' and 'new' PPBs and Table 9 provides one set of performance statistics for 2008-2009.

********** insert Table 9 here **********

The performance statistics based on YRs and ACRs resemble those presented in Tables 2 and 3 for funds. In the case of the PPBs, as with funds, there is robust evidence of statistical outperformance for the EM-E PPBs. In contrast with the statistics the FI PPBs show stronger statistical outperformance during the financial crisis but also a stronger statistical underperformance in the years before the financial crisis. The ACR-based performance (Panel B) also confirms the earlier results for the equity and the FI investment styles.

The multiple entries of the PPBs have been restricted by removing those observations that had several identical PPBs entering in the same calendar month, but this might not be enough to completely overcome overrepresentation of some periods of high entry by the pension funds. Therefore, the reported statistics may be still driven by high concentration of observations in particular periods of time.

7. Summary and Conclusions

This paper provides the first comprehensive and large scale analysis of the performance of personal pension funds in relation to their Primary Prospectus Benchmarks (PPBs). The study covers 9,659 personal pension funds from across 30 ABI investment sectors that operated in the UK between 1980 and 2009. We succeeded

in reconstructing returns of the PPBs for 4,531 pension funds, and use these returns to assess the funds perform in relation to these benchmarks. The performance measured by ordinary excess returns over the UK T-bills and over PPBs, as well as the Sharpe ratio, Sharpe ratio adjusted for skewness and kurtosis, Sortino ratio in relation to the UK T-bills and PPBs, and the Modigliani-Modigliani measure (M^2) are calculated for arithmetic, geometric and log returns. The results reveal that in contrast with the previous research, pension funds may be performing better than previously reported, at least with regard to benchmarks. Below we provide a brief summary of the findings and a discussion of the implications of the research. Two, interconnected implications seem to be particularly important.

The results reveal that in contrast with the previous research, having looked at different horizons and broader set of investment styles, 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 the annual and the long-term basis. 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 2.17% higher than those of T-bills over the period 1980-2009, and 3.46% for the 1980-2007 period. This means that if annual fees are about 1%-1.8%, contributors may still be left with a bit more than an investment in the T-bills would deliver, unless hidden charges wipe out even those small gains.[15] The funds specialising in emerging markets equities are, on average, most profitable delivering 10.8% and 26.70% over the 1980-2009 and 1980-2007 period respectively. The next in line are the funds specialising in international equities with the returns 2.79% and 4.476% over the 1980-2009 and 1980-2007 period respectively. The performance of the most common investment styles (allocation, fixed income and domestic, i.e., UK, equity) is not so impressive. The funds specialising in UK equity were particularly badly affected by the market crash of during the financial crisis. The fixed income focused funds have provided a better shelter during the financial crisis, but their pre-crisis performance was not that impressive. The allocation funds, as a combination of fixed income and equity funds, provide some smoothing of the fluctuations of the fixed income and equity portfolios, but overall their performance

[15] There is 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)

seems inferior to that of funds specialising in oversees equities. This result is consistent with the diversification argument, however, does not offer an ultimate solution for pension saving allocation. The risk of overseas funds, and in particular those specialising in emerging markets, is much higher than the risk of any other investment styles. This, high risk exposure may not be agreeable with a preferred risk profile of many pension contributors. Moreover, the reported high returns earned by the emerging market indexes and the funds specialising in emerging markets should be treated with caution.

The performance analysis based on annual returns shows that on average pension funds outperformed their PPBs but did not outperform T-bills, except for funds specialising in emerging markets equity. This finding indicates that the analysis of the performance of pension funds using average yearly returns may be misleading. This is because if in the short-run pension funds attempt to mimic, to some extent, risk-return characteristics of their assigned benchmarks, then the lack of statistical significance of the annual excess returns may result from high risk differentials between the PPBs and the T-bills. However, in the long-run, i.e., when 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.

There are two interconnected implications stemming from these results. The first concerns benchmarks and whether they are challenging or not. The paper shows that all investment styles outperform the PPBs both on an annual and long term basis. This suggests that the benchmarks that funds choose are not particularly challenging. We argue that this may be the result of funds investing in broader asset classes than those used to define their PPBs. For example, funds are allowed to invest up to 20% of the AUM in a broader asset class than those defining their PPB. Such investment practices are not forbidden and are consistent with the ABI classification but make the existing PPBs inefficient benchmarks. The paper uses an example of an 80-20 allocation between the FTSE All Share Index and selected emerging market indexes to illustrate that such a strategy can deliver substantial returns and be a plausible explanation of the scale of outperformance identified in the paper. Outperforming the benchmark seems a desirable thing, but this has limited value if it is achieved in an inefficient way, e.g., by adopting a non-challenging benchmark rather than one that is a true reflection of the investment strategies available to the fund. Tying a portfolio's risk to the one of its benchmark is likely to result in sub-optimal asset allocation than could be achieved if

the full scale of investment opportunities for investment asset classes included in the portfolio were explored. Our research suggests that benchmarks, and the fact that funds have beaten the benchmark, would be far more informative if the benchmarks were a better reflection of the underlying investment strategy permitted within the relevant ABI classification of the fund. Currently these are not available for investors. This raises the question whether there should be greater scrutiny of the process of opening new pension funds and monitoring their subsequent performance.

The second implication relates to the timeframe. The results of the paper show that the annual and the long-term performance of funds differ not just in levels but also in statistical significance. Using geometric averaging to assess the long-tern performance shows greater statistical significance in comparison with T-bills compared to those based on yearly returns. This distinction between timeframe is not observed with PPBs. This seems to be a result of pension funds being constructed to have similar risk characteristics as those of the PPBs and being more diversified. So, as is shown in the paper, a focus on short-term assessments does not typically provide statistically significant measures of comparative performance against T-bills and so pushes the focus towards PPBs, which as we have indicated are not unduly challenging. Broadening the focus toward inclusion of longer term assessment of performance would increase the scope for statistically significant assessment against T-bills. T-bills are less volatile than equity, and even bonds, so if an investor wishes to get some understanding of how much money he/she can hope to have in their pension pot at retirement, it may be more informative to test the investment in terms of its return above the average T-bill rate than above a more volatile index. Thus bringing additional longer term performance assessment increases the scope for assessment and can help broaden the focus beyond performance against PPBs.

8. References

Ambachtsheer K, Capelle R, Sheibelhut T (1998) Improving Pension Fund Performance. Financial Analysts Journal 54(6): 15-21

Antolin P (2008) Pension Fund Performance. OECD Working Papers on Insurance and Private Pensions

Aydogdu M, Wellman JW (2011) The effects of advertising on mutual fund flows: Results for a new database. Financial Management 40(3): 785-809

Asset Management in the UK 2012-2013: The IMA Annual Survey (2013) Investment Management Association (IMA), London

Blake D (2003) Pension Schemes and Pension Funds in the United Kingdom. Oxford University Press

Blake D, Lehmann BN, Timmermann A (1999) Asset Allocation Dynamics and Pension Fund Performance. Journal of Business 72(4): 429-461

Blake D, Lehmann BN, Timmermann A (2002) Performance clustering and incentives in the UK pension fund industry. Journal of Asset Management 3(2): 173 - 194

Blake D, Timmermann A (1998) Mutual Fund Performance: Evidence from the UK. European Finance Review 2(1): 57-77

Blum ME, Friend I (1975) The asset structure of individual portfolios and some implications for utility functions. Journal of Finance 30(2): 585-603

Bollen NPB, Busse JA (2005) Short-Term Persistence in Mutual Fund Performance. Review of Financial Studies 18(2): 569-597

Brown SJ, Goetzmann WN (1995) Performance Persistence. Journal of Finance 50(2): 679-698

Brown G, Draper P, McKenzie E (1997) Consistency of UK Pension Fund Investment Performance. Journal of Business Finance & Accounting 24(2): 155-178

Campbell JY, Viceira LM (2002) Strategic asset allocation: portfolio choice for long-term investors, Oxford University Press, USA

Capocci D, Corhay A, Hübner G (2005) Hedge fund performance and persistence in bull and bear markets. European Journal of Finance 11(5): 361-392

Carhart MM (1997) On Persistence in Mutual Fund Performance. Journal of Finance 52(1): 57-82

Chan L, Dimmock S, Lakonishok J (2009) Benchmarking money manager performance: Issues and evidence. Review of Financial Studies 22(11): 4553-4599

Chen SS (2009) Predicting the bear stock market: Macroeconomic variables as leading indicators. Journal of Banking & Finance 33(2): 211-223

Chordia T, Roll R, Subrahmanyam A (2001) Market liquidity and trading activity. Journal of Finance 56(2): 501-530

Cochrane JH (2014) A mean-variance benchmark for intertemporal portfolio theory. Journal of Finance 69(1): 1-49

Coggin TD, Fabozzi FJ, Rahman S (1993) The Investment Performance of U.S. Equity Pension Fund Managers: An Empirical Investigation. Journal of Finance 48(3): 1039-1055

Cohen R, Coval J, Pastor L (2005) Judging fund managers by the company they keep. Journal of Finance 60: 1057-1096

Cooper MJ, Gulen H, Rau PR (2005) Changing names with style: mutual fund name changes and their effects on fund flows. Journal of Finance 60(6): 2825-2858

Cuthbertson K, Nitzsche D, O'Sullivan N (2008 UK mutual fund performance: Skill or luck? Journal of Empirical Finance 15(4): 613-634

Daniel K, Grinblatt M, Titman S, Wermers R (1997) Measuring Mutual Fund Performance with Characteristic-Based Benchmarks. Journal of Finance 52(3): 1035-1058

Davis JL (2001) Mutual Fund Performance and Manager Style. Financial Analysts Journal 57(1): 19-27

Dor AB, Jagannathan R, Meyer I (2003) Understanding mutual fund and hedge fund styles using return - based style analysis. Journal of Investment Management 1(1): 94-134

Driscoll JC, Kraay AC (1998) Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data. Review of Economics and Statistics 80: 549–560

Eling M, (2008) Does the Measure Matter in the Mutual Fund Industry? Financial Analysts Journal 64(3): 1-13

Elton EJ, Gruber MJ, Blake CR (1996) The persistence of risk-adjusted mutual fund performance. Journal of Business 69: 133-157

Elton EJ, Gruber MJ, Blake CR (2001) A first look at the accuracy of the CRSP mutual fund database and a comparison of the CRSP and Morningstar mutual fund databases. Journal of Finance 56: 2415-2450

Elton EJ, Gruber MJ, Blake CR (2011) Holdings data, security returns, and the selection of superior mutual funds. Journal of Financial and Quantitative Analysis 46(2): 341-367

Fabozzi FJ, Francis JC (1977) Stability tests for alphas and betas over bull and bear market conditions. Journal of Finance 32(4): 1093-1099

Fama EF, French KR (2010) Luck versus skill in the cross-section of mutual fund returns. Journal of Finance 65(5): 1915-1947

Ferson WE, Sarkissian S, Simin T (1999) The alpha factor asset pricing model: A parable. Journal of Financial Markets 2(1): 49-68

Financial Services Authority (FSA) (2008) Quality of advice on pension switching: A report on the findings of a thematic review. The Financial Services Authority, London.

Gonzalez L, Powell JG, Shi J, Wilson A (2005) Two centuries of bull and bear market cycles. International Review of Economics & Finance 14(4): 469-486

Grinblatt M, Titman S (1993) Performance measurement without benchmarks: an examination of mutual fund returns. Journal of Business 66: 47-68

Henriksson RD (1984) Market Timing and Mutual Fund Performance: An Empirical Investigation. Journal of Business 57(1): 73-96

Hibbert AM, Lawrence ER (2010) Testing the performance of asset pricing models in different economic and interest rate regimes using individual stock returns. ePublications@bond

Hinz RP, Heinz R, Antolin P (2010) Evaluating the financial performance of pension funds. Washington, D.C., World Bank Publications

Hoechle D (2007) Robust standard errors for panel regressions with cross-sectional dependence. Stata Journal 7(3): 281-312

Huij J, Verbeek M (2009) On the use of multifactor models to evaluate mutual fund performance. Financial Management 38 (1): 75-102

Ingersoll J, Spiegel M, Goetzmann W, Welch I (2007) Portfolio Performance Manipulation and Manipulation-proof Performance Measures. Review of Financial Studies 20(5): 1503-1546

Investment Company Institute (ICI) (2011) Characteristics of Mutual Fund Investors, 2011. October 2011, vol 11(6); www.ici.org/pdf/per17-06.pdf

Investment Company Institute (ICI) (2013) Investment Company Fact Book (2013) ed. 53rd; http://www.icifactbook.org/fb_ch2.html#us

Ippolito RA, Turner JA (1987) Turnover, Fees and Pension Plan Performance. Financial Analysts Journal 43(6): 16-26

Jensen MC, Black F, Scholes MS (1972) The capital asset pricing model: Some empirical tests. Michael C. Jensen, Studies in the Theory of Capital Markets, Praeger Publishers Inc.

Khotari SP, Warner JB (2001) Evaluation mutual fund performance. Journal of Finance 56(5): 1985-2010

Klein A, Rosenfeld J (1987) The influence of market conditions on event-study residuals. Journal of Financial and Quantitative Analysis 22(3): 345-351

Kryzanowski L, Rahman A (2008). Portfolio performance ambiguity and benchmark inefficiency revisited. Journal of Asset Management 9, 321–332.

Lakonishok J, Shleifer A, Vishny RW, Hart O, Perry GL (1992) The Structure and Performance of the Money Management Industry. Brookings Papers on Economic Activity. Microeconomics 1992: 339-391.

Lo AW (2002) The Statistics of Sharpe Ratios. Financial Analysts Journal 58(4): 36-52

Maheu J M, McCurdy TH (2000) Identifying bull and bear markets in stock returns. Journal of Business & Economic Statistics 18(1): 100-112.

Massa M (2003) How do family strategies affect fund performance? When performance-maximization is not the only game in town. Journal of Financial Economics 67(2): 249-304

Modigliani F, Pogue GA (1974) An introduction to risk and return: Concepts and evidence. Financial Analysts Journal 30(3): 69-86

Modigliani F, Modigliani L (1997) Risk-adjusted performance. Journal of Portfolio Management 23(2): 45-54

Novy-Marx R, Bauh J (2011) Public pension promises: How big are they and what are they worth? Journal of Finance 64(4): 1211-1249

Peizer, J., and A. White (2006) The relative merits of investible hedge fund indices and of funds of hedge funds in optimal passive portfolios, ICMA DP Series DP2006-10

Phelps ES, Pollak RA (1968) On Second-Best National Saving and Game-Equilibrium Growth. Review of Economic Studies 35(2): 185-199

Rooij van M, Alessie R, Lusardi A (2011) Financial Literacy and Stock Market Participation. Journal of Financial Economics 101(2): 449-472

Roll R (1977) A critique of the asset pricing theory's tests Part I: On past and potential testability of the theory. Journal of Financial Economics 4(2): 129-176

Roll R, Ross SA (1994) On the Cross-Sectional Relation between Expected Returns and Betas. Journal of Finance 49(1): 101-121

Roy AD (1952) Safety First and the Holding of Assets. Econometrica 20(3): 431-449

Sensoy BA (2009) Performance evaluation and self-designated benchmark indexes in the mutual fund industry. Journal of Financial Economics 92(1): 25-39

Sharpe WF (1966) Mutual Fund Performance. Journal of Business 39(1): 119-138

Sortino FA, van der Meer R (1991) Downside risk. Journal of Portfolio Management 17(4): 27-31

Thomas A, Tonks I (2001) Equity performance of segregated pension funds in the UK. Journal of Asset Management 1(4): 321-343

Wilcox RR (2005) Winsorized Robust Measures. Encyclopedia of Statistics in Behavioral Science

Wood A, Young P, Crowther N, Toberman A (2012) Processes and costs of transferring a pension scheme: Qualitative research with pension providers and third-party administrators. Department for Work and Pensions, Working Paper 107

Vaze P, Roker R (2011) Is it advisable? An investigation into switching and advice in the individual personal pensions market. Consumer Focus

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 shows the statistics for all the funds for which information on returns for at least six months was available. Panel C 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 and 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 sample 1980-2007	
Style	Funds	Obs.	Funds	Obs.	Funds	Obs.	Funds	Obs.	Funds	Obs.
ALL of which	10,086	75,638	9,659	74,175	4,531	25,292	7,838	15,665	3,515	23,786
ALC	2,043	15,021	1,910	14,682	337	1,814	1,515	3,028	274	1,719
FI	1,427	10,844	1,357	10,649	630	3,586	1,125	2,250	480	3,367
Equity, of which	5,135	36,135	4,978	35,410	3,230	18,340	4,047	8,085	2,554	17,322
EM-E	259	1056	246	1,023	158	590	151	302	97	498
I-E	2,864	21,451	2,768	21,010	1,708	10,061	2,253	4,500	1,333	9,494
UK-E	2,012	13,628	1,964	13,377	1,364	7,689	1,643	3,283	1,124	7,330
Other	1,481	13,638	1,414	13,434	334	1,552	1,151	2,302	207	1,378
ALL of which	100%	100%	100%	100%	100%	100%	100.0%	100.0%	100%	100%
ALC	20.3%	19.9%	19.8%	19.8%	7.4%	7.2%	19.3%	19.3%	7.8%	7.2%
FI	14.1%	14.3%	14.0%	14.4%	13.9%	14.2%	14.4%	14.4%	13.6%	14.2%
Equity, of which	50.9%	47.8%	51.5%	47.7%	71.3%	72.5%	51.6%	51.6%	72.7%	72.8%
EM-E	2.6%	1.4%	2.5%	1.4%	3.5%	2.3%	1.9%	1.9%	2.8%	2.1%
I-E	28.4%	28.4%	28.7%	28.3%	37.7%	39.8%	28.7%	28.7%	38.0%	39.9%
UK-E	19.9%	18.0%	20.3%	18.0%	30.1%	30.4%	21.0%	21.0%	31.9%	30.8%
Other	14.7%	18.0%	14.6%	18.1%	7.4%	6.1%	14.7%	14.7%	5.9%	5.8%

Table 2. Performance of pension funds based on the PPB-restricted (Panels A and C) and PPB-unrestricted (Panels B and D) samples based on yearly returns (YRs, %) calculated over 1980-2009 (Panels A and B) and over 1980-2007 (Panels C and D) with Driscoll-Kraay standard errors. Fund and year fixed-effects included (not reported). P-values are shown in parenthesis. ***: 1% significance; **: 5% significance and *: 10% significance.

	1980-2009						1980-2007					
	Panel A: PPB-restricted sample				Panel B: PPB-unrestricted sample		Panel C: PPB-restricted sample				Panel D: PPB-unrestricted sample	
	R-PPB	M^2	R-Tbill	Sharpe	R-Tbill	Sharpe	R-PPB	M^2	R-Tbill	Sharpe	R-Tbill	Sharpe
ALL	2.573***	2.970***	3.004	0.311	1.890	-0.234	2.613***	2.003***	4.092	0.337*	2.437	-0.257
	(0.000)	(0.000)	(0.499)	(0.217)	(0.554)	(0.750)	(0.000)	(0.000)	(0.132)	(0.081)	(0.275)	(0.648)
Funds	4,531	4,531	4,531	4,531	9,659	9,659	3,305	3,305	3,305	3,305	7,405	7,405
Obs.	25,292	25,292	25,292	25,292	74,175	74,175	16,756	16,756	16,756	16,756	55,376	55,376
ALC	2.950***	3.495***	1.952	0.358	1.586	0.631	2.505***	1.940***	2.794	0.363	2.258	0.767
	(0.000)	(0.002)	(0.671)	(0.297)	(0.627)	(0.482)	(0.000)	(0.000)	(0.407)	(0.188)	(0.385)	(0.293)
Funds	337	337	337	337	1,910	1,910	246	246	246	246	1,414	1,414
Obs.	1,814	1,814	1,814	1,814	14,682	14,682	1,171	1,171	1,171	1,171	11,027	11,027
FI	3.135***	3.080***	1.317	0.095	1.049	0.119	3.446***	3.191***	-0.124	-0.071	0.128	-0.152
	(0.002)	(0.000)	(0.434)	(0.695)	(0.469)	(0.868)	(0.000)	(0.000)	(0.890)	(0.735)	(0.889)	(0.822)
Funds	630	630	630	630	1,357	1,357	456	456	456	456	1,076	1,076
Obs.	3,586	3,586	3,586	3,586	10,649	10,649	2,407	2,407	2,407	2,407	7,982	7,982
EM-E	2.557***	5.180**	18.620*	1.087***	16.712**	2.604**	0.859	-0.360	19.29***	1.048***	17.043***	2.626***
	(0.001)	(0.049)	(0.054)	(0.003)	(0.050)	(0.019)	(0.122)	(0.454)	(0.000)	(0.000)	(0.000)	(0.000)
Funds	158	158	158	158	246	246	90	90	90	90	138	138
Obs.	590	590	590	590	1,023	1,023	304	304	304	304	579	579
I-E	2.326***	2.700***	3.272	0.321	2.524	0.639	2.036***	1.311***	4.890	0.397**	3.427	0.831
	(0.000)	(0.004)	(0.435)	(0.101)	(0.500)	(0.321)	(0.000)	(0.000)	(0.142)	(0.028)	(0.295)	(0.187)
Funds	1,708	1,708	1,708	1,708	2,768	2,768	1,262	1,262	1,262	1,262	2,138	2,138
Obs.	10,061	10,061	10,061	10,061	21,010	21,010	6,828	6,828	6,828	6,828	15,584	15,584
UK-E	2.727***	3.147***	2.620	0.417	2.452	1.006	3.376***	2.605***	4.828	0.564**	4.034	1.496*
	(0.000)	(0.000)	(0.677)	(0.259)	(0.649)	(0.380)	(0.000)	(0.000)	(0.154)	(0.047)	(0.218)	(0.098)
Funds	1,364	1,364	1,364	1,364	1,964	1,964	1,051	1,051	1,051	1,051	1,547	1,5470
Obs.	7,689	7,689	7,689	7,689	13,377	13,377	5,082	5,082	5,082	5,082	9,484	9,484
Other	1.662	2.136	2.430	-0.133	0.210	-4.276***	1.284***	1.592***	1.837	-0.524***	0.698	-4.676***
	(0.177)	(0.211)	(0.487)	(0.559)	(0.904)	(0.000)	(0.003)	(0.002)	(0.220)	(0.000)	(0.512)	(0.000)
Funds	334	334	334	334	1,414	1,414	200	200	200	200	1,092	1,092
Obs.	1,552	1,552	1,552	1,552	13,434	13,434	964	964	964	964	10,720	10,720

Table 3. Performance of pension funds based on PPB-restricted (Panels A and C) and the PPB-unrestricted (Panels B and D) samples of the yearly returns (YRs, %) over 2008-2009 with Driscoll-Kraay standard errors. Fund and year fixed-effects included (not reported). P-values are shown in parenthesis. ***: 1% significance; **: 5% significance and *: 10% significance.

	Funds created in the 1980-2007 period						Funds created in the 2008-2009 period					
	Panel A: PPB-restricted sample				Panel B: PPB-unrestricted sample		Panel C: PPB-restricted sample				Panel D: PPB-unrestricted sample	
	R-PPB	M^2	R-Tbill	Sharpe	R-Tbill	Sharpe	R-PPB	M^2	R-Tbill	Sharpe	R-Tbill	Sharpe
ALL	2.245*	4.653***	-1.420	0.127	-1.380	-0.589	3.201***	5.835***	12.717**	0.905***	9.443	2.314*
	(0.088)	(0.003)	(0.908)	(0.829)	(0.898)	(0.779)	(0.003)	(0.000)	(0.044)	(0.004)	(0.216)	(0.088)
Funds	3,515	3,515	3,515	3,515	7,838	7,838	1,015	1,015	1,015	1,015	1,820	1,820
Obs.	7,030	7,030	7,030	7,030	15,665	15,665	1,506	1,506	1,506	1,506	2,637	2,637
ALC	3.412**	5.996***	-0.929	0.229	-1.885	-0.269	4.571**	8.254***	8.972	1.105**	7.082	2.925*
	(0.011)	(0.000)	(0.933)	(0.747)	(0.859)	(0.913)	(0.019)	(0.002)	(0.176)	(0.016)	(0.257)	(0.059)
Funds	274	274	274	274	1,515	1,515	63	63	63	63	394	394
Obs.	548	548	548	548	3,028	3,028	95	95	95	95	559	559
FI	2.153	2.559	3.545	0.313	3.238	0.624	3.256	3.618*	7.487***	0.966***	8.768**	3.521***
	(0.500)	(0.259)	(0.320)	(0.381)	(0.416)	(0.620)	(0.124)	(0.084)	(0.006)	(0.000)	(0.033)	(0.003)
Funds	480	480	480	480	1,125	1,125	150	150	150	150	232	232
Obs.	960	960	960	960	2,250	2,250	219	219	219	219	334	334
EM-E	3.502***	9.684***	7.659	0.798	8.567	1.739	6.753***	15.07***	21.95***	1.881***	36.124**	4.402**
	(0.003)	(0.009)	(0.769)	(0.418)	(0.731)	(0.594)	(0.000)	(0.000)	(0.001)	(0.000)	(0.017)	(0.017)
Funds	97	97	97	97	151	151	61	61	61	61	95	95
Obs.	194	194	194	194	302	302	92	92	92	92	132	132
I-E	2.783*	5.366***	-2.251	0.062	-1.725	-0.191	3.719***	6.577***	11.240**	0.691***	8.583	1.654
	(0.072)	(0.008)	(0.848)	(0.897)	(0.881)	(0.909)	(0.000)	(0.000)	(0.046)	(0.005)	(0.255)	(0.127)
Funds	1,333	1,333	1,333	1,333	2,253	2,253	374	374	374	374	515	515
Obs.	2,666	2,666	2,666	2,666	4,500	4,500	567	567	567	567	769	769
UK-E	1.619***	4.569***	-3.675	0.042	-3.173	-0.487	-0.485	1.878***	11.700	0.773*	7.700	1.464
	(0.000)	(0.000)	(0.823)	(0.956)	(0.842)	(0.856)	(0.153)	(0.000)	(0.166)	(0.052)	(0.475)	(0.402)
Funds	1,124	1,124	1,124	1,124	1,643	1,643	240	240	240	240	321	321
Obs.	2,248	2,248	2,248	2,248	3,283	3,283	359	359	359	359	483	483
Other	0.256	1.237	-0.245	0.132	-3.306	-3.428	6.628**	8.571**	13.513**	1.177***	8.128	2.034*
	(0.942)	(0.768)	(0.980)	(0.802)	(0.620)	(0.141)	(0.013)	(0.014)	(0.025)	(0.000)	(0.205)	(0.072)
Funds	207	207	207	207	1151	1,151	127	127	127	127	263	263
Obs.	414	414	414	414	2302	2,302	174	174	174	174	360	360

Table 4. Performance of pension funds based on the PPB-restricted annualised compounded returns (ACRs, %) over 1980-2009 (Panel A) and over 1980-2007 (Panel B) with standard errors clustered by provider. P-values are shown in parenthesis. ***: 1% significance; **: 5% significance and *: 10% significance.

	Panel A: 1980-2009							Panel B: 1980-2007						
	R-PPB	M^2	R-Tbill	Sharpe	SharpeAdj	$Sortino_{TB}$	$Sortino_{PPB}$	R-PPB	M^2	R-Tbill	Sharpe	SharpeAdj	$Sortino_{TB}$	$Sortino_{PPB}$
ALL	2.146***	2.616***	2.174***	0.175***	0.149***	0.750***	0.135**	2.262***	1.946***	3.463***	0.221***	-0.010	0.512***	0.357***
	(0.310)	(0.265)	(0.727)	(0.049)	(0.046)	(0.212)	(0.065)	(0.230)	(0.185)	(0.736)	(0.065)	(0.026)	(0.103)	(0.046)
Funds	4,531	4,531	4,531	4,531	4,531	4,531	4,441	3,305	3,305	3,305	3,305	3,305	3,305	3,272
ALC	3.154***	3.662***	1.757*	0.202**	0.188**	0.993**	0.311***	1.633***	1.569***	1.373*	0.114	-0.001	0.248*	0.254**
	(0.240)	(0.457)	(0.858)	(0.084)	(0.081)	(0.381)	(0.052)	(0.440)	(0.387)	(0.698)	(0.092)	(0.033)	(0.136)	(0.101)
Funds	337	337	337	337	337	337	325	246	246	246	246	246	246	239
FI	1.942***	2.657***	2.033***	0.273***	0.260***	1.069***	0.363***	2.464***	2.352***	-1.531***	-0.390***	0.029	-0.537***	0.689***
	(0.363)	(0.340)	(0.514)	(0.059)	(0.058)	(0.278)	(0.083)	(0.293)	(0.301)	(0.279)	(0.067)	(0.020)	(0.095)	(0.090)
Funds	630	630	630	630	630	630	625	456	456	456	456	456	456	455
EM-E	1.622**	2.845***	10.812***	0.469***	0.396***	1.251**	0.063	-1.201	-2.881*	26.695***	1.456***	0.312***	3.364***	-0.270
	(0.628)	(0.570)	(1.875)	(0.094)	(0.078)	(0.465)	(0.051)	(1.432)	(1.422)	(1.590)	(0.093)	(0.048)	(0.296)	(0.262)
Funds	158	158	158	158	158	158	158	90	90	90	90	90	90	90
I-E	2.078***	2.585***	2.790***	0.167***	0.133***	0.543***	0.146***	2.023***	1.737***	4.476***	0.327***	0.002	0.701***	0.283***
	(0.363)	(0.290)	(0.842)	(0.051)	(0.046)	(0.157)	(0.049)	(0.263)	(0.199)	(0.675)	(0.053)	(0.024)	(0.100)	(0.041)
Funds	1,708	1,708	1,708	1,708	1,708	1,708	1,708	1,262	1,262	1,262	1,262	1,262	1,262	1,262
UK-E	1.976***	2.249***	1.359	0.075	0.056	0.608**	0.074	2.841***	2.454***	3.343***	0.331***	-0.058	0.597***	0.404***
	(0.467)	(0.387)	(0.847)	(0.055)	(0.053)	(0.271)	(0.115)	(0.245)	(0.200)	(0.973)	(0.085)	(0.037)	(0.128)	(0.045)
Funds	1,364	1,364	1,364	1,364	1,364	1,364	1,364	1,051	1,051	1,051	1,051	1,051	1,051	1,051
Other	2.811***	3.024***	3.036***	0.272***	0.244***	1.309***	-0.340	2.606***	2.303***	1.362	-0.045	-0.079*	0.321	0.202
	(0.583)	(0.524)	(0.946)	(0.077)	(0.073)	(0.341)	(0.347)	(0.548)	(0.460)	(1.014)	(0.102)	(0.042)	(0.199)	(0.222)
Funds	334	334	334	334	334	334	261	200	200	200	200	200	200	175

Table 5. Performance of pension funds based on the PPB-restricted annualised compounded returns (ACRs, %) created in the 1980-2007 period (Panel A) and in the 2008-2009 period (Panel B). The performance is measured over the 2008-2009 period. Standard errors clustered by provider. P-values are shown in parenthesis. ***: 1% significance; **: 5% significance and *: 10% significance.

	Panel A: Funds created in the 1980-2007 period							Panel B: Funds created in the 2008-2009 period						
	R-PPB	M^2	R-Tbill	Sharpe	SharpeAdj	$Sortino_{TB}$	$Sortino_{PPB}$	R-PPB	M^2	R-Tbill	Sharpe	SharpeAdj	$Sortino_{TB}$	$Sortino_{PPB}$
ALL	2.012***	2.177***	-5.004***	-0.194***	-0.025	-0.247***	0.107**	1.479	3.157***	11.254***	0.842***	0.756***	4.271***	-0.048
	(0.277)	(0.262)	(0.222)	(0.011)	(0.023)	(0.021)	(0.047)	(1.321)	(1.084)	(2.524)	(0.176)	(0.162)	(1.150)	(0.254)
Funds	3,515	3,515	3,516	3,516	3,516	3,516	3,470	1,015	1,015	1,015	1,015	1,015	1,015	957
ALC	3.170***	3.320***	-3.223***	-0.163***	-0.010	-0.229***	0.210*	3.786***	6.221***	9.888***	1.141***	1.099***	10.084**	0.492***
	(0.656)	(0.582)	(0.247)	(0.013)	(0.031)	(0.019)	(0.109)	(0.586)	(1.122)	(2.085)	(0.221)	(0.216)	(4.212)	(0.149)
Funds	274	274	274	274	274	274	266	63	63	63	63	63	63	58
FI	1.808***	2.494***	2.207***	0.214***	0.026	0.538***	0.294***	1.546	3.146**	8.163***	1.047***	1.024***	5.386***	0.175
	(0.443)	(0.375)	(0.371)	(0.027)	(0.019)	(0.060)	(0.084)	(1.151)	(1.261)	(1.850)	(0.234)	(0.234)	(1.778)	(0.280)
Funds	480	480	480	480	480	480	478	150	150	150	150	150	150	146
EM-E	2.338***	2.722***	-4.262***	-0.091***	0.271***	-0.126***	0.118***	2.322	5.380***	16.954***	0.722***	0.594***	4.391	0.049
	(0.494)	(0.625)	(0.735)	(0.024)	(0.058)	(0.037)	(0.024)	(1.481)	(0.952)	(4.533)	(0.239)	(0.198)	(3.128)	(0.113)
Funds	97	97	97	97	97	97	97	61	61	61	61	61	61	61
I-E	2.266***	2.361***	-5.175***	-0.203***	-0.010	-0.309***	0.136***	2.010	3.784***	13.102***	0.772***	0.641***	2.474***	0.068
	(0.127)	(0.142)	(0.151)	(0.005)	(0.023)	(0.008)	(0.011)	(1.559)	(1.305)	(3.161)	(0.196)	(0.166)	(0.654)	(0.210)
Funds	1,333	1,333	1,334	1,334	1,334	1,334	1,333	374	374	374	374	374	374	374
UK-E	1.816***	1.832***	-8.819***	-0.382***	-0.081**	-0.554***	0.068	-1.464	0.299	10.440**	0.778***	0.699***	4.217**	-0.638
	(0.462)	(0.449)	(0.215)	(0.010)	(0.032)	(0.013)	(0.083)	(2.753)	(2.178)	(3.909)	(0.247)	(0.239)	(1.467)	(0.596)
Funds	1,124	1,124	1,124	1,124	1,124	1,124	1,124	240	240	240	240	240	240	240
Other	0.231	0.367	-2.607***	-0.145*	-0.085**	-0.078	-0.550**	3.850***	4.135***	8.944***	0.837***	0.794***	5.401**	0.313
	(1.119)	(1.244)	(0.733)	(0.071)	(0.040)	(0.182)	(0.252)	(0.951)	(1.156)	(1.816)	(0.129)	(0.128)	(2.005)	(0.241)
Funds	207	207	207	207	207	207	172	127	127	127	127	127	127	78

Table 6. Performance of pension funds based on PPB-restricted annualised arithmetic average of monthly returns (AARs, %) over 1980-2009 (Panel A) and over 1980-2007 (Panel B) with standard errors clustered by provider. P-values are shown in parenthesis. ***: 1% significance; **: 5% significance and *: 10% significance.

	Panel A: 1980-2009							Panel B: 1980-2007						
	R-PPB	M^2	R-Tbill	Sharpe	SharpeAdj	$Sortino_{TB}$	$Sortino_{PPB}$	R-PPB	M^2	R-Tbill	Sharpe	SharpeAdj	$Sortino_{TB}$	$Sortino_{PPB}$
ALL	5.520***	5.968***	4.124***	0.269***	0.202***	0.906***	1.435***	2.393***	2.005***	4.349***	0.284***	0.065**	0.618***	0.383***
	(0.756)	(0.850)	(0.726)	(0.049)	(0.043)	(0.215)	(0.381)	(0.236)	(0.183)	(0.765)	(0.066)	(0.024)	(0.105)	(0.045)
Funds	4,531	4,531	4,531	4,531	4,31	4,531	4,441	3,305	3,305	3,305	3,305	3,305	3,305	3,272
ALC	3.362***	3.910***	2.771***	0.272***	0.227***	1.100***	1.701**	1.627***	1.556***	1.921**	0.163*	0.054	0.322**	0.269**
	(0.681)	(0.930)	(0.854)	(0.084)	(0.077)	(0.381)	(0.756)	(0.437)	(0.381)	(0.705)	(0.092)	(0.032)	(0.136)	(0.102)
Funds	337	337	337	337	337	337	325	246	246	246	246	246	246	239
FI	3.974***	4.487***	2.519***	0.319***	0.284***	1.154***	1.270***	2.463***	2.348***	-1.395***	-0.365***	0.070***	-0.496***	0.692***
	(0.493)	(0.530)	(0.525)	(0.060)	(0.050)	(0.280)	(0.187)	(0.296)	(0.303)	(0.282)	(0.067)	(0.022)	(0.096)	(0.091)
Funds	630	630	630	630	630	630	625	456	456	456	456	456	456	455
EM-E	17.741***	19.044***	16.266***	0.643***	0.471***	1.538***	1.343***	-0.887	-2.784*	29.145***	1.576***	0.395***	3.619***	-0.216
	(1.742)	(2.078)	(1.764)	(0.093)	(0.069)	(0.472)	(0.268)	(1.454)	(1.433)	(1.609)	(0.092)	(0.035)	(0.300)	(0.254)
Funds	158	158	158	158	158	158	158	90	90	90	90	90	90	90
I-E	6.728***	7.231***	5.160***	0.276***	0.184***	0.725***	0.690***	2.220***	1.831***	5.636***	0.402***	0.092***	0.832***	0.313***
	(0.920)	(1.026)	(0.838)	(0.051)	(0.039)	(0.159)	(0.135)	(0.278)	(0.201)	(0.703)	(0.054)	(0.023)	(0.102)	(0.042)
Funds	1,708	1,708	1,708	1,708	1,708	1,708	1,708	1,262	1,262	1,262	1,262	1,262	1,262	1,262
UK-E	3.737***	3.981***	2.167**	0.169***	0.134**	0.757***	0.657***	2.958***	2.514***	4.125***	0.394***	0.017	0.694***	0.424***
	(1.033)	(1.135)	(0.821)	(0.055)	(0.060)	(0.274)	(0.210)	(0.244)	(0.195)	(0.978)	(0.085)	(0.036)	(0.129)	(0.045)
Funds	1,364	1,364	1,364	1,364	1,364	1,364	1,364	1,051	1,051	1,051	1,051	1,051	1,051	1,051
Other	5.934***	6.309***	5.469***	0.366***	0.273***	1.478***	10.491*	2.780***	2.352***	2.507**	0.018	-0.002	0.450**	0.307*
	(0.741)	(0.884)	(1.093)	(0.081)	(0.065)	(0.347)	(5.648)	(0.589)	(0.480)	(1.065)	(0.103)	(0.047)	(0.204)	(0.172)
Funds	334	334	334	334	334	334	261	200	200	200	200	200	200	175

Table 7. Performance of pension funds based on PPB-restricted yearly log-returns (YLRs x100) calculated over 1980-2009 (Panels A and B) and over 1980-2007 (Panels C and D) with Driscoll-Kraay standard errors. Fund and year fixed-effects included (not reported). P-values are shown in parenthesis. ***: 1% significance; **: 5% significance and *: 10% significance.

	Panel A: 1980-2009							Panel B: 1980-2007						
	R-PPB	M^2	R-Tbill	Sharpe	SharpeAdj	$Sortino_{TB}$	$Sortino_{PPB}$	R-PPB	M^2	R-Tbill	Sharpe	SharpeAdj	$Sortino_{TB}$	$Sortino_{PPB}$
ALL	2.200***	2.700***	0.500	0.614	0.689	2.883*	5.192***	2.200***	1.804***	2.200	0.737	-0.559	2.686**	5.346***
	(0.000)	(0.000)	(0.904)	(0.454)	(0.852)	(0.051)	(0.000)	(0.000)	(0.000)	(0.411)	(0.240)	(0.849)	(0.016)	(0.000)
Funds	4,531	4,531	4,531	4,531	4,531	4,531	4,531	3,305	3,305	3,305	3,305	3,305	3,305	3,305
	25,292	25,292	25,292	25,292	25,292	25,292	25,292	16,756	16,756	16,756	16,756	16,756	16,756	16,756
ALC	2.700***	3.300***	0.400	0.936	1.715	3.022	6.048***	2.300***	1.810***	1.512	0.975	0.018***	0.015	0.975
	(0.000)	(0.001)	(0.930)	(0.395)	(0.721)	(0.123)	(0.000)	(0.000)	(0.000)	(0.660)	(0.298)	(0.000)	(0.660)	(0.298)
Funds	337	337	337	337	337	337	337	246	246	246	246	246	246	246
	1,814	1,814	1,814	1,814	1,814	1,814	1,814	1,171	1,171	1,171	1,171	1,171	1,171	1,171
FI	2.700***	2.900***	0.600	0.196	0.442	2.195	10.585***	3.100***	3.001***	-0.402	-0.268	-4.187	0.956	12.069***
	(0.007)	(0.000)	(0.682)	(0.800)	(0.909)	(0.114)	(0.000)	(0.000)	(0.000)	(0.680)	(0.695)	(0.239)	(0.429)	(0.000)
Funds	630	630	630	630	630	630	630	456	456	456	456	456	456	456
	3,586	3,586	3,586	3,586	3,586	3,586	3,586	2,407	2,407	2,407	2,407	2,407	2,407	2,407
EM-E	1.700***	4.200**	9.700	2.614**	17.814**	7.554***	2.536***	0.603	-0.302	13.70***	2.701***	11.598***	6.523***	1.501***
	(0.001)	(0.029)	(0.315)	(0.018)	(0.012)	(0.001)	(0.000)	(0.206)	(0.469)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Funds	158	158	158	158	158	158	158	90	90	90	90	90	90	90
	590	590	590	590	590	590	590	304	304	304	304	304	304	304
I-E	1.900***	2.400***	0.600	0.691	1.488	2.511**	3.413***	1.600***	1.004***	2.300	0.920	1.071	2.924***	3.170***
	(0.000)	(0.004)	(0.886)	(0.284)	(0.589)	(0.030)	(0.000)	(0.000)	(0.000)	(0.490)	(0.120)	(0.725)	(0.006)	(0.000)
Funds	1,708	1,708	1,708	1,708	1,708	1,688	1,688	1,262	1,262	1,262	1,262	1,262	1,262	1,262
	10,061	10,061	10,061	10,061	10,061	9,821	9,821	6,828	6,828	6,828	6,828	6,828	6,828	6,828
UK-E	2.500***	3.100***	-0.300	0.968	-0.851	3.614*	5.586***	3.000***	2.300***	3.205	1.560*	1.177	3.646**	6.170***
	(0.000)	(0.000)	(0.967)	(0.432)	(0.877)	(0.099)	(0.000)	(0.000)	(0.000)	(0.334)	(0.091)	(0.751)	(0.019)	(0.000)
Funds	1,364	1,364	1,364	1,364	1,364	1,364	1,364	1,262	1,262	1,262	1,262	1,262	1,262	1,262
	7,689	7,689	7,689	7,689	7,689	7,689	7,689	6,828	6,828	6,828	6,828	6,828	6,828	6,828
Other	1.300	1.300	0.400	-1.616**	-3.870	1.443	2.571***	0.900**	1.100**	0.401	-2.708***	-14.195***	-0.298	1.389***
	(0.221)	(0.396)	(0.887)	(0.034)	(0.226)	(0.221)	(0.000)	(0.034)	(0.015)	(0.792)	(0.000)	(0.000)	(0.659)	(0.000)
Funds	334	334	334	334	334	334	334	200	200	200	200	200	200	200
	1,552	1,552	1,552	1,552	1,552	1,552	1,552	964	964	964	964	964	964	964

Table 8. Annualised nominal and risk adjusted performance on portfolios consisting of 80% of the FTSE All Share Index and 20% of the 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

Table 9. Performance of PPBs under the restriction that if several funds were incepted with the same PPB at the same calendar month that PPB enters the regressions only once. YRs denotes yearly returns and ACRs denotes annualised compounded returns. P-values are shown in parenthesis. ***: 1% significance; **: 5% significance and *: 10% significance.

	Panel A: YRs						Panel B: ACRs					
	1980-2009		1980-2007		2008-2009		1980-2009		1980-2007		2008-2009	
	PPB-Tbill	Sharpe	PPB--Tbill	Sharpe	PPB--Tbill	Sharpe	PPB-Tbill	Sharpe	PPB--Tbill	Sharpe	PPB--Tbill	Sharpe
ALL	0.587	0.140	1.122	0.140	-0.703	0.142	0.550	0.050	1.154***	0.020	-2.547***	-0.017
	(0.863)	(0.442)	(0.668)	(0.425)	(0.939)	(0.708)	(0.495)	(0.307)	(0.010)	(0.612)	(0.009)	(0.761)
Funds	2,068	2,068	1,527	1,527	2,068	2,068	2,068	2,068	1,527	1,527	2,068	2,068
Obs.	13,253	13243	9,370	9,360	3,883	3,883						
ALC	-0.624	0.214	0.696	0.242	-3.195	0.203	-0.966	0.088	0.163	0.141	-4.157***	-0.036
	(0.874)	(0.426)	(0.824)	(0.311)	(0.729)	(0.694)	(0.284)	(0.419)	(0.702)	(0.126)	(0.001)	(0.764)
Funds	204	204	151	151	204	204	204	204	151	151	204	204
Obs.	1,135	1,135	750	750	385	385						
FI	-1.633*	-0.400**	-3.354***	-0.648***	2.348***	0.166**	0.206	-0.074	-3.712***	-0.796***	2.166***	0.152***
	(0.093)	(0.040)	(0.000)	(0.001)	(0.000)	(0.024)	(0.727)	(0.254)	(0.000)	(0.000)	(0.002)	(0.008)
Funds	384	384	286	286	384	384	384	384	286	286	384	384
Obs.	2,382	2,381	1,663	1,662	719	719						
EM-E	15.403	0.841***	17.021***	0.973***	13.414	0.681	10.077***	0.402***	15.254***	1.579***	2.424	0.172
	(0.113)	(0.009)	(0.000)	(0.000)	(0.557)	(0.363)	(0.001)	(0.006)	(0.000)	(0.000)	(0.456)	(0.274)
Funds	81	81	44	44	81	81	81	81	44	44	81	81
Obs.	321	321	177	177	144	144						
I-E	0.914	0.173	2.315	0.259	-2.618	-0.043	0.698	0.024	2.453***	0.187***	-3.749***	-0.124**
	(0.810)	(0.355)	(0.484)	(0.164)	(0.790)	(0.909)	(0.506)	(0.653)	(0.000)	(0.000)	(0.003)	(0.045)
Funds	882	882	662	662	882	882	882	882	662	662	882	882
Obs.	5,873	5,864	4,205	4,196	1,668	1,668						
UK-E	0.415	0.223	1.771	0.300	-2.001	-0.022	-1.207	-0.050	1.223*	0.068	-7.292***	-0.265***
	(0.938)	(0.477)	(0.727)	(0.255)	(0.909)	(0.977)	(0.198)	(0.245)	(0.071)	(0.279)	(0.000)	(0.000)
Funds	303	303	250	250	303	303	303	303	250	250	303	303
Obs.	2,451	2,451	1,867	1,867	584	584						
Other	0.961	0.670***	0.894	0.547***	1.086	0.888***	0.874	0.353***	0.068	0.204**	0.290	0.419***
	(0.681)	(0.000)	(0.619)	(0.000)	(0.851)	(0.000)	(0.339)	(0.000)	(0.937)	(0.012)	(0.770)	(0.000)
Funds	214	214	134	134	214	214	214	214	134	134	214	214
Obs.	1,091	1,091	708	708	383	383						

Figure 1. Number of funds opened in the period 1980-2009 per investment style.

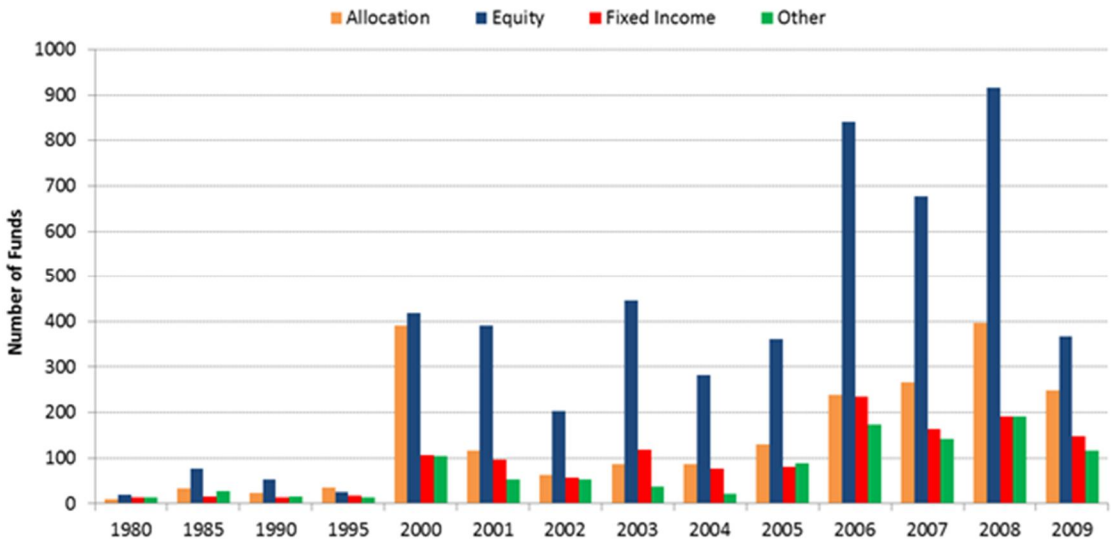


Figure 2. Expansion of a frontier when additional assets are included.

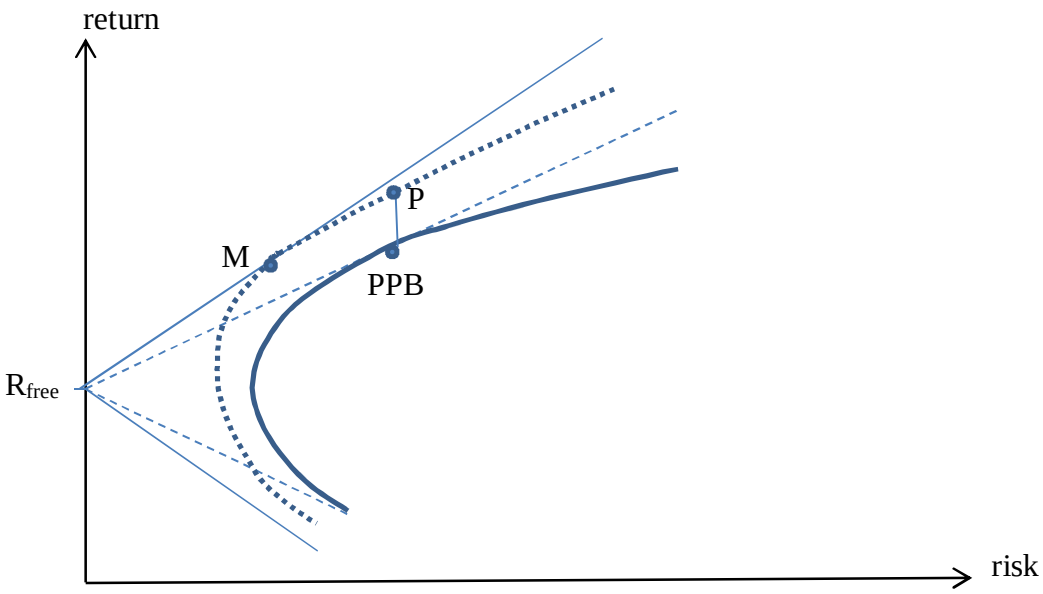
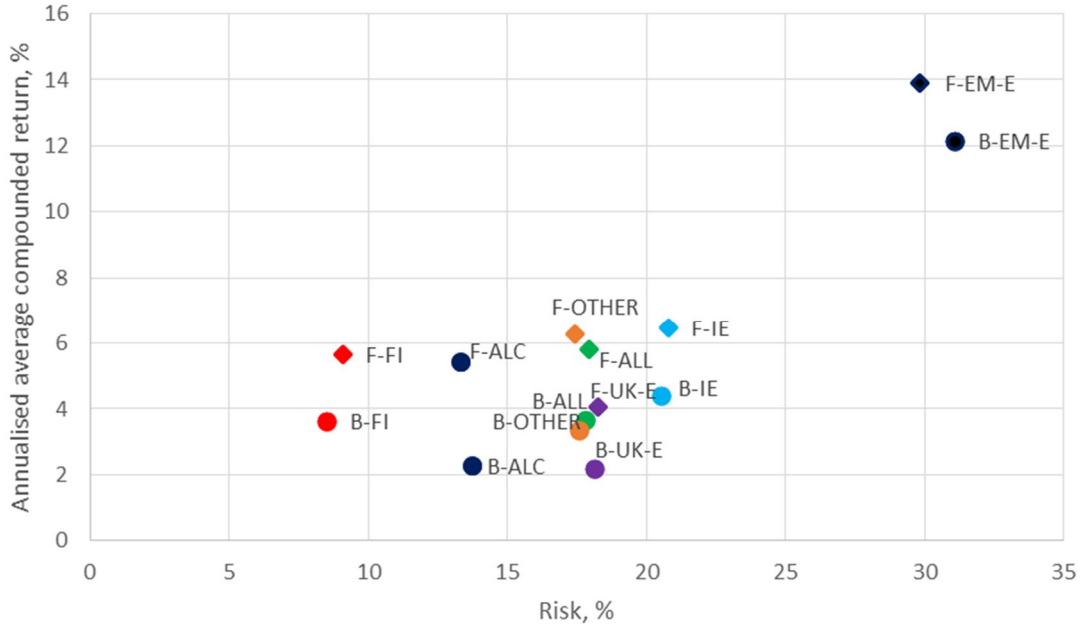
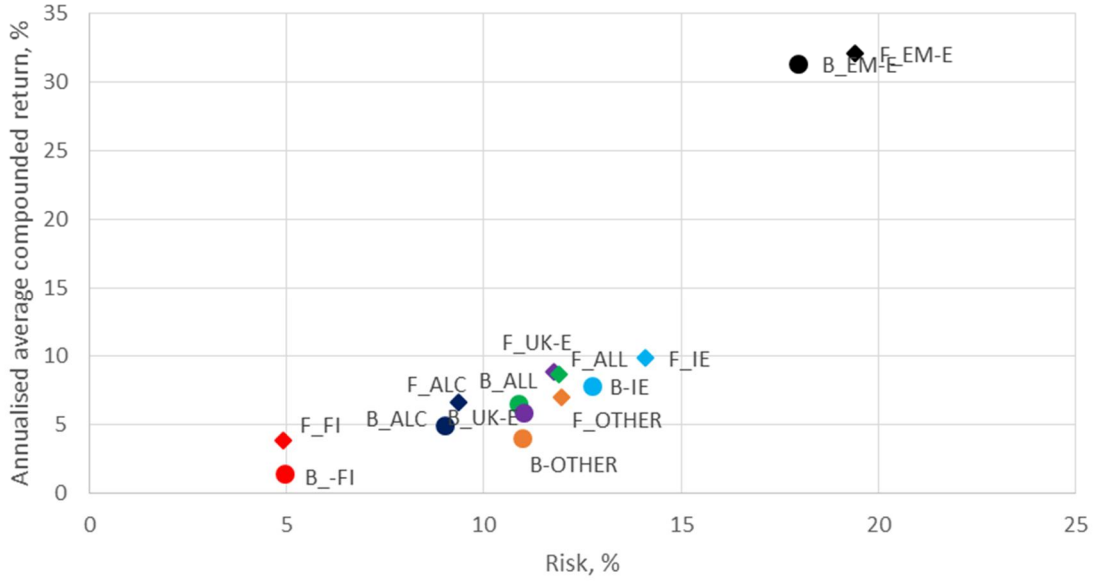


Figure 3. Average risk-return characteristics of funds (denoted by F_ and the abbreviation of the investment style name; diamond shapes) and their PPBs (denoted by B_ and the abbreviation of the investment style name; circle shapes) based on annualised compounded returns, ACRs. Investment styles: ALC – 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.

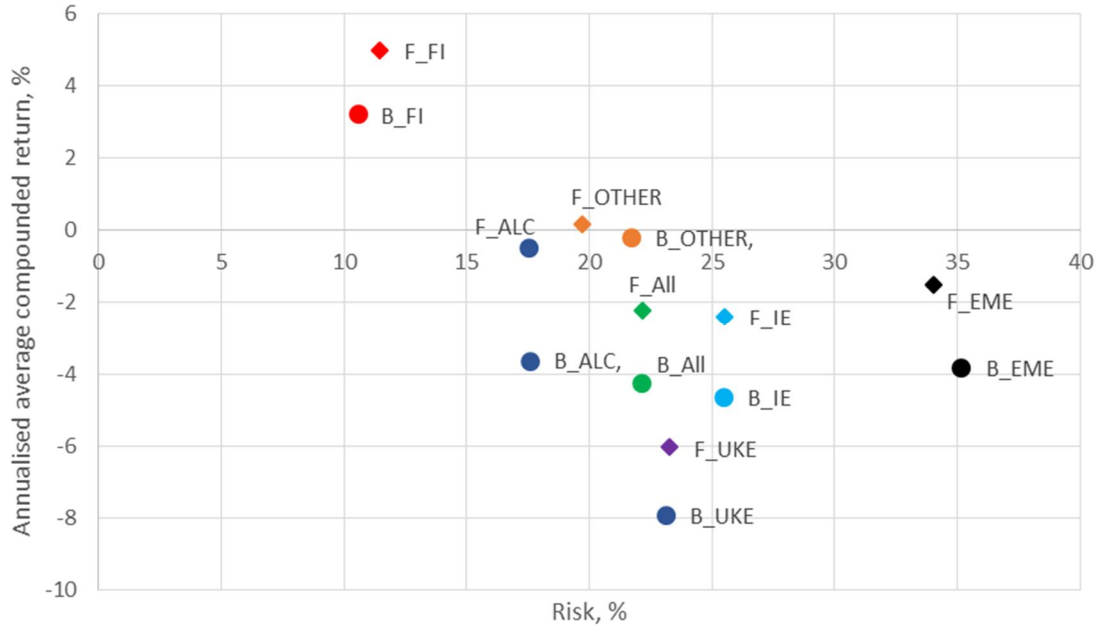
Panel A. Performance in 1980-2009



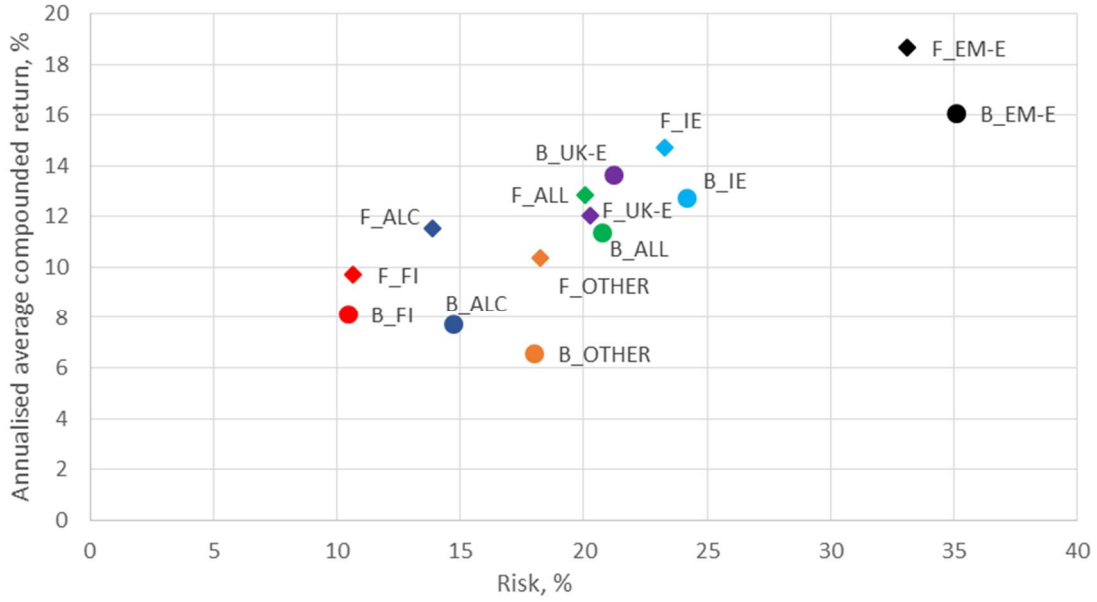
Panel B. Performance in 1980-2007



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



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



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	