Performance Persistence of Pension Fund Managers

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Abstract

Previous work on UK pension funds found only slight evidence of fund manager persistence, but survivorship bias in the construction of these data samples, may have disguised true persistence. Using a large sample of pension funds over the period 1983-97 in which there is less survivorship bias, we find strong evidence of persistence in abnormal returns generated by fund managers over one year time horizons, but weaker evidence over longer horizons. Even when an allowance is made for momentum in stock returns, we find pension fund managers exhibit performance persistence.

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I Introduction

In this paper we examine whether fund managers consistently add value to the performance of the funds under their management. This is a general question in the context of delegated portfolio management, and we focus on the specific area of the investment decisions of pension funds. Pension funds are major investors in financial markets, owning 20 per cent of UK corporate equity (Myners Report, 2001). A number of recent policy documents in the UK have argued that pension contributions should be investing in tracker funds, on the basis that "there is little evidence that active fund management can deliver superior investment returns for the consumer"[1]. The purpose of this paper is to assess this claim making use of a large database on quarterly returns to UK pension funds, in which the fund management house managing the pension fund in each quarter is identified.[2]

Occupational pension schemes in the UK are usually funded and require contributions throughout the employees working life. In a funded scheme an employee pays into a fund that accumulates over time, and then is allowed to draw on this fund in retirement. These schemes are provided by an employer and may pay on a defined benefit or a defined contribution basis. Defined benefit (or final salary) schemes offer a pension, guaranteed by the employer, usually defined in terms of some proportion of final year earnings, and are related to the number of years of employment. Defined contribution (or money purchase) schemes are always funded and convert the value of the pension fund at retirement into an annuity. Under both types of scheme, trustees, usually nominated by the employer, administer the fund and the trustees, following advice from actuaries, decide whether to invest the assets of the fund in a pooled or segregated investment vehicle.

According to the Occupational Pensions Regulatory Authority (2001), there are nearly 110,000 occupational pension schemes in the UK. The vast majority of these schemes have less than 100 members and are run by insured fund management or as pooled investment schemes. The trustees of the remaining relatively large pension funds typically delegate the management of the pension fund portfolio to fund managers. These fund managers may be in-house, employed directly by the pension

[1] para. 420, p. 71 Office of Fair Trading (1997). See also Consumers' Association (1997); Department of Social Security (1998); Financial Services Agency (1999)

[2] The term fund manager in this paper applies to a fund management house, rather than to any individual fund manager who is employed by that fund management house

fund, or the trustees may out-source the management of the fund to an external fund management house. The pension funds in our sample are these segregated funded occupational pension schemes.

In a pooled vehicle, the fund simple purchases units of a diversified investment from a financial institution such as an insurance company. In a segregated vehicle the trustees hire a fund manager (in-house or out-sourced) to make the investment decisions on behalf of the fund according to some specified mandate and specific return expectation. The contract is usually on the basis of a rolling three to five year evaluation cycle with the fund manager reporting back to the trustees on a quarterly basis, [Myners (2001), paragraph. 5.64]. According to the Myners' Report (2001) "one-third of schemes had changed manager in the past 12 months (though of course this may be one of many managers). . 64 per cent of trustees from smaller funds said they had not changed their manager for more than three years" (paragraph 5.40). Lakonishok, Shleifer and Vishney (1992) refer to the fund management of pension funds as a double agency situation, since the employee as principal, and who will eventually become the recipient of the pension, delegates pension fund decisions to the trustees who in turn delegates the investment allocation decisions to a fund manager.

The objective of this paper is to analyse the existence of performance persistence of individual fund management houses that have been appointed as fund managers of segregated occupational pension funds. Is it possible for a pension fund trustee to identify fund management houses that consistently outperform the benchmark? The significance of this work for trustees and plan advisors is compelling. At the most fundamental asset allocation level, the conclusions of the analysis of the distribution of returns will aid trustees in their decision as to whether to invest their pension fund monies in an active or in a passive vehicle.

II Previous Evidence on Performance of Managed Funds

The early literature of the performance of mutual funds in the US [Jensen (1968)] found that simple tests of abnormal performance did not yield significant out-performance. More recent work by Daniel *et al* (1997) using normal portfolio analysis shows that mutual fund managers – in particular aggressive-growth funds, exhibit some selectivity ability but that funds exhibit no timing ability. For the UK Blake and Timmermann (1998) examine the returns on 2300 UK open ended mutuals over 23-year period (1972- 1995) gross of fees. Over the period the data includes 973 dead and 1402 surviving funds, and by studying the termination of funds, they are able to shed light on the extent of survivorship

bias. They find economically and statistically very significant under-performance that intensifies as the termination date approaches, and they conclude that survivorship does not alter the results significantly.

The evidence on the average performance of pension funds relative to external benchmarks has also been disappointing. Ippolito and Turner (1987) examined returns on 1,526 US pension funds and find under-performance relative to the S&P500 Index. Lakonishok *et al* (1992) provide evidence on the structure and performance of the Money Management Industry in the US in general, but focus on the role of pension funds, examining 769 pension funds, with total assets of $129 billion at the end of 1989. They find the equity performance of funds under-performed the S&P 500 by 1.3% per year throughout the eighties. They emphasise that although there is a long literature on the under-performance of mutual funds, pension funds also under-perform relative to mutual funds on average. Coggin, Fabozzi and Rahman (1993) investigate the investment performance of a random sample of 71 US equity pension fund managers for the period January 1983 through December 1990, and find that the average selectivity measure is positive and average timing ability is negative. Both selectivity and timing are sensitive to the choice of benchmark when management style is taken into consideration. For example they find that funds that target value strategies yielded out-performance of 2.1 per cent per annum, but funds that adopted growth strategies under-performed by -0.96 per cent.

Blake, Lehmann, and Timmermann, (1999) examine the asset allocations of a sample of 364 UK pension funds that retained the same fund manager over the period 1986-1994. They find that the total return is dominated by asset allocation, with average return from stock selection negative, and average return to market timing very negative. They find that UK fund managers are comparatively good at selecting equities – although only 16% of sample beat their peer group average. Thomas and Tonks (2001) in a large sample of pension funds find little evidence of any abnormal performance, but find that pension funds seem to follow very similar investment strategies, so that identifying out-performance is difficult.

Although on average fund managers do not outperform, in any sample there is a distribution to the performance, and more recently research on performance measurement has investigated whether the out-performers in the sample continue to outperform in the future. Grinblatt and Titman (1992) find that differences in mutual fund performance between funds persist over 5-year time horizons and this persistence is consistent with the ability of fund managers to earn abnormal returns. Hendricks, Patel and Zeckhauser (1993) analysed the short-term relative performance of no-load, growth orientated

mutual funds, and found the strongest evidence for persistence in a one-year evaluation horizon. Malkiel (1995) however argues that survivorship bias is more critical than previous studies have suggested.[3] When an allowance is made for survivorship bias in aggregate, funds have underperformed benchmark portfolios both after management expenses and even gross of expenses. Further he finds that whilst considerable performance persistence existed in the 1970s, there was no consistency in fund returns in the 1980s. Brown and Goetzmann (1995) examine the performance persistence of US mutual funds and claim that the persistence is mostly due to funds that lag the S&P. They demonstrates that relative performance pattern depends on the period observed and is correlated across managers, suggesting that that persistence is probably not due to individual managers – it is a group phenomenon, due to a common strategy that is not captured by standard stylistic categories or risk adjustment procedures. This is consistent with herding behaviour identified in Grinblatt, Titman and Wermers, (1995). They suggest that the market fails to discipline underperformers, and their presence in the sample contributes to the documented persistence. Carhart (1997b) demonstrates that common factors in stock returns (including a momentum factor) and investment expenses explain persistence in equity mutual funds' mean and risk-adjusted returns. The only significant persistence not explained, is concentrated in strong underperformance by the worst return mutual funds. His results do not support the existence of skilled or informed mutual fund portfolio managers. Blake and Timmerman (1998), Allen and Tan (1999), Fletcher and Forbes (2002), Giles, Wilson and Worboys (2002) have all investigated performance persistence in UK mutual funds (unit trusts) over the last two decades, and have identified persistence caused by poor performers continuing to under-perform.

Brown, Draper and McKenzie (1997) examine the consistency of UK pension fund performance, and find "limited evidence of persistence in performance" (p. 155) for a small number of fund managers. Their sample consists of 232 funds 1981-90 and 409 funds 1986-92, and they construct their sample of funds from those that retained the same single fund manager over the time-span of their database. They find that this limited consistency holds over different time horizons, samples and classification schemes, though this finding seems to be influenced by the out-performance of one particular fund manager. Blake, Lehmann, and Timmermann, (1999) also examine persistency of long-lived pension fund with a sample of funds that retain the same fund manager. Although they find evidence of persistence in fund returns for UK equity portfolios at the one-year horizon, they argue that the persistence results are entangled with an inverse relationship between fund size and fund performance.

[3] Malkiel points out that only the more successful mutual funds survive. Higher risk funds that fail tend to be merged into other products to hide their poor performance. Also bias from tendency to run incubator funds – run ten different products –

They conclude that when an allowance is made for fund size "these regularities [of persistence] are second order" (page 37).

In constructing their data samples, both the Brown *et al* (1997) and Blake *et al* (1999) studies of UK pension funds specify that the pension fund have the same single fund manager over the length of their respective samples. However this specification of the database may have induced survivorship bias in these data samples, since pension fund may have continued to hire the same fund management house, because their performance has satisfied the pension fund trustees, and not triggered their removal. Survivorship bias can affect performance evaluation in two opposite ways. Brown *et al* (1992) suggest that if fund volatility is constant across time, but varies cross-sectionally, and if the worst performing funds in a period disappear, then survivorship will induce spurious persistence and bias persistence upwards. Conditional on surviving the best funds tend to have high volatility: in a sample of survivors, first-period winners tend to have high volatility and subsequently win in the second period. On the other hand Grinblatt and Titman (1992) and Hendricks *et al* (1993) argue that if fund survival depends on average performance over several periods, then survivorship induces spurious reversals: first-period losers must subsequently win in order to survive, and this biases persistence downwards. Simulation results in Carpenter and Lynch (1999) suggest that persistence is weaker in samples that exhibit survivorship bias, implying that it is the second of the two survivorship bias effects that dominates. Pension fund mandates are typically over a three year period, so that the survivorship criteria for UK pension fund managers is likely to depend on performance over several periods [Myners (2001), paragraphs 5.64 - 5.72]. Previous studies that have only focused on the same single-manager pension funds may have underestimated the true degree of persistence. In this study we use data on all UK pension funds irrespective of whether they change manager. As a consequence we might expect that our sample will not suffer from the same extent of survivorship bias, and we will be more likely to identify true persistence.

III Measuring Fund Performance

We examine the consistency or persistence of fund manager performance. That is, we assess whether a fund management-house that has performed well in one period can repeat this feat in subsequent periods. Our database consists of the returns on pension funds managed by fund management-houses, and so to examine the consistency in performance of a specific fund management-house we examine the performance across all the funds under management of that investment-house. We do this by

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see which are best and market those, ignoring the poor record of the rest

averaging abnormal returns across the funds under management to a particular fund manager. This averaging across pension funds is undertaken for both equally weighted and weighted by fund size, since it could be argued that fund managers put greater effort into managing larger funds. Blake *et al* (1997) has difficulty distinguishing between fund performance and fund size, but this difficulty of interpretation is less important with the average performance of the funds under management. There are a number of tests for persistence, and recently Carpenter and Lynch (1999) have assessed the power of these difference tests particularly in the presence of different types of survivorship bias. Carpenter and Lynch classify persistence tests into two types: performance ranked portfolio strategies, and contingency tables.

Fund manager performance is measured as the average abnormal returns on the funds under management, where the abnormal returns AR_{Pt} for each pension fund P are computed from an asset pricing model. Alternative asset pricing models are the single factor CAPM, the Fama-French three-factor model and a four-factor model that includes a momentum factor, where the factor loadings are estimated over the whole sample period. In the three-factor model the standard three factors are the excess return on the market $R_{mt} - r_{ft}$, the returns on a size factor SMB_t which is the difference between the returns on a portfolio of small companies and a portfolio of large companies, and a book-to-market factor HML_t which is the difference in returns on a portfolio of high book-to-market companies and low book-to-market companies.

$$AR_{Pt} = R_{Pt} - r_{ft} - \beta_P (R_{mt} - r_{ft}) - \gamma_P SMB_t - \lambda_P HML_t \qquad (1)$$

In the case of the CAPM $\gamma_P = \lambda_P = 0$. To calculate abnormal returns we follow a two step procedure,: we first regress returns on the factors to produce the factor loading requiring a minimum of 12 time series observations to estimate the regression parameters. In the second stage we calculate the abnormal return on each fund. The abnormal returns in equation (1) relate to the performance of a pension fund *P*, managed by fund manager *F*. To obtain a measure for the performance of fund manager *F*, the abnormal returns from equation (1) relating to pension fund *P* of the pension funds managed by fund manager *F* are averaged for each fund manager and for each quarter. The three-factor specification in equation (1) is the base specification in this paper, which we examine in some detail. We also re-estimate abnormal returns from a four-factor model, where the fourth factor is a momentum factor, constructed as the returns on a zero investment portfolio based on a long-short position from a one year momentum strategy. Carhart (1997b) finds that a four-factor model can explain differences in the

performance of past winners and past losers, with the momentum factor accounting for much of the explanation. He suggests that Jegadeesh and Titman's (1993) one-year momentum in individual stock returns accounts for the persistence in mutual fund returns, since some mutual funds happen by chance to hold relatively large positions is last year's winning stocks. Wermers (1997) also finds that persistence in mutual fund performance is due to investing in past winners, but suggests that this is due to an active momentum trading rule strategy by the out-performing mutual funds. Hon and Tonks (2003) identify momentum at up to a two-year horizon in UK stock returns, so that Carhart's findings could also apply to UK investment funds. We follow Carhart (1997b) and construct a one-year return momentum factor as an additional factor for the UK stock market over the period 1984-97. To form this factor-mimicking portfolio, every month we rank stocks listed on the London Stock Exchange from the Lspd (London Share Price Database) files on the basis of their previous eleven-month returns lagged one month. We then compute an equally-weighted portfolio return of the highest 30 percent of stocks minus the lowest 30 percent of stocks. The portfolios are re-formed monthly throughout the sample period, and the quarterly return on this portfolio is compounded from the monthly returns.[4]

Performance ranked portfolio tests sort fund manager each period into portfolios based on past performance. Over an initial period, called the ranking period, the performance of fund managers are compared and ranked. The ranking period can be one quarter, four quarters (one year) or twelve quarters (three years). This averaged abnormal return across pension funds is attributed to the skills of fund manager *F* in the ranking period. Fund managers are ranked on the basis of the average return on the funds under management in the ranking period, and five portfolios are formed on the basis of this ranking, with equal numbers of fund managers in each portfolio. The top portfolio consists of those fund managers with the highest average abnormal returns in the ranking period, down to the bottom portfolio with those fund managers with the lowest average abnormal returns.

We then compute the equally weighted average portfolio abnormal return of the top and bottom portfolios over a subsequent evaluation period, which we denote AV5(τ) and AV1(τ) respectively, where τ denotes the particular evaluation period. We then advance the ranking period by one period, and repeat the ranking process and subsequent evaluation. We report the average abnormal returns AV5 and AV1 of the top and bottom portfolios, in the evaluation periods, averaged over all evaluation periods. The evaluation periods can also be one quarter, one year or three years. These procedures are followed for overlapping periods throughout the full period of the database, and we compute DIF as

[4] We are grateful to Alan Gregory for providing the UK Momentum Factor used in Gregory and Tonks (2004)

AV5-AV1, and then report TDIF, which is a t-statistic on DIF, which is calculated after allowing for the autocorrelation induced by the overlapping observations. Under the null hypothesis of no persistence the value of DIF should be centred on zero, which would mean that past performance is no predictor of future performance. From their simulations Carpenter and Lynch find that the persistence test based on TDIF is the best specified under the hypothesis of no persistence, and the most powerful against the alternatives considered.

In these persistency tests we examine alternative ranking and evaluation time periods, since it may be the case that persistency is only apparent at particular time intervals. For example to test for long run persistency 12QR12QE means we form portfolios on the basis of twelve-quarter ranking period and twelve quarter evaluation period. To test for short-run persistency, or the "hot-hands" phenomenon, we examine 1QR1QE, which means one quarter ranking and one quarter evaluation period. We also test for asymmetric strategies, such as 12QR1QE, that allow for ranking on the basis of long-run (short-run) past returns and evaluation over short-run (long-run) future returns.

Contingency tables classify funds as winners or losers in each of two consecutive time periods, and the numbers of winner-winner (WW), winner-loser (WL), loser-winner (LW), and loser-loser (LL) combinations are counted. We compute the following related statistics: a) Percentage of repeat winners, PRW = WW/(N/2) is a purely descriptive statistic which gives the percentage of the sample that are in the winner-winner box; b) Cross-product ratio CP = (WW x LL)/(WL x LW); which is also referred to as the odds-ratio and $\log(CP)/\sigma_{\log(CP)}$ has a standard normal distribution, with $\sigma_{\log(CP)} = \sqrt{[(1/WW) + (1/WL) + (1/LW) + (1/LL)]}$, so that we may test for the statistical significance of deviations of the cross-product ratio from unity; c) Chi-Squared test with 1 d.o.f. where $CHI = \{(WW - N/4)^2 + (WL - N/4)^2 + (LW - N/4)^2 (LL - N/4)^2\}/N/4$; and we may reject independence if CHI exceeds the critical value of 3.84 for a 5% test; and d) TCS is the t-statistic for the slope coefficient in the cross-section OLS regression of evaluation period abnormal returns on ranking period abnormal returns. Carpenter and Lynch (1999) find that in the presence of survivorship bias the Chi-Squared test performs best, and that the cross-sectional t-test (TCS) is the weakest. We will discuss the results of these persistence tests in the light of the simulation results of Carpenter and Lynch (1999) on the relative power of these alternative tests.

Ferson and Schadt (1996) have advocated allowing for the benchmark parameters to be conditioned on economic conditions: called conditional performance evaluation, on the basis that some market timing

skills may be incorrectly credited to fund managers, when in fact they are using publicly available information to determine future market movements. In which case Ferson and Schadt argue that the predictable component of market movements should be removed in order to assess fund managers' private market timing skills. Under a conditional version of the three-factor model, the abnormal returns equation (1) becomes

$$AR_{Pt} = R_{Pt} - r_{ft} - \beta_P(Z_{t-1})\,(R_{mt} - r_{ft}) - \gamma_P\, SMB_t - \lambda_P\, HML_t \qquad (2)$$

where Z_{t-1} is a vector of instruments for the information available at time t (and is therefore specified as $t-1$) and $\beta_P(Z_t)$ are time conditional betas, and their functional form is specified as linear

$$\beta_P\,(Z_t) = b_0 + B'z_{t-1} \qquad (3)$$

where $z_{t-1} = Z_{t-1} - E(Z)$ is a vector of deviations of the Zs from their unconditional means. Implementing this approach involves creating interaction terms between the market returns and the instruments. The instruments used in this study are: lagged Treasury bill rate, dividend yield, a default premium (the difference between low and high quality corporate bonds), and the slope of the term structure (the difference between long and short run government bond yields). To implement the conditional performance evaluation tests, we follow the same two step procedure outlined earlier, though we now require 20 time-series observations to produce meaningful coefficients. First for each fund we run a time series regression of excess returns against the three factors, with the interaction terms included, which enables us to calculate the abnormal return on each fund. In the second stage we compute the abnormal returns.

IV Data

The Combined Actuarial Performance Services Ltd (CAPS) provided the data used in this study. It consists of quarterly returns on UK equity portfolios of 2,175 UK pension funds from March 1983 to December 1997. Typically over this period a UK pension fund invested about 57% of assets in UK equities, so that our database consists of returns on the major asset class in which UK pension funds invest. In addition for each fund-quarter the manager of the fund and the size of the fund is provided. CAPS provide a performance measurement service for about half of all segregated pension fund schemes in the UK. The full database consists of a total of 59,509 observations on quarterly returns and fund size, and the maximum number of Quarters is 56.

Table 1, Panel A illustrates the Distribution of fund quarters over the database, and shows that 50 per cent funds have 24 or less observations, and the average life of a fund in the data is just less than seven years. This high attrition rate is of apparent concern since it implies that there is a possibility of survivorship biases, which bedevils performance evaluation studies of mutual funds. However it is important to emphasise that the ease at which mutual funds may close down or merge poorly performing funds documented in Elton, Gruber and Blake (1996), is not so readily available to the firms sponsoring an occupational pension fund, since the obligation to provide a pension remains. There were two major performance measurement services in the UK over the data sample: CAPS and WM, and UK pension funds typically subscribe to one or other of these two services. According to CAPS there are three reasons why funds enter or leave the database: 1) Structural reorganisation, due to birth or death (including takeover or merger) of the sponsoring firm, or mergers between pension funds within the same sponsoring firm; 2) change of fund management measurement service, due to client (pension fund) preferences, perhaps due to dissatisfaction with the quality or price of the current service; 3) change of manager, possibly prompted by poor performance, with the new manager having a preference for one particular measurement service provider.

It is possible that the second and third reasons may be related to poor performance of the pensions fund and hence could induce survivorship bias into or dataset. However it is important to emphasise that there were only two performance measurement services in the UK over the data period, so that any switching between measurement services should be symmetric. A pension fund may drop out of our database because of poor performance, but there will be new entrants into our database as pension funds that have previously been assessed by the alternative measurement service, switch into the CAPS measurement service. In effect our sample may lose pension funds due to poor performance, but poor performers from the alternative measurement service replace them.

Following the suggestion of a referee, I compare the average prior one year performance of the funds leaving the dataset with the average post one year performance of the funds entering the dataset. There are 1230 new funds entering the dataset after the start date, meaning that of the 2170 funds noted in Table 2, 1230 funds have their first observation after March 1984. There are 1091 funds leaving the

dataset before the terminal date, meaning that 1091 funds have their final observation before December 1997.[5]

It can be seen that the average quarterly return in the twelve months after a new fund has entered the database, and the average quarterly return in the twelve months before a fund exits the dataset, are both below the quarterly returns across the entire dataset reported in Table 2 of 0.0432. The performance of the new funds are slightly higher than the performance of the existing funds, but the difference in the average quarterly abnormal returns (from the 3-factor model, which requires a minimum of 12 time series observations) of new and exiting funds is 0.0007. A simple t-test shows that this number is insignificantly different from zero. The implication is that funds leaving the database are being replaced at roughly the same rate, and in terms of the same returns as funds entering the database.

Carhart (1997a) distinguishes between survivorship bias and look-ahead bias: True survivorship bias is a property of the sample selection method, and results from only including funds in a sample that survive until the end of the sample period. Look-ahead bias is a property of the test methodology. Tests of performance persistence, require funds to exist during both the ranking and evaluation periods. Carhart defines look-ahead bias as the bias that results from eliminating funds from the sample that fail to survive a minimum period of time after the ranking period. He distinguishes between partial (PLA) and full (FLA) look-ahead bias. PLA ranks on the basis of all funds available in the ranking period, and then eliminates funds that disappear before the end of the evaluation period. FLA eliminates disappearing funds before the ranking process starts.

In our study we have argued that true survivorship problems should be less of a concern, since we have the replacement of poorly performing funds with other poorly performing funds. However, look-ahead

[5] Quarterly Returns to funds Entering and Exiting the Dataset June 1984 - September 1997

	Observations	Mean	Standard dev.
Entering funds			
Post-Ret4	1230	0.0410	0.0354
Post-Abret4	1037	0.0005	0.0110
Exiting funds			
Pre-Ret4	1091	0.0369	0.0353
Pre-Abret4	816	-0.0002	0.0101

Mean returns are quarterly returns based on quarterly average of the 12 month return pre and post the fund exiting or entering the dataset.

bias may affect our results, since we require at least 12 time series observations to estimate the parameters in equation (1). By requiring at least 12 quarterly observations in the database we are imposing an FLA methodology on our sample. According to the simulation results of Carpenter and Lynch (1999) (Tables 1 and 3), if elimination is based on a single period criterion, then the PLA and FLA methodologies identify spurious persistence, whereas if elimination is based on a multi-period criterion the PLA and FLA methodologies understate persistence. In both cases, the PLA biases are more pronounced than for the FLA. For these reasons we have adopted the FLA methodology in our sample construction, and by eliminating observations when there is less than twelve quarters worth of data we are imposing in many cases a multi-period elimination criterion, which according to Carpenter and Lynch will understate the true level of persistence.

Panel B shows that the management of pension fund equity portfolios is relatively concentrated. There are a total of 191 different fund manager categories (including in-house managers), 25 per cent of fund managers manage only 17 quarters or less (across funds), and 50 per cent manage across 45 quarters or less. Since the average life of a fund is just under seven years (28 quarters), this implies that fifty per cent of fund managers in the database are managing only two funds.

Pension funds hire fund managers to manage the investment portfolio, and the funds may choose to change fund managers within the database. Panel C reports the distribution of changes in managers across funds. Over 80 per cent of the observations in the database have the same fund manager as in the previous quarter. From the middle pair of columns in Panel C we report that 559 funds, or just over 25 per cent of the funds change their manager at least once during the period, with 3 funds changing the manager four times. The final column in Panel C shows the distribution of the change in fund manager within funds, and reports that over 80 per cent of the time periods on average across funds retain the same manager. These figures suggest that our database over the period 1984-97 has much less fund manager turnover than was reported in Myners (2001) [paragraph 5.40], based on a survey in 2001. This may be because the Myners' Report noted the increased tendency in the late 1990s for large funds to appoint multiple external managers. We might conjecture that a fund that adopts a multiple-manager hiring strategy is more likely to change fund mangers.

Panel D provides further evidence on the concentration of fund management. We have ranked the fund managers is terms of the number of fund-quarters under management. The top ranked fund manager[6]

[6] This fund manager is actually identified as #28, in our database - all the fund managers are identified by a code.

(1RMan) managers 10.8% of observations, the second ranked 2RMan managers 5.6% and 3RMan managers 4.8%, and another 14 fund managers (4RMan-18RMan) manage a total of 23.14% of observations. 1RMan manages across 244 funds, and 81.04% of these funds' observations are using 1RMan. There is also a multi-manager category and a change of manager category (ΔMan). Most funds use a single fund manager in any quarter, but 659 funds have multiple fund managers at some time, and 29.07% of all observations have multiple fund managers. In the case of the multi-manager category we do not have information on the identity of the multiple managers, and further the definition of multiple fund managers has changed over time. Only 85 funds use the same fund manager over the fund's life. The change of manager category sometimes applies to a fund when the fund manager has changed during the quarter, in which case if it is not possible to identify the fund manager that is managing the portfolio during that quarter, a change of manager category is noted.

Table 2 provides descriptive statistics on the returns to, and the size of, the UK equity portfolios of the pension funds in our database. From Panel A, the average discrete quarterly return over all funds over all quarters is 4.32%, compared with an average discrete return of 4.38% for the FT-All Share Index. The overall standard deviation of these returns is 8.67%, and the distribution of returns also emphasises the variability in returns. But these pooled measures disguises an important statistic that is made clear in Panel C, which is that the between funds standard deviation is much less than the within fund distribution. This implies that for a particular quarter the distribution of fund returns is tightly packed around the mean, but that over time the variability of returns is much higher. In fact the correlation between the time series values of the FT-All Share index and the average return each quarter across the pension funds is 0.995. The contrast in the within and between standard deviations might be indicative of the herding behaviour of pension funds suggested by Lakonishok *et al*. (1992). The between variation of fund returns by manager is much smaller than the within manager standard deviation, which implies that is may be difficult to identify individual fund manager performance. Our subsequent results of manager performance are all the more striking, given this feature of the data.

Table 2 Panel A also reports on the distribution of returns weighted by the value of the fund at the beginning of each quarter. The value weighted average return of 3.80% indicates that small funds have a slightly higher return than large funds. In the subsequent regression analysis, we require a minimum number of observations to undertake a meaningful statistical analysis, and we imposed the requirement that time series fund parameters are only estimated when there were 12 or more quarterly returns for that fund. The cut-off value of three years accords with the typical fund mandate. Table 2 Panel A

reports the distribution of returns of the sub-sample of 1,717 funds with at least 12 time series observations, and this may be compared with the distribution of returns across the whole sample, to check that the sub-sample is indeed representative. We also report the distribution of returns for those 453 funds with less than 12 observations that we drop from the database. In fact the mean and median for this sub-sample is slightly higher than for the entire distribution, and for the retained sub-sample. This suggests that we are not dropping poorly performing funds from the database. The standard deviations of both groups are also very similar, and it is slightly surprising that the standard deviation of the eliminated funds is not greater than that for the remaining funds, since both Carhart (1997a) and Carpenter and Lynch (1999) find it is the higher volatility funds that are eliminated in their samples.

In Panel B of Table 2 we report statistics of the size of the equity portion of the pension funds in our sample, at three different dates at the start, in the middle and at the end of our sample. The size distribution is highly skewed with a large number of very small funds. For example in 1997 the median size fund had an equity portfolio of 28 million pounds, whereas the largest fund had an equity portfolio of over 9 billion pounds. In Panel C we also report the distribution of fund size across funds and across fund managers. We report two measures of fund size: smv is the starting market value of the equity portfolio of the fund at the start of each quarter; smv97 is the starting market value of the funds, with the fund value inflated to December 1997 values. This measure of fund size at constant prices is obtained by compounding to December 1997 fund size (smv) in each quarter by the average rate of return over the life of the fund. Panel C shows that the distribution of firm size when measured at non-constant prices is bigger between funds than within funds. This difference in the between and within distribution of fund size is much sharper when size is measured at constant prices, where the within variation is only a fifth of the between variation. This statistic emphasises that pension fund size is relatively constant over time, with most variation occurring between funds.

In this study we use data on all UK pension funds irrespective of whether they change manager. The Brown *et al* (1997), and Blake *et al* (1999) studies of UK pension funds specify that the pension fund have the same fund manager over the length of their respective samples. As we have argued, it is likely that survivorship bias is more of an issue in same manager funds, since pension fund trustees who have retained the same fund manager, are likely to have been satisfied with that fund manager's performance. We expect that our sample does not suffer from this survivorship bias, and consequently we will be more likely to identify true persistence.

V Results

The results of the persistency tests of fund manager performance for the base case of the three factor model of abnormal returns are reported in Table 3. Panel A reports the performance ranked portfolio tests, and Panel C the contingency table tests for the three factor model. Each panel has three rows representing the number of time periods over which the ranking and evaluation periods have been evaluated. The first two columns in Panel A report the average evaluation period returns of top and bottom quintile portfolios, formed on the basis of ranking period fund manager abnormal returns. In panels A and C the measure of fund manager abnormal returns is the equally weighted average abnormal return of the funds under management in a particular quarter.

It can be seen that for each row the mean return on the high quintile portfolio is always greater than that on the low quintile portfolio (DIF is always positive). We might think of DIF as being the return to an arbitrage or zero-net-investment portfolio that has been constructed by going long in the high quintile portfolio (AV5) and short in the low quintile portfolio (AV1). The one quarter on one quarter results (1QR1QE) shows only weak evidence of persistency as measured by TDIF, though the longer term abnormal returns show much stronger evidence of persistency. The results in Panel A suggest that there is some persistency at all time horizons, with the strongest at one year. The evidence in this table is that at the one year ranking and evaluation horizon the difference in excess returns between the top and bottom quintiles averages about 1.56% per year. Further, in contrast to previous studies which have suggested that any persistence is due to under-performing funds continuing to under-perform, we find although there is persistence in the bottom quintile, for the 4QR4QE strategy the top performing funds produce excess returns that are significantly above zero.

These findings are confirmed from the contingency table tests in Panel C. The chi-squared test on independence is easily rejected for the one year horizon abnormal returns, and the odds ratio is also significantly different from unity at both the one quarter and one year horizons. Similarly the t-statistic on the slope coefficient in the cross-section regression of one-year abnormal returns on lagged one year abnormal returns is 6.17 for the one year abnormal returns, indicating significant persistence at one year. One slight inconsistency in these tables is that CHI implies that quarterly abnormal returns are more persistent that three year returns, whereas all the other measures suggest that it is the longer term returns are more persistent than the short-term measures. Though the percentage of repeat winners is only 52 per cent for the quarterly horizon, but rises to 57 per cent for the longer horizons. Brown *et al* (1992) suggest that some persistency in performance may be due to consistently poor performance of

some funds, which for institutional reasons are allowed to continue. The percentage of repeat winners in the PRW columns does not support that finding in our database. Recall that Carpenter and Lynch (1999) suggest that the TDIF measure is the most powerful from among the alternative tests for persistency. So that we should put more emphasis on the findings in Panel A which report persistence at the one year horizon.

Blake *et al* (1999) produce a statistic that is directly comparable with the data in Panel A. They find that the return to the "zero net investment portfolio" for UK equities in the case of abnormal returns estimated from a multi-factor model (similar to out three-factor model) for the year on year ranking and evaluation strategies yielded an annual return of 0.5 of a per cent. This is substantially less than the annualised return of 1.56 per cent implied by the equivalent strategy in panel A. We will return to this comparison below.

Our measure of fund manager performance was computed by taking the equally weighted average abnormal return of the pension funds under management in a particular quarter, as a measure of the fund manager's performance in that quarter. A potential criticism of this approach is that fund managers will give a better service to larger pension funds, since if fees are *ad valorem* and based on the value of assets under management (Myners, 2001), the larger pension funds are paying a higher fee to the fund manager. We therefore computed an alternative measure of fund manager performance as the average performance of funds under management weighted by the fund size at the beginning of the quarter. The results of this alternative measure of fund manager performance, still based on a three-factor model of pension fund abnormal returns, is given in panels B and D of Table 3. The performance ranked portfolio test results are given in panel B, and it can be seen that the evidence suggests even stronger evidence of persistence at the one year and three year horizons: the quarterly return on DIF is 0.41 percentage points. The contingency tests in panel D also report evidence of persistence at the one year horizon, with less evidence in the shorter or longer terms.

In Table 4 we report the results of recalculating the measures of pension fund abnormal returns using alternative asset pricing models. In Panels A and D we investigate the effect of including a momentum factor as the fourth factor in the calculation of abnormal returns. The effect of introducing this momentum factor into the portfolio performance tests, is to reduce the value of DIF slightly in all three cases in Panel A. However the value of DIF is still significantly positive for the four quarter and twelve quarter horizons. In the case of the contingency tables Panel D tells a similar story. The effect of

introducing the momentum factor at the one quarter and four quarter horizons is to reduce the percentage of repeat winners, the cross product ratio, the odds ratio, the chi-squared test for independence, and the coefficient of the cross-section regression. Hence the momentum factor does seem to explain a small amount of the observed persistence. However, the strong result that comes out of Panels A and D is that at the four quarter horizon, persistence is still a significant feature of the dataset even after allowing for momentum in individual stocks.

In panels B and E we report the performance ranked portfolio tests and the contingency tables derived from a CAPM measure of abnormal returns. Again we find that DIF has its highest vale and is significant at the one year horizon, with the value of DIF at 0.37 percentage points being very similar to the equivalent value of DIF in the three-factor model. At other time horizons, the value of DIF being insignificantly different from zero, and there is even some evidence of fund manager performance reversals at the long-horizon. The contingency tables in panel E for the CAPM measure also report significant persistence at the one year horizon, and also find evidence of persistence at the short horizon: the CP, CHI, and TCS statistics are all significant over successive one quarter periods. At the twelve quarter horizon there is evidence of fund manager performance reversals both in a negative TCS and the fact that the odds ratio (CP) is less than unity.

In panels C and F we report the performance ranked portfolio tests and the contingency tables derived from a three-factor model of conditional abnormal returns, where the conditioning variables include lagged macroeconomic variables. Following the Ferson and Schadt (1996) argument, by excluding lagged macroeconomic factors which were publicly available at the time that fund managers make their investment decisions, the resulting abnormal returns are more likely to reflect the fund managers' true abilities. According to panel C this measure of fund manager performance produces the significant consistency in performance at all horizons, with the strongest persistence at the one-year period. The annualised value on DIF is 1.93 per cent. The contingency tables in panel F also report persistence in the short-run and medium-term, though not in the longer-term. The slightly stronger result on persistence in the case of the conditional benchmarks implies that the unconditional benchmarks are disguising fund managers' true abilities, though to only a minor extent.

In Table 5 we also examine the performance ranked portfolio tests based on non-symmetric ranking and evaluation periods. We undertake this test for the abnormal returns derived from the three factor model, and therefore the results should be compared with those in Table 3 Panel A. Indeed, the

elements in the leading diagonal of Table 5 are the same as in the DIF column for Table 3 Panel A. It can be seen that there is significant evidence of persistence at all combinations of ranking and evaluation periods except for the very short-term. The value of DIF appears to be maximised on the basis of a 12 quarter ranking and a 1 quarter evaluation period. This yields annual returns on an arbitrage portfolio of 1.68%

Finally we wish to compare our results with the previous studies in the UK on performance persistence of pension funds. Earlier work by Brown *et al* (1997) and Blake *et al* (1999) found little evidence of performance persistence in the returns of pension funds, but as we have already mentioned, both studies concentrated on pension funds that employed the same fund-manager over a long time period, and we have suggested that this may have led to a survivorship bias that disguised the true level of persistence. To examine the effects of imposing these restrictions on our data we redefined our sample using similar criteria. In table 5 we report the results of imposing two data restrictions on our database: we only consider those pension funds that have remained in the datafile for all 56 quarters from March 1984 to December 1997, and in addition have retained the same fund manager over those 56 quarters. This results in a sample of 129 pension funds, which is smaller than the number of pension funds in the Brown *et al* (1997) and the Blake *et al* (1999) samples, because the length of the database is longer in our study. In Table 5 we report the results of including these restrictions into our database on our performance persistence statistics, for the unconditional three factor model of fund performance. From Panel A, it can be seen that the imposition of the same fund manager, and the requirement of long-lived funds, reduces the value of DIF for the one year horizon from 0.0039 to 0.0023. A simple t-statistic on these two values shows that they are significantly different, with the implication that imposing the restrictions on our database reduces the observed degree of persistence at the one year horizon. Interestingly the performance ranked portfolio tests for the one quarter and twelve quarter horizons are not affected by the data restrictions. The contingency tables of fund manager performance for the restricted sample in panel B of table 5 on the other hand, seems to find stronger evidence of persistence than for the full sample from panel C in Table 3: the CHI and CP values are significant at all time horizons. This may seem surprising, but is exactly the result predicted by the simulation findings of Carpenter and Lynch (1999) who find that in the presence of survivorship bias the contingency tests are more robust, "Overall, in the absence of survivor bias, the DIF t-test using one year evaluation periods appears to be the best specified under the null hypothesis of no persistence and one of the most powerful against the alternatives that we consider. Also well-specified and powerful in large samples the chi-squared test is the most robust to the presence of survivor bias". (page 367).

VI Conclusions

With the advent of low cost stakeholder pensions in the UK, there has been a continuing trend into index funds and a movement away from active fund management, as a portfolio strategy for pension funds. However the results in this paper, from a large sample of occupation pension funds, suggest that there appears to be a role for active fund management of pension funds.

We have measured the abnormal returned generated by fund management houses in managing the equity portfolios of UK pension funds over the period 1983-97. We have found evidence of significant persistence in the performance of fund managers at the one-year time horizon using a number of different consistency tests, as well as weaker evidence of persistence at longer time intervals. We found that the returns on a zero investment portfolio of a long position in a portfolio of fund managers that performed well over the previous 12 months and a short position in a portfolio of fund managers that performed poorly, would have yielded an annualised abnormal return of 1.56%. According to Carpenter and Lynch (1999) this test is the most powerful in detecting persistence in performance. Further, we have examined how robust these results are to the inclusion of a momentum factor. In contrast to Carhart (1997b) and Wermers (1997) we find that although a momentum factor can explain a small degree of the observed persistence, after extracting the momentum factor there is still significant persistence in the performance of pension fund managers. The returns on a zero-investment-portfolio net of momentum effects would have yielded 1.48% per annum. This is an important result and conflicts with the view presented in the Myners' Report (2001) which states "selecting managers according to past performance figures first and brand second is widely acknowledged to be a poor way to select a manager" (paragraph 5.44). How can we explain this gradual erosion of persistence at longer time horizons? As we note in footnote 2, the underlying unit of analysis in this paper is the fund management house, not individual fund managers. It may be that the fund management skills we have identified are due to individuals, but over time these individuals move between jobs so that over longer horizons the persistence in fund management house performance weakens.

We have argued that earlier studies of performance persistence in pension fund returns may have induced a selection bias by restricting the data sample to the same fund manager over a long time period, and this survivor bias may have reduced the level of persistence in the sample. Using our database with a restriction that only long-lived funds with the same fund manager be included, did indeed reduce the return on a zero investment portfolio.

Two caveats are in order. First we have made no allowance for the costs of fund management. We have found that some fund managers generate consistent abnormal returns above the benchmark portfolios, but whether these abnormal returns outweigh the costs of active fund management is not an issue that we have explicitly addressed. Myners (2001) suggests that annual fund management costs are typically around 40 basis points of the funds under management for a £100 million mandate, and that the upper quartile of management fees are 48 basis points. In both cases the excess return of 148 basis points that we have identified clearly covers the fund management fees. Second, having identified performance persistence at the one-year horizon, it is less clear how pension fund trustees could take advantage of this fact. One implication of these results might be that a pension fund mandate should be set up on a yearly basis, however this would ignore the substantial transactions costs involved in shifting a pension funds assets from one fund manager to another, on such regular intervals.

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Table 1: Descriptive Statistics on Pension Funds and Fund Managers

Panel A: *Fund-Quarters*

No. of Funds	2,175		No. of Quarters		59,509
Distribution of Fund-Quarters					
min	5%	25%	50%	75%	95%	max
1	4	12	24	41	56	56

Panel B: *Manager-Quarters*

No. of Managers	191		No. of Quarters		59,509
Distribution of Manager-Quarters					
min	5%	25%	50%	75%	95%	max
2	4	17	45	179	1,063	17,299

Panel C: Distribution of Change in Managers Across Funds

ΔMan code	Overall		Between Funds		Within Funds
	Freq	%	Freq.	%	%
0	48,435	81.39	2,175	100	81.39
1	9,382	15.77	559	25.7	42.47
2	1,475	2.48	110	5.06	28.08
3	197	0.33	17	0.78	22.83
4	20	0.03	3	0.14	13.25
Total	59,509	100	2,864 (n=2,175)	131.68	71.33

Where ΔMan=0 denotes an observation with the manager the same as the previous manager by fund; ΔMan=1 denotes an observation where the fund has changed its manager once up to that point in time, ΔMan=2 denotes an observation where the fund has changed its manager twice etc.

Panel D: Distribution of Managers Across Funds by Category of Manager

Fman category	Overall		Between Funds		Within Funds
	Freq	%	Freq.	%	%
Multi-manager	17,299	29.07	659	30.3	78.10
1RMan	6,410	10.77	244	11.22	81.04
2RMan	3,318	5.58	184	8.46	59.55
3RMan	2,881	4.84	116	5.33	73.40
4RMan-17RMan[#]	13,758	23.14	681	31.31	68.16
18RMan-188RMan	15,595	26.22	965	44.65	58.84
ΔMan	248	0.42	225	10.34	2.64
Total	59,509	100.0	3,074 (n=2,175)	141.33	63.43

where total within = (659*78.1+244*81.04+ .....)/3,074; 'n'RMan denotes 'n'*th* ranked fund manager by frequency of observations. [#] denotes that each of these fund managers had greater than 1% of the overall frequency.

Table 2: Descriptive Statistics

Panel A: Returns Across Quarters and Funds

Returns, R_{Pt}	All	Weighted by fund size	≥12 Quarters	<12 Quarters	FT-All ShareRets
Mean	0.0432	0.0380	0.0428	0.0511	0.0438
Std. Dev.	0.0867	0.0814	0.0867	0.0872	0.0834
Distribution of returns:					
10%	-0.0543	-0.0537	-0.0544	-0.0503	
25%	0.0016	0.0016	0.0015	0.0048	
50%	0.0463	0.0441	0.0459	0.0528	
75%	0.0896	0.0747	0.0885	0.1061	
90%	0.1525	0.1346	0.1527	0.1457	
Obs.	59,317	59,314	56,344	2,973	56
# funds	2,170	2,170	1,717	453	

Panel B: Distribution of Fund Size Across Funds

	Fund Size at start of Quarter (£m)		
	March 1983	Dec 1990	Dec 1997
Mean	25.02	50.24	102.27
Std. Dev.	85.01	194.45	387.30
Distribution of Fund size:			
10%	0.441	1.36	6.02
25%	1.06	3.31	12.39
50%	3.20	8.35	28.12
75%	14.25	27.36	70.14
90%	51.64	102.88	221.90
Obs.	833	1131	1004

Panel C: Returns and Fund Size Across Funds and Across Fund Managers

Variable		Mean	Std. Dev	Min	Max	Observations	
R_{Pt}	overall	0.0432	0.0867	-0.5257	0.8707	No. obs	59,317.0
	between funds		0.0165	-0.1285	0.2366	# funds	2,170
	within funds		0.0863	-0.5144	0.7139	Obs per fund	27.3
	between managers		0.0177	-0.1147	0.1170	# managers	189
	within managers		0.0866	-0.5241	0.8722	Obs per man	313.8
smv	overall	58.4	240.1	0.0	9,108.6	No. obs	59,453.0
	between funds		174.4	0.0	5,096.6	# funds	2,175
	within funds		89.6	-3,352.7	4,070.4	Obs per fund	27.3
	between managers		506.0	0.2	6,747.4	# managers	190
	within managers		164.8	-2,865.3	4,258.4	Obs per man	312.9
smv97	overall	204.2	869.1	0.0	24,411.4	No. obs	59,437.0
	between funds		1,049.2	0.0	21,804.7	# funds	2,170.0
	within funds		189.7	-5,106.4	7,187.2	Obs per fund	27.4
	between managers		1,001.5	0.1	11,851.8	# managers	189.0
	within managers		733.1	4,268.2	24,260.8	Obs per man	314.5

where R_{Pt} is the quarterly return on fund *P* in quarter *t*; and smv is the fund market value at the beginning of the quarter

Table 3: Persistence Tests based on 3-factor Abnormal Returns of Fund Manager Performance

Panel A. Performance ranked portfolio tests: unweighted abnormal returns

	AV5	AV1	DIF	TDIF
1QR1QE	-0.0002	-0.0018	0.0016	1.41
4QR4QE	0.0015*	-0.0023*	0.0039*	6.72
12QR12QE	0.0013*	-0.0005	0.0018*	3.10

Panel B. Performance ranked portfolio tests: abnormal returns weighted by fund size

	AV5	AV1	DIF	TDIF
1QR1QE	-0.0004	-0.0017	0.0013	1.14
4QR4QE	0.0015*	-0.0025*	0.0041*	8.15
12QR12QE	0.0008	-0.0005	0.0013*	3.36

For performance ranked tests, fund managers are sorted each year into quintile portfolios based on past performance of the pension funds under management - average (weighted and unweighted) abnormal returns of each fund over the ranking period. The equally weighted average portfolio abnormal returns of the top and bottom portfolios over the subsequent evaluation period is computed; AV5 and AV1 are the abnormal returns of the top and bottom portfolios in the evaluation period, averaged over all time periods in the sample. There are three different ranking and evaluation periods: 12QR12QE means three-year ranking period and three year evaluation period, and 1QR1QE means a one quarter ranking period and one quarter evaluation period. This procedure is followed for overlapping periods throughout the full period of the database, and DIF is AV5-AV1, and TDIF is a t-statistic on DIF, allowing for the autocorrelation induced by using overlapping observations. * denotes significantly different from zero at 95 per cent confidence limits.

Panel C: Contingency tables: unweighted abnormal returns

	N	PRW	CP	Z-stat	CHI	TCS
$1Q_{-t}1Q_t$	5,360	0.523	1.139*	2.373	6.169*	0.15
$4Q_{-t}4Q_t$	1,166	0.578	1.531*	3.614	15.125*	6.17*
$12Q_{-t}12Q_t$	195	0.574	1.249	0.773	1.821	1.72

Panel D: Contingency tables: abnormal returns weighted by fund size

	N	PRW	CP	Z-stat	CHI	TCS
$1Q_{-t}1Q_t$	5,360	0.520	1.112	1.936	4.282	-0.29
$4Q_{-t}4Q_t$	1,166	0.576	1.563*	3.788	15.520*	5.45*
$12Q_{-t}12Q_t$	195	0.574	1.049	0.167	2.149	1.23

Fund managers are classified as winners or losers based on abnormal returns in each of two consecutive time periods Q_{-t} and Q_t, and the numbers of winner-winner (WW), winner-loser (WL), loser winner (LW) and loser-loser (LL) are counted in each time period. There are three sets of consecutive periods: $12Q_{-t}12Q_t$ means the two consecutive periods are of three year length (12 quarters), and similarly for $4Q_{-t}4Q_t$ and for $1Q_{-t}1Q_t$. The following statistics are computed: a) Percentage of repeat winners, PRW = WW/(N/2); b) Cross-product ratio CP = (WW x LL)/(WL x LW); where $\log(CP)/\sigma_{\log(CP)}$ has a standard normal distribution, and $\sigma_{\log(CP)} = \sqrt{[(1/WW) + (1/WL) + (1/LW) + (1/LL)]}$; c) Chi-Squared test with 1 d.o.f. where CHI = $\{(WW - N/4)^2 + (WL - N/4)^2 + (LW - N/4)^2 (LL - N/4)^2\}/N/4$, and N is the number of pairs; and d) TCS is the t-statistic for the slope coefficient in the pooled cross-section OLS regression of evaluation period abnormal returns on ranking period abnormal returns.

Table 4: Persistence Tests based on Alternative Measures of Abnormal Returns of Fund Manager Performance

Panel A. Performance ranked portfolio tests: unweighted 4-factor abnormal returns

	AV5	AV1	DIF	TDIF
1QR1QE	-0.0008	-0.0019	0.0012	1.14
4QR4QE	0.0012*	-0.0025*	0.0037*	6.45
12QR12QE	0.0011	-0.0005	0.0016*	3.18

Panel B. Performance ranked portfolio tests: unweighted CAPM abnormal returns

	AV5	AV1	DIF	TDIF
1QR1QE	0.0002	-0.0019	0.0021	1.28
4QR4QE	0.0017*	-0.0020	0.0037*	3.07
12QR12QE	-0.0002	0.0008	-0.0010	-1.76

Panel C. Performance ranked portfolio tests: unweighted 3-factor conditional abnormal returns

	AV5	AV1	DIF	TDIF
1QR1QE	0.0006	-0.0021*	0.0027*	2.43
4QR4QE	0.0020*	-0.0028*	0.0048*	8.04
12QR12QE	0.0011	-0.0002	0.0013*	3.34

See notes to Table 3

Panel D: Contingency tables based on unweighted 4-factor abnormal returns

	N	PRW	CP	Z-stat	CHI	TCS
$1Q_{-t}1Q_t$	5,360	0.515	1.079	1.331	2.123	-1.47
$4Q_{-t}4Q_t$	1,166	0.568	1.507*	3.357	12.043*	4.18*
$12Q_{-t}12Q_t$	195	0.590	1.320	0.933	2.290	0.94

Panel E: Contingency tables based on unweighted CAPM abnormal returns

	N	PRW	CP	Z-stat	CHI	TCS
$1Q_{-t}1Q_t$	5,360	0.526	1.164*	2.783	8.272*	4.19*
$4Q_{-t}4Q_t$	1,166	0.587	1.700*	4.488	21.575*	6.37*
$12Q_{-t}12Q_t$	195	0.523	0.826	-0.663	1.615	-3.28*

Panel F: Contingency tables based on unweighted 3-factor conditional abnormal returns

	N	PRW	CP	Z-stat	CHI	TCS
$1Q_{-t}1Q_t$	4,980	0.537	1.273*	4.245	18.593*	3.18*
$4Q_{-t}4Q_t$	1,088	0.574	1.545*	3.565	13.919*	7.03*
$12Q_{-t}12Q_t$	183	0.536	1.067	0.218	0.497	0.84

See notes to Table 3

Table 5: Asymmetric Persistence Tests based on 3-factor Abnormal Returns of Fund Manager Performance

Performance ranked portfolio tests: unweighted abnormal returns

		Evaluation Period		
		1QE	4QE	12QE
Ranking Period	1QR	0.0016	0.0024*	0.0012*
		(1.41)	(4.80)	(5.07)
	4QR	0.0040*	0.0039*	0.0018*
		(4.75)	(6.72)	(3.15)
	12QR	0.0042*	0.0041*	0.0018*
		(6.52)	(5.66)	(3.10)

As in table 3 fund managers are sorted each year into quintile portfolios based on past performance of the pension funds under management. Each element in the table is DIF – the difference in the equally weighted average portfolio abnormal returns of the top and bottom quintile portfolios over the subsequent evaluation period. There are nine combinations of different ranking and evaluation periods: for example 4QR12QE means a four quarter ranking period and twelve quarter evaluation period. The term in brackets is a t-statistic on DIF, allowing for the autocorrelation induced by using overlapping observations. * denotes significance at 95 per cent

Table 6: Persistency Tests based on 3-factor Abnormal Returns of Fund Manager Performance for Restricted Sample of Single Same-Manager Funds

Panel A. Performance ranked portfolio tests of fund manager performance

	AV5	AV1	DIF	TDIF
1QR1QE	0.0018	0.0001	0.0017	2.11
4QR4QE	0.0028*	0.0005	0.0023*	3.35
12QR12QE	0.0038*	0.0019	0.0019*	4.30

see notes to Table 3

Panel B: Contingency tables of fund manager performance

	N	PRW	CP	Z-stat	CHI	TCS
$1Q_{-t}1Q_t$	7,060	0.522	1.159*	3.093	9.738*	6.63*
$4Q_{-t}4Q_t$	1,668	0.553	1.477*	3.960	15.794*	6.43*
$12Q_{-t}12Q_t$	384	0.630	2.840*	4.945	25.021*	1.19

see notes to Table 3