Decentralized Investment Management: Evidence from the Pension Fund Industry

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Abstract

Using a unique dataset, we document two secular trends in the shift from centralized to decentralized pension fund management over the past few decades. First, across asset classes, sponsors have replaced generalist balanced managers with better-performing specialists. Second, within asset classes, funds have replaced single managers with multiple competing managers following diverse strategies to reduce diseconomies-of-scale as funds grow larger, relative to capital markets. Consistent with a model of decentralized management, sponsors implement risk controls that trade off higher anticipated alphas of multiple, specialist managers with the increased difficulty in coordinating their risk-taking and greater uncertainty concerning their true skills.

JEL: G11, G23

Key words: decentralized investment management, diversification loss, coordination problems, fund manager skill, pension funds

Pension funds hold a significant share of the global market portfolio. During 2009, U.S. and U.K. pension fund assets amounted to \$9.7 and \$1.8 trillion (at 2011 exchange rates), representing 67.6% and 80.5% of GDP, respectively; by comparison, U.S. and U.K. mutual fund assets during 2009 amounted to \$11.1 and \$0.72 trillion, respectively.[1] While a great deal of research has focused on the performance and structure of mutual fund markets, such as Carhart (1997) and Chen et al. (2004), surprisingly little research has been conducted on pension funds. While this omission is driven by the scarcity of available data on the returns and characteristics of pension funds, differences between the structures of the pension and mutual fund markets are significant, making pension funds a fertile ground for study.

Specifically, mutual fund investors assign their monies to a fund manager with a designated investment style, and these investments are pooled with other investor assets. Typically, each investor has a very small share of total mutual fund assets, so the fund manager is not greatly motivated by the threat of any individual withdrawing her money from the fund. By contrast, sponsors of corporate defined benefit pension plans generally employ fund managers to invest their sizable pools of assets in separate accounts under an arrangement known as "delegated portfolio management". These sponsors are able to directly monitor the fund manager, as well as having a large influence on the investment strategy adopted. At one extreme, a pension fund sponsor may employ a single fund manager with a "balanced mandate" across all asset classes, while, at the other extreme, the pension fund might employ multiple managers, each with a "specialist mandate" within each asset class.[2]

The practice of using multiple managers, referred to as "decentralized investment management" by Sharpe (1981), might at first appear to be surprising. Specifically, as modeled by van Binsbergen, Brandt and Koijen (2008, hereafter BBK) and van Binsbergen, Brandt and Koijen (2009), the unconstrained solution to the mean-variance optimization problem for a sponsor is usually different from the optimal combination of mean-variance efficient portfolios chosen by the individual managers employed by the sponsor. Thus, employing multiple managers usually leads to a "diversification loss",

[1] See oecd.org/daf/pensions for pension fund statistics and ici.org/research#statistics for mutual fund statistics.

[2] Other important differences exist. For example, mutual funds are subject to strict disclosure regulations, and benchmarks and fees are published widely; pension funds have little such disclosure, with privately negotiated, unpublished benchmarks and fees.

since individual managers have little incentive to account for the correlation of their own portfolio returns with the returns of other managers in the fund. This coordination problem can be managed through well-designed managerial incentive contracts, but cannot be eliminated entirely. Moreover, employing separate fund managers to oversee investments in individual asset classes, rather than hiring a single manager to oversee all asset classes, shifts the responsibility for market timing (e.g., tactical asset allocation) away from fund managers and back to the sponsor.

However, there are many potential benefits from employing multiple managers, especially as funds grow larger. For example, pension funds can use multiple managers to diversify the skills of specialist active managers having superior knowledge of a particular asset class (Sharpe (1981), BBK). They might also employ multiple managers to induce a "yardstick competition", and benefit from the resulting higher effort levels exerted by these managers (Shleifer (1985)). Such benefits from using multiple managers can be particularly important for a sponsor with a large fund, given the significant diseconomies-of-scale in pre-fee returns in asset management.

In this paper, we investigate whether pension fund sponsors have rationally moved toward decentralized management, given the greater coordination problem and higher fees that decentralization brings. Alternatively, it is possible that the increased prevalence of specialized fund managers is simply due to successful new marketing strategies by fund management companies (FMCs) to generate higher asset management fees.

The time period of our study (1984 to 2004) witnessed many changes in the "technology" of managing pension funds, as confirmed through a survey of industry professionals.[3] For instance, the discovery of return patterns that depend on the price-to-earnings or book-to-market equity characteristics of stocks (e.g., Fama and French (1993)) has led to "specialist" managers (a "financial innovation" in asset management) who oversee portfolios of either growth or value stocks (but not both). During the early part of our sample period, most funds employed a single manager (termed a "balanced" manager) across all asset classes. This was, for the most part, the only type of manager available in those days; also, most pension funds were small (relative to the size of the markets in which they traded), and did not wish to pay the higher fees charged by more specialized managers. By

[3]We sent a survey to a number of prominent pension fund sponsors, fund managers, and consultants to learn more about these changes in the industry, as well as to confirm the central findings of our paper. The survey results are summarized in an online appendix.

the end of our sample, the majority of pension funds employed multiple managers, most of which were specialists. Our paper investigates both the economic drivers of this widespread decentralization, and its effect on the performance and risk-taking of defined benefit pension funds. Our study also has implications for decentralized investment management in other asset management sectors, such as open-end mutual funds.

While there are a few existing studies of pension funds (e.g., Lakonishok, Shleifer and Vishny (1992)), these studies do not examine the effect of the delegation arrangement on performance and risk-taking, due to the unavailability of data on specific fund mandates.[4] Our paper, by contrast, studies a dataset on U.K. pension funds which uniquely contains, in addition to quarterly returns and total assets under management (AUM), information on the type of mandate (balanced or specialist) followed by each pension fund sponsor/manager pairing at each point in time. For instance, we know the investment mandate type followed by, say, fund manager A in managing U.K. equities for a given pension fund sponsor during a particular quarter. This knowledge of the mandate chosen by each sponsor when employing each manager allows us, for example, to test for differences in the performance of a particular investment manager in U.K. equities when acting as a specialist manager vs. a balanced manager (with different sponsors), thereby enabling us to assess the specialization hypothesis of Sharpe (1981) described above. As another example, we are able to see whether manager A differs in his risk-taking in U.K. equities when he is the sole specialist vs. when he competes with other specialists. This allows us to test whether, as a result of coordination problems, sponsors limit the risk-taking of multiple competing managers, as predicted by the BBK model. Thus, our data allows us to determine whether particular types of mandates lead to differential performance and/or risk-taking, controlling for asset class and manager characteristics.[5]

[4]Lakonishok, Shleifer and Vishny (1992) note (as mentioned earlier) that up to the early 1980s, most US pension fund managers operated under balanced mandates, with very few specialists. Brinson, Hood and Beebower (1986) report that, by 1985, this situation had changed, with most US pension funds employing multiple specialist managers, similar to the UK two decades later. Lakonishok, Shleifer and Vishny (1992) consider the performance of specialist managers grouped by styles (growth, value, and yield), but do not have data on specialist versus balanced managers.

[5]BBK assume that managers have no skills. Therefore, in their setting, the decision to decentralize fund management (which is made outside of their model) always produces suboptimal outcomes. Our setting makes no such assumptions: we study performance and risk-taking in a unified framework where managers might have differential skills. As such, besides studying the decentralization issues highlighted by BBK, we also assess the rationality of the decentralization

To structure our empirical tests, we develop a simple model of pension fund management (building on BBK), with both centralized and decentralized management as special cases, from which we develop several predictions regarding the economics of pension fund decentralization. This model assumes that decentralized managers (e.g., specialist managers) possess higher skills than centralized managers (e.g., balanced managers). In our first empirical tests, we confirm that this assumption is valid for our dataset – specialists significantly outperform balanced managers, especially in the dominant asset class among U.K. pension funds, U.K. equities. Further, the performance of U.K. equity specialists persists over consecutive three-year periods. Thus, balanced managers appear to only provide lower-fee diversification across asset classes for pension funds, relative to specialists, who provide superior performance.

Next, our study shows that pension fund sponsors react by switching from balanced to specialist managers as higher-skilled specialists become more widely available during the latter half of our sample period. Further, we find that sponsors change from single managers of either type (balanced or specialist) to multiple managers (predominantly multiple specialists) to reduce the impact of scale-diseconomies as the assets of a fund increase over time. The change to multiple managers incurs higher fees for the sponsor (due to scale-economies in fees), but the increase in pre-fee returns more than compensates for this.

Our theory model (and that of BBK) shows that a fund sponsor faces the problem of coordinating multiple managers to achieve optimal diversification, relative to a single manager scheme. This indicates that the sponsor must trade-off the benefits of higher performance against the cost of lower diversification prior to switching from sole- to multiple-management. Our extension of BBK shows that sponsors should allow decentralized managers higher risk budgets than centralized managers, when specialists possess higher skills. Consistent with this prediction, our empirical results show that sponsors do allow decentralized managers higher risk budgets. However, perhaps surprisingly, sponsors budget risk such that the overall pension fund volatility is lower under decentralized management, compared to centralized management. An extension of our model shows that this outcome is consistent with the sponsor being initially uncertain about the skills of the new decentralized managers and reducing risk accordingly.

decision itself.

Overall, the benefits and costs of decentralization produce a Sharpe ratio that is comparable with that of funds that have not decentralized. This implies that decentralization actually improves performance sufficiently to compensate for the suboptimal total risk level that results. The shift to decentralized management can, therefore, be interpreted as rational, since it offers funds with growing AUM a path for reducing the effects of scale-diseconomies.

Finally, we show evidence that sponsors employ multiple managers to introduce competitive incentives for managers to perform well, similar to the incentives for outsourced mutual fund management documented by Chen, Kubik and Hong (2006) and Goyal and Wahal (2008). Specifically, we find negative abnormal returns during the four quarters prior to a switch from a single to multiple managers, followed by significantly improved performance during the following four quarters. We show that most of this performance improvement can be traced to the incumbent manager (who, in large schemes, is generally retained by the chief investment officer (CIO)), consistent with the incumbent responding sharply to the threat of a new competing manager in the same asset class.[6] The absolute size of the underperformance (of the incumbent) prior to the switch averages only 53 basis points (bps)/year, however, indicating that sponsors switch to decentralized management even when the new managers have skills only modestly superior to the incumbent – also predicted by our model.

Overall, our paper explains the move toward decentralization as exploiting the increased skills of specialized managers, as well as benefiting from competitive pressures when multiple managers are used. Another novel (and previously unmodeled) finding of our study is evidence of the sponsor being initially uncertain about the true skill levels of new managers: not only is the incumbent manager retained in many cases, new managers are initially given a relatively low portfolio allocation.[7] Portfolio allocations to new managers, on average, increase over time, consistent with the sponsor learning more about their skills: indeed, new managers do, on average, outperform incumbent or replaced managers.

[6] According to our survey of pension professionals, there is a reluctance to fire a manager that the sponsor has known for some time, unless there has been a breakdown in the relationship. This could be explained by the fact that the sponsor recognizes the existence of diseconomies-of-scale and does not penalize the incumbent manager for the poor performance that results from this.

[7] Our survey of industry professionals supports the idea that the sponsor is reluctant to fire incumbent managers in part because of uncertainty concerning the skills of the new manager(s).

To summarize, the dynamics uncovered by our empirical analysis appear to be largely driven by two developments in the industry over the sample period: (i) the rapidly increasing size of pension funds, relative to capital markets (and the ensuing increased diseconomies-of-scale and associated market impact effects), and (ii) the introduction of specialist fund managers with higher levels of skills than balanced managers. Sponsors move cautiously toward decentralized management, consistent with uncertainty in specialist manager skills.

The remainder of the paper is organized as follows. In Section I, we discuss the theoretical predictions of a simple model of decentralization when there is first certainty and then uncertainty in fund manager skills. Section II describes the pension fund data, the performance evaluation models used and how fund manager fees are estimated. Section III looks at pension fund performance and the impact of mandate type, distinguishing between specialist and balanced mandates; it also looks at persistence in performance. Section IV examines how performance influences the decentralization pathways and the transitions between balanced and more specialist mandates, as well as the transitions between single and multiple managers. Section V investigates the drivers and consequences of the different decentralization pathways; it also looks at decentralization and risk and evidence concerning the uncertainty in manager skills. Section VI concludes.

I. Decentralized Investment Management: Theory and Predictions

I.A. Certainty in Manager Skills

A recent theory paper by BBK demonstrates the hazards of decentralized investment management. Specifically, the CIO of a pension fund (whose incentives are assumed to be perfectly aligned with the pension plan beneficiaries) faces a loss of diversification when adding new managers to a single-managed pension fund.[8] While a carefully designed benchmark incentive contract can minimize this loss, it cannot be eliminated when the actions of the managers cannot be perfectly observed. In this setting, the CIO would not choose to decentralize from a single to multiple managers with

[8]In larger pension plans, the decision-maker is the pension fund's investment committee. In a small pension plan, the decision-maker might be, for example, the CFO of the sponsoring company. In this paper, we use the term CIO to refer to either decision-making body regarding manager selection (as well as the centralization vs. decentralization decision) on behalf of the fund.

the same skill levels as the incumbent. BBK assign all managers zero skill, which also implies no scale-diseconomies in pension fund management.

We generalize the model of BBK by allowing for heterogeneity in skills in the set of managers from which the CIO selects: we assume "differential skills" arise from differences in baseline manager skills and/or from differences in scale-diseconomies faced by managers using different investment strategies, reflecting, e.g., declining investment opportunities as a function of fund size. This extended model allows us to study the economic drivers of the transition from centralized to decentralized fund management, which is the focus of our paper. While the full model is shown in the appendix, we have derived predictions in a simple setting with two types of manager, one unskilled centralized (i.e., balanced) and the other skilled decentralized (i.e., specialist), where these skill levels are perfectly known by the CIO. We first state the main predictions, then follow with examples to illustrate these predictions:

(i) Even with a relatively low level of manager skills (net of fees), the CIO will prefer decentralized skilled managers to a centralized unskilled manager across all asset classes.

(ii) A skilled manager will optimally choose a riskier portfolio than an otherwise identical unskilled manager, under the same incentive contract.

(iii) The CIO will optimally choose a riskier overall pension fund portfolio with decentralized skilled managers, relative to the chosen level of risk with a single, centralized unskilled manager.

The first prediction can be illustrated as follows. Using the asset class historical expected returns and covariances documented in BBK (see their Table 1) and assuming a coefficient of relative risk aversion of 5 for both the CIO and the individual managers, a 2% increase in the price of risk due to manager skill (i.e., multiplying expected manager returns by just 1.02 due to skill), would result in the CIO optimally replacing a single, unskilled balanced manager with separate, skilled specialist stock and bond managers, even though this would result in a lower overall level of portfolio diversification.[9,10]

[9]This increase in assumed expected returns corresponds to alphas of only 0.11% and 0.27% per annum for the bond and stock managers, respectively.

[10]Consistent with Figure 2 in BBK (which computes certainty equivalent losses when switching to decentralized

As an example of the second prediction, based also on the empirical estimates from BBK, suppose the price of risk for the skilled decentralized manager is 10% higher than that of the unskilled centralized manager.[11] Then, the decision by the CIO to replace a single unskilled manager with separate skilled stock and bond managers would increase the standard deviations of the stock and bond portfolios from 18.0% to 18.4%/year and from 10.4% to 10.7%/year, respectively. Moreover, in this case, the overall portfolio (stock plus bond) standard deviation increases from 15.8% to 17.1%, thus, illustrating the third prediction.

A corollary of the third prediction is that the CIO will optimally choose a riskier portfolio within a single asset class (e.g., U.K. equities) with decentralized multiple managers operating within that asset class, relative to his chosen level of risk with a single manager in that asset class when he is certain of the managers' skill levels. Furthermore, we note here that diseconomies-of-scale in asset management skills may play a role in the centralized manager having lower skills than decentralized managers who oversee smaller portfolios: the CIO may observe declining performance from a single manager as the portfolio grows in size (equivalent to a declining level of skills), driving him toward adding new managers.

I.B. Uncertainty in Manager Skills

The above extended model assumes that the CIO perfectly knows the skill level of each of the managers. We further extend the model of BBK to a setting where the skills of the decentralized managers are uncertain (this case is also derived in the appendix).[12]

With uncertainty about manager skills, the CIO may choose not to decentralize, given that his knowledge of the skill level of the incumbent centralized fund manager is known with much better precision than that of outside managers. If a sufficient portion of the portfolio is allocated to a new

managers having no skills), the point at which it becomes optimal for the CIO to switch to decentralized management depends on both the assumed skill level and the level of risk aversion, with higher levels of risk aversion, in particular, requiring higher levels of skill.

[11]This corresponds to increasing the expected returns by between 0.41% (corporate bonds, Aaa) and 1.07%/year (value stocks) in Table 1 of BBK, where expected return levels range between 9.1% and 15.7%/year.

[12]In addition, the model assumes that the CIO perfectly knows the correlations between the returns of the new managers. Since the CIO presumably does not know the exact strategies to be used by these managers, this unknown correlation can also lead to increased risks for the CIO under decentralization.

manager who turns out to be unskilled, then the pension fund would be worse off, since obtaining, say, the same expected return as the centralized manager would result in a higher level of risk (due to the lower level of diversification under decentralization).

Alternatively, the CIO may optimally choose to decentralize if he believes that either the proportion of skilled managers in the universe of managers or their average ability level is sufficiently high. In this case, the CIO might wish to lower the overall (decentralized) pension fund risk level (through strict risk budgets imposed on the managers) relative to the centralized manager case, contrary to result (iii) above. Now, the CIO will optimally decentralize, and will have higher expected utility after decentralization, but will reduce the risk budgets of decentralized managers (relative to the certain skills case) because of the reduced level of diversification (despite the preference for riskier portfolios exhibited by skilled managers, which is result (ii) above).

As a numerical example, we again use the information in BBK's Table 1 to calibrate our extended model to the case of two decentralized managers. Each of these two managers is assumed, with a probability of 15%, to face prices of risk that are 10% higher than those of the unskilled balanced manager, otherwise they face the same price of risk (implying, in this case, that 85% of decentralized managers are unskilled). Now, the standard deviation of the optimal decentralized portfolio selected by the CIO is 15.7% compared with 15.8% when the portfolio has a single centralized manager. Despite this apparently small difference, it should be recalled that, with certainty in the decentralized managers' skills, the optimal portfolio had a somewhat higher risk level of 17.1%.

Although both BBK's model and our extension assume that the CIO acts in accordance with the interests of the pension fund's beneficiaries, it is also useful to recognize the potential effect of career concerns on a CIO's choices, arising from the risk of being fired for a potentially poor decentralization decision. With a myopic CIO, the decision to decentralize might be delayed longer than in the case where there are no career concerns. If the proportion of skilled managers is low in the fund manager universe and their skills are also slight, then a career-concerned CIO could optimally decide not to decentralize at all. While we do not extend BBK's model in this direction, we note (when appropriate) results that seem consistent with CIO career concerns later in this paper.

II. Methodology

II.A. Data

The dataset used in this study was provided by *BNY Mellon Asset Servicing* (formerly *Russell-Mellon-CAPS* – commonly known as "*CAPS*") and consists of quarterly returns on the investment portfolios of 2,385 U.K. pension funds that had their performance monitored by *CAPS* at some stage between March 1984 and March 2004. These pension funds hold the assets of occupational defined-benefit – principally final salary – pension plans. The investment portfolios of each pension fund are allocated across seven asset classes: U.K. equities, U.K. bonds, international equities, international bonds, index-linked bonds, cash, and property. In addition, for each unique fund/quarter, the coded identity of the fund manager (or managers) and the size (starting market value) of the investment mandate under management are provided. All the pension funds in this particular *CAPS* dataset have "segregated" (i.e., bespoke) as distinct from "pooled" (i.e., co-mingled) investment mandates. The assets of these pension funds were managed by 364 different FMCs, including external and in-house management teams.[13]

Our *CAPS* dataset covers about half (by value) of all pension funds in the U.K. There is one other major provider of pension fund performance measurement services in the U.K., and that organization monitors the other half of the sample. Tonks (2005) shows that there are no serious selection biases in our dataset since any switching between these two measurement services will be symmetric. Although pension funds may exit the *CAPS* database because of poor performance, they will be replaced by poor performers from the alternative measurement service.[14]

[Table 1 about here]

Panel A of Table 1 shows the total size of pension fund assets, in billions of constant 2004 pounds

[13]The *CAPS* dataset has coded information on the FMC that operates the investment mandate. We use the terms "fund manager" and "FMC" interchangeably in the paper, since we have no information on the specific individuals from the FMC who manage the assets of a specific fund.

[14]The real value of pension fund assets in our sample grew by 262% between 1984 and 1994, and fell by 23% between 1994 and 2004. This contraction over the second half of the period reflects a combination of the closure of some defined benefit pension plans to new members (and, in some cases, to further accruals by existing members) and poor U.K. equity returns between 2000 and 2003.

sterling, and the aggregate asset allocation at three evenly spaced sample dates. Note that the three most important asset classes are U.K. equities, U.K. bonds and international equities, which together account for more than 85% of total pension fund assets. We focus on these three asset classes in this paper.

Panel B shows the average size of a fund manager mandate, conditional on the number of managers employed across asset categories at three different dates. In 1984, over 80% of contracts in each asset class were for a single fund manager, as part of a balanced mandate.[15] The remaining contracts employed two or more managers, as part of competing balanced mandates; specialist managers were not common in those days.[16] By 2004, almost half of UK equity mandates involved multiple managers. There also appear to be fund size limits – which differ in different asset classes – before additional managers are appointed. Both these observations are consistent with the idea that performance deterioration due to scale-diseconomies became a major concern over time.

The *CAPS* dataset also reports the investment mandate under which a fund manager operates. There are three broad classes of mandate: specialist (the manager exclusively manages assets from a single asset class), multi-asset (the manager can choose assets from more than one, but fewer than all asset classes[17]), and balanced (the manager can select assets from all asset classes). Panel C shows the distribution of funds and the number of fund managers employed for each of the investment mandates, again across asset classes and at the three different dates. Both the number of funds and the number of managers have contracted over time. This is partly explained by the closure of funds and the merger or closure of FMCs, as well as possible switches to *CAPS*'s rival performance measurement service. Nevertheless, the panel provides additional evidence of the shift away from balanced management.

[Figure 1 about here]

[15]Note that the number of funds in each asset class is not the same. Although fund managers may have been operating under a balanced mandate, they might have chosen not to invest in certain asset classes, and, therefore, the *CAPS* data would not include these funds as reporting returns in those asset classes.

[16]Property was the first asset class to attract specialist managers, and our classification of balanced mandates includes those mandates that were balanced-excluding-property (BXP), with any property holdings managed by specialists.

[17]For example, a multi-asset manager might manage a pension fund's entire bond portfolio of U.K., international, and index-linked bonds.

Figure 1 shows the evolution through time in the proportion of U.K. equity mandates in our sample that follow a specialist, multi-asset, or balanced strategy; these proportions are separately depicted for each of these types, and further separated into proportions of each type that are in single- or multiple-managed mandates. The figure again illustrates the secular move by U.K. pension funds away from balanced managers and towards multi-asset and specialist managers during the period March 1984 to March 2004. Roughly 99% of portfolios were allocated to balanced mandates during 1984, but only about 12% were by 2004 – at which time 63% of mandates were multi-asset and 25% were specialist.

[Figure 2 about here]

Figure 2 shows the evolution through time in the proportion of switches in a given quarter between different types of U.K. equity manager mandates, namely specialist, multi-asset and balanced, and also whether these were single- or multiple-manager mandates both before and after the switch. In the early part of the sample, the dominant switch is from single-balanced to multiple-balanced management: diseconomies-of-scale were becoming more pronounced, but specialists had not yet made significant inroads into the U.K. investment management industry. The big switch away from balanced management began around 1990 and two trends are discernible. The first is a switch from balanced to multi-asset management. Interestingly, funds with multiple balanced managers tended to switch to multiple multi-asset managers and funds with single balanced managers tended to switch to single multi-asset managers. The second trend is a switch to purely specialist managers. This switch is associated with large pension funds. Beginning in the mid-1980s, but only really taking off after around 1990, there is a switch from multiple balanced to multiple specialist managers: close to half of the total switches are of this type in 1993. However, 1994 sees the beginning of a switch from multiple multi-asset to multiple specialist management. By the end of the sample period, this is the largest single category of switches at around 30%; the next two largest categories are multiple multi-asset management and single multi-asset management switches from their balanced counterparts.

By the end of our sample period, balanced mandates had largely been replaced by a mix of active multi-asset, specialist U.K. equity, and specialist international equity mandates. The vast majority of mandates are active – in 2004, only 6-8% of the UK bond and international equity, and

12% of the UK equity mandates were passive. Specialist equity mandates accounted for 7.5% of the total, covering such specialities as small, medium, and large cap stocks, and global and pan-regional equities. Similar switches had taken place in the other key asset classes.

II.B. Performance Evaluation Models

We now turn to our empirical results, concentrating on the three main asset classes. To test for security selection skills in U.K. equities, we estimate a five-factor model with intercept:

$$r_{ift} = \alpha_{if} + \beta_{1if} r_{mt} + \beta_{2if} SMB_t + \beta_{3if} HML_t + \beta_{4if} MOM_t + \beta_{5if} r_{mt}^2 + \varepsilon_{ift}, \tag{1}$$

where r_{ift} is the pre-fee excess return (over a T-bill rate) by fund manager i at pension fund f during quarter t; r_{mt} is the excess return on the benchmark U.K. equity portfolio, the *FTSE All-Share Total Return Index*; and SMB_t, HML_t and MOM_t are the U.K.-equivalent Fama-French (1993) size and value common risk factors, and the U.K.-equivalent of the Carhart (1997) momentum factor.[18] The squared market return, r_{mt}^2, is included to capture possible market timing skills or, alternatively, co-skewness between fund and market returns (e.g., Harvey and Siddique (2000)).

For each mandate type, we base our tests for abnormal performance on the estimated values of Jensen's alpha, averaged across funds and managers. To conduct inference about the statistical significance of this mean alpha estimate, or any other estimate, we use the residual-resampling bootstrap procedure prescribed by Kosowski et al. (2006).[19] Finally, to capture both selectivity

[18] *CAPS* uses the total return on the *FTSE All-Share Index* as the benchmark for UK equities. Accordingly, we compute the excess return of this index over the UK Treasury bill rate. SMB_t, HML_t and MOM_t are UK versions of these factors supplied by Professor Alan Gregory of Exeter University (xfi.exeter.ac.uk/researchandpublications/portfoliosandfactors/index.php). These UK style factors have been used in several papers, including, for example, Grout and Zalewska (2006).

[19] For each bootstrap iteration, we sample with replacement from the error terms for fund manager i at pension fund f of Equation (1). These innovations are drawn for common time periods, t, to preserve potential cross-sectional dependencies (across funds). Using these innovations, we generate bootstrapped returns, while imposing $\alpha_{if} = 0$ to reflect the null of no abnormal performance. We then re-estimate the model and obtain a fitted value for each fund-manager alpha for that bootstrap. These are averaged cross-sectionally to form an average bootstrapped alpha. Repeating this across B bootstraps, we obtain a bootstrapped distribution of the average alpha estimate, which can be used to compute the p-value for the average alpha estimate obtained using the actual data. This procedure preserves cross-sectional differences in sample lengths across fund/manager relationships, and, so, replicates the variability in

and timing skills, we use the Treynor-Mazuy (1966) total performance measure, $TM_{if} = \alpha_{if} + \beta_{5if} Var(r_m)$.

To test for selection and market timing skills in U.K. bonds, we estimate a four-factor model consisting of the excess returns on the *FTSE All-Gilts Total Return Index* ($GOVB$) and U.K. government consol (i.e., perpetual) bonds ($CONS$), their squared terms and an intercept:[20]

$$r_{ift} = \alpha_{if} + \beta_{1if} GOVB_t + \beta_{2if} CONS_t + \beta_{3if} GOVB_t^2 + \beta_{4if} CONS_t^2 + \varepsilon_{ift}. \tag{2}$$

The market-timing measure for fund manager i at pension fund f is constructed as the sum of β_{3if} and β_{4if}, while the TM performance measure is $TM_{if} = \alpha_{if} + \beta_{3if} Var(GOVB) + \beta_{4if} Var(CONS)$.

For international equities, we use a six-factor model that includes sterling-denominated excess returns on the *MSCI North American* (NA) and *Europe Australasia Far Eastern ex-U.K. (EAFEX) Total Return Indices* as well as their squared terms, plus global SMB and HML factors:[21]

$$\begin{aligned} r_{ift} &= \alpha_{if} + \beta_{1if} NA_t + \beta_{2if} EAFEX_t + \beta_{3if} SMB_t \\ &\quad + \beta_{4if} HML_t + \beta_{5if} NA_t^2 + \beta_{6if} EAFEX_t^2 + \varepsilon_{ift}. \end{aligned} \tag{3}$$

The market-timing measure for fund manager i at pension fund f is constructed as the sum of β_{5if} and β_{6if}, while the TM performance measure is $TM_{if} = \alpha_{if} + \beta_{5if} Var(NA) + \beta_{6if} Var(EAFEX)$. We separate the global equity return into North American and $EAFEX$ components because of the evidence in Timmermann and Blake (2005) that U.K. pension fund weights on North America differed significantly from their corresponding market capitalization weights over the sample period studied here.

[Table 2 about here]

the α-estimates arising from heterogeneity in fund-manager tenures. A bootstrap that simultaneously draws (with replacement) fund residuals and factor returns, as recommended by Fama and French (2010), gives almost identical results to those reported here.

[20] To test for robustness of results, other performance evaluation models are considered in the online appendix.

[21] As the value factor, we use the sterling return on the *MSCI Barra World ex-U.K. Standard Value Index*. As the growth factor, we use the sterling return on the *MSCI Barra World ex-U.K. Standard Growth Index*. We have also experimented with versions of this model that add a momentum factor. We tried both the US momentum factor from Ken French's website (mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html), and a European-constructed momentum factor (see the online appendix for results). In each case, the results were qualitatively similar.

Table 2 presents summary statistics on our manager population, within each asset class. Panel A1 reports the distribution of the funds' yearly pre-fee mean returns within each asset class. As might be expected, the mean of the pre-fee distribution (15.96%/year) is highest for the U.K. equity portion of the funds, next highest for international equities (which are likely to be more diversified), and lowest for U.K. bonds.

Panel B1 presents the distribution of pre-fee alpha estimates using the above models. The mean annual pre-fee alpha for U.K. equities is -5 bps, while, for U.K. bonds and international equities, it is 70 and 94 bps, respectively. (As we will see shortly, these results change when we condition on the investment mandate under which the manager operates.) Panel C1 reports the distribution of beta estimates, which are loadings on the general market factor(s) in the three models. The mean beta results suggest that the models for all three asset classes are appropriate, since betas are centered on unity.

II.C. Fees

Our *CAPS* dataset does not include information on manager-specific management fees which are typically negotiated on a case-by-case basis between each pension fund and FMC and are not publicly disclosed. To overcome this limitation, we derive a set of fund manager fees for each pension fund mandate, using a comparable dataset from *Defaqto* of the same FMCs' fees for retail products, which allows us to estimate both a cross-sectional and a time-series distribution of fees for the managers in the *CAPS* dataset. These retail fees are then rescaled using a dataset on institutional fees from *Mercer* (2006). Comparing our estimated fees with those available from other sources confirms that there is a close correspondence. For example, Myners (2001) reports the distribution of fees charged across fund managers for a £100 million segregated pension fund mandate in U.K. equities as (30:40:48) bps/yr at the (25:50:75) percentiles, which compares with our estimated fees for U.K. equities of (31:42:50) bps/yr.[22]

Panel A2 of Table 2 presents summary statistics on post-fee returns, while Panel B2 reports regression alphas when estimated fees are deducted from quarterly gross returns. Note that, similar to research on U.S. pension funds and mutual funds (e.g., Bauer et al. (2007)), post-fee alphas for

[22] The detailed construction of this estimated fee database along with the distribution of annual fees by asset class and mandate type is contained in the online appendix.

U.K. equity managers are slightly negative (at -40 bps/yr) for the mean fund. Finally, Panel C2 shows that the market loadings are still centered around unity even after accounting for fees.

III. Pension Fund Performance

To confirm the skills of decentralized managers relative to centralized managers (as well as relate our research to previous research on pension fund performance), we conduct a brief analysis of the relative skills of balanced vs. specialist managers. Since balanced managers are used more often in a centralized role than specialists, we would expect that specialists would generally have higher levels of pre- and post-fee performance to compensate both for the difficulty in coordinating their actions and for the lower level of pension fund diversification that necessarily results.

III.A. Performance of Balanced vs. Specialist Managers

Table 3 presents pre- and post-fee evidence on the security selection and market-timing skills of managers within each mandate type (with bootstrapped p-values). Our results generally show that, before fees, U.K. equity specialists outperform the U.K. equity portion of balanced manager portfolios, according to our model that accounts for both selectivity and market-timing skills, Equation (1); similar results hold for U.K. bonds and international equities, using Equations (2) and (3). To illustrate, in the case of U.K. equities, the average pre-fee selectivity alpha for specialist mandates is a statistically significant 67 bps/year, while the alpha for balanced managers is insignificant. Among all asset classes, alphas for multi-asset mandates lie between those for the specialist and balanced mandates, consistent with their hybrid structure. Note, also, that the evidence on superior market timing skills across the asset classes is weak, with little sign that balanced managers outperform specialist managers in timing.

[Table 3 about here]

Our estimated fees allow us to estimate the actual value-added to pension fund sponsors from managers operating under different mandates. Table 3 shows that post-fee performance is highest for specialists, which helps to compensate for the greater coordination problems they bring. For instance, we estimate that the average U.K. equity specialist generates a post-fee total TM performance alpha of 59 bps/year, which is statistically significant, and that the majority of this performance (35 bps/year) comes from security selection skills. Even higher levels of alpha are evident among specialist international equity managers, which again compensates sponsors for the greater difficulty of integrating them into a well-diversified portfolio.[23]

In the online appendix, we conduct several robustness checks: in particular, we look at performance over sub-periods and consider different models of performance in computing the security selection and timing performance of each mandate type. We briefly summarize the results here. First, we find qualitatively consistent results across the two 10-year subperiods of our sample – specialists outperform balanced managers. Second, we add some additional factors to our performance regressions (1), (2), and (3), such as a momentum factor in the international equity model, and find that these make little difference to the overall performance results. Third, we apply several different models of timing to determine whether the equity fund managers are able to time the non-market factors (such as SMB and HML in the U.K. equity model): we find little evidence of such "style timing" abilities by the fund managers, whether they are U.K. or international equity specialists or balanced.

III.B. Performance persistence

There is little consensus about persistence in pension fund performance. Among recent studies, Tonks (2005) finds evidence of persistence in a sample of U.K. pension funds at the one-year horizon, whereas Bauer et al. (2007) do not find persistence for a sample of U.S. pension funds. We briefly investigate this issue in our dataset.

To test for persistence in the performance of a given fund/manager pairing, we divide the data into non-overlapping three-year periods. For each period, we run the performance regressions described in Section II.B, obtain α estimates, then sort funds into deciles. Next, we estimate the probability that a fund is ranked in the same decile during two consecutive three-year periods. In the absence of persistence, this probability is one-tenth. For U.K. and international equities, we find persistence only among specialists, with probabilities of 0.22 (p-value=0.003, against a null of 10%)

[23]For instance, international equity managers are usually free to overweight various global regions, such as North America, if they see opportunities that justify the overweighting. Unanticipated overweighting can make efficient diversification especially difficult for the CIO.

and 0.15 (p-value=0.094), respectively; for U.K. bonds, persistence is statistically significant for all mandates, with probabilities of 0.26 (p-value=0.038), 0.18 (p-value=0.041), and 0.14 (p-value=0.011) for specialist, multi-asset, and balanced mandates, respectively.

Because the procedure described above might be affected by survivor bias, we provide an alternative estimate of persistence. We compute α estimates recursively over three-year periods for all fund/manager pairings, sort funds into quintiles, then compute the performance of equal-weighted portfolios over the subsequent three-year period. To avoid survivor bias, a fund is included in the test period until it disappears, then the portfolio is rebalanced at the beginning of the following quarter. The procedure results in five portfolios, each with 68 quarterly observations. Here, persistence is statistically significant only for U.K. equity specialist and balanced mandates; a portfolio that is long the top quintile (prior three-year winners) and short the bottom quintile (losers) delivers a statistically significant α of 75 bps (p-value < 0.001) and 24 bps (p-value < 0.001), respectively, during the following three years.

In summary, our results show that subgroups of fund managers having a particular mandate (e.g., specialists) outperform their benchmarks, even though the average manager underperforms, as shown by almost all past studies (and as reflected in Table 2).[24] In particular, our results show that specialist fund managers display significant security selection abilities, and their pre- and post-fee total performance exceeds that of balanced managers. The performance of the managers operating under a multi-asset mandate falls between that of the specialist and balanced managers. Further, we find little evidence that any managers have market timing abilities. Pension sponsors appear to realize this, as indicated by their movement away from balanced managers and toward investment consultants or in-house models over the past couple of decades for tactical asset allocation decisions. Finally, there is evidence that the performance of some types of managers persists for longer than

[24] Beebower and Bergstrom (1977), Brinson, Hood and Beebower (1986), Ippolito and Turner (1987), Lakonishok, Shleifer and Vishny (1992), Coggin, Fabozzi and Rahman (1993), Christopherson, Ferson and Glassman (1998), and Bauer et al. (2007) for the US, and Blake, Lehmann and Timmermann (1999) for the UK, find little evidence of either security selection or market-timing skills by pension fund managers. An exception is Busse, Goyal and Wahal (2010), who find evidence of persistence in the performance of 1,475 U.S. institutional investment managers in domestic equities and international bonds between 1991 and 2004. Our results suggest that these different time-period-specific results are due to the dominance of balanced managers during the early part of our sample and specialist mandates during the latter part.

previously recognized.

IV. Decentralization Pathways

As Figure 2 indicates, there are two principal pathways along which the centralization/decentralization decision might proceed. In this section, we examine these two pathways in detail.

IV.A. Transitions Between Balanced, Multi-asset, and Specialist Mandates

The first pathway along which the CIO might decentralize is by switching from a single balanced manager across all asset classes to a specialist manager within each asset class. For instance, the CIO may decide that manager A is best suited to manage U.K. equities, while manager B is best suited to manage U.K. and international bonds.

Sharpe (1981) argues that specialists might invest in acquiring superior private information on securities within a particular asset class, giving them better performance than generalists. Therefore, if the movement toward specialist managers is rational, specialists should deliver better performance (as per Sharpe, 1981) than balanced managers that is more than sufficient to compensate for the diversification loss (as per BBK). To provide deeper insights into the economic motivation for a pension fund CIO to switch between balanced, multi-asset, and specialist mandates, Panel A of Table 4 presents transition matrices that contain summary statistics across all manager change events within the U.K. equity asset class.[25]

[Table 4 about here]

Specifically, the panel shows all events where a single manager within a given asset class is replaced by another single manager. It is important to recognize that some of these transitions retain the same level of decentralization (or lack, thereof) within the pension fund. For instance, the replacement of a single balanced manager with another single balanced manager retains a fully centralized structure, while the replacement of a single specialist with another specialist retains the

[25] Our survey of industry professionals indicates that decentralization events are generally undertaken to improve performance within U.K. equities, the largest asset class, or because of dissatisfaction with the balanced manager's performance in one of the smaller, more specialized asset classes.

same level of centralization within that asset class (and the same level of decentralization across asset classes).[26]

The most common single-manager replacement (206 cases) occurs when a balanced manager is replaced by another balanced manager, across all asset classes, thereby retaining fully centralized asset management. A very uncommon event (only 12 occurrences) is the replacement of a single balanced manager with a single specialist manager, a move to fully decentralized management under a new set of mandates. There are no shifts from a single specialist to a single balanced manager (i.e., from fully decentralized to fully centralized management) in our dataset, suggesting that decentralization, when optimally undertaken, is intended to be irreversible, since the benefits for the plan sponsor are anticipated to be permanent.

The cells also show the average relative size (AUM) of the U.K. equity asset class of those funds making switches in a given quarter, relative to the U.K. equity allocation of all other pension funds during the same quarter (where "1.0" indicates that the fund making a manager replacement has U.K. equity assets of the average size at that date). First, note that all funds making single-manager-to-single-manager switches are much smaller than the average fund, as indicated by the size indicator being below unity in all cells – these small funds cannot move to a multiple-manager mandate, due to the high fees involved.

Changes in fee levels and realized pre-fee returns, computed relative to the asset class benchmarks, are also shown in the cells beneath the size information. Same-mandate switches (specialist-to-specialist or balanced-to-balanced) result in improved pre-fee returns, at only a slightly increased fee level. For instance, a switch from one balanced manager to another results in a (statistically significant) pre-fee return increase of 169 bps from the year prior to the year following a manager replacement, with an average fee increase of only 3 bps/year. Since there is no change in mandate type (and, hence, the same level of manager centralization or decentralization), this significantly improved performance indicates that sponsors appear to delay replacing managers with lagging performance, due to the uncertainty in the performance of the new manager (and, perhaps, to the career risk faced

[26]Note that this "within-asset-class" perspective is a simplified one-dimensional view of decentralization, which can also occur in more complex scenarios across asset classes. For instance, a CIO adding a U.K. equity specialist (but no other managers) to a single balanced mandate (across asset classes) would have decentralization implications for the other asset classes (e.g., U.K. bonds).

by the CIO when executing such a switch).

To summarize, it is typically smaller funds that tend to transition from one single manager (within an asset class) to another. Smaller funds generally switch from a single-balanced (or multi-asset) manager to a new single-balanced (or multi-asset) manager when performance lags. The replacement of a single balanced (or multi-asset) manager with a single specialist manager is rare among smaller pension funds.

IV.B. Transitions Between Single and Multiple Managers

The second pathway along which the CIO might decentralize is to move from a single manager to multiple managers within each asset class. For instance, a pension fund can choose a number of balanced managers, each managing across all asset categories. Similarly, a fund that wishes to employ a specialist strategy might hire one or more specialist managers within each asset class. Either decision represents a switch from centralized to decentralized management within asset classes.

Why might pension fund sponsors consider employing multiple managers? Since Chen et al. (2004) report evidence of strong scale-diseconomies in fund management (before fees) and Berk and Green (2004) demonstrate that such performance diseconomies result from growth in AUM for successful funds, we would expect that CIOs would be especially keen to switch to multiple managers when their funds have grown too large for a single manager to maintain an acceptable level of performance. Further, if the CIO is uncertain about the manager's true skill level, he might want to employ a number of managers in order to diversify alpha risk. Indeed, Sharpe (1981) distinguishes between diversification of style (where funds employ multiple managers with different investment approaches) and diversification of judgment (where multiple managers are employed to analyze the same subset of securities). The latter is related to uncertainty about the true level of each manager's alpha. If fund managers have specialist skills that are not perfectly known by the sponsor, Kapur and Timmermann (2005) show that a risk-averse sponsor (in our setting, represented by the CIO) will employ multiple managers to diversify the risk of employing a low-skilled fund manager.[27] If this effect is important, we would expect to find a tighter distribution of alphas among multiple-managed funds than among single-managed funds. Also, we would expect the CIO to be especially concerned about alpha risk

[27]Our survey of industry professionals confirms that this practice is common in large funds that can afford to employ multiple managers.

as a fund grows larger, due to the higher penalty from underperformance.

Hiring multiple managers could also induce an internal yardstick competition (Shleifer (1985)), allowing the CIO to assess the managers' comparative performance and helping to overcome the problems of shirking and hidden actions. Mookherjee (1984) shows that, with multiple agents, relative performance evaluation when agents' outputs are correlated enables the principal (in this case, the CIO) to obtain first-best outcomes.

Nevertheless, hiring multiple managers introduces a coordination problem – this time within an asset class – in addition to the cross-asset-class coordination problem discussed earlier. BBK argue that the CIO will contract with each fund manager in a way that induces the manager to optimally choose a lower risk portfolio than would be chosen without the coordination problem. However, as discussed in our model of Section I, if the CIO expects the new manager to have greater skills than the incumbent, the CIO will allocate a greater risk budget to each of the new managers, although the total risk budget (across all managers) can still be lower than the case in which there is no coordination problem, due to imperfect correlations in the managers' returns.

To provide an initial exploration of these issues, Panel B of Table 4 presents a transition matrix that illustrates the economics of single-to-multiple U.K. equity manager decentralization switches. The majority of these switches maintain the same mandate-type (for instance, single-specialist to multiple-specialist). Further, a substantial fraction (61%) of the switches occur within the balanced mandate, as Figure 2 shows. The figure also shows that the bulk of these particular types of switches occurred during the first half of the sample (1984-1994); the proportion drops to 38% if we restrict the analysis to the second half (1994-2004).

An examination of the relative size of funds changing from single to multiple managers within an asset class offers additional insights. These funds are much larger than those switching from one single manager to another, as shown by comparing the corresponding cells in Panels A and B of Table 4. Also, funds switching from single to multiple specialists are substantially larger than funds switching from single to multiple balanced managers, which indicates that an optimal strategy for funds facing severe scale-diseconomies is to employ multiple specialist managers.

A more extensive analysis of returns and fees enables a better understanding of the economic motivation behind the different changes. Single-to-single replacements (Panel A) generally result in higher improvements in returns than single-to-multiple switches (Panel B). This finding suggests that single-to-single manager changes are motivated by an attempt to find a more-skilled manager, while single-to-multiple manager changes are made to avoid anticipated increased scale-diseconomies as a pension fund's assets grows larger.

The smaller improvement in performance associated with single-to-multiple manager switches suggests that the CIO moves more quickly to make this type of switch than the single-to-single manager switch. We also find a tighter distribution of manager skills in larger funds and this could additionally contribute to the smaller improvement. There are a few potential explanations for these findings. First, although there may be some residual uncertainty about the true skill level of the incumbent manager, initially there is likely to be a great deal of uncertainty about the skills of any newly appointed manager. The CIO may be reluctant to fire a long-standing manager who might have had a spell of bad luck and replace him with a manager whose performance could be worse. With a single-to-multiple manager change, the incumbent can be retained while learning more about the skills of the new manager.[28] Second, a CIO will learn from experience where the scale-diseconomies in asset management begin to bite for his particular fund, so he will be able to predict more precisely when a single manager's skills will likely begin to tail off as a function of the size of the manager's AUM. And, finally, the first prediction of our theory model is that a relatively low level of additional skill is required to motivate the CIO to optimally change to more specialized managers.

V. Drivers and Consequences of the Different Decentralization Pathways

Building on the analysis in the previous section, we now attempt to identify some of the causal factors explaining the different pathways to decentralization.

V.A. Balanced-to-Specialist Mandate Switches

In order to explain the mandate switches by pension funds, we conduct an event study. Each mandate switch by a pension fund within an asset class is included as an observation, and we focus

[28] Our survey of pension professionals confirms that this practice is common among CIOs.

on the eight quarters surrounding the switch.[29]

[Table 5 about here]

Panel A of Table 5 reports the results of this analysis for each of the three major asset classes and for the total pension fund portfolio. In particular, we compute the manager return in excess of the asset class benchmark return during the four quarters preceding the switch, as well as during the subsequent four quarters, then value-weight across managers within either the asset class or across all asset classes.[30] The panel shows that, for both U.K. equities and the total portfolio, the average benchmark-adjusted pre-fee return is negative before the switch, at -36 and -17 bps/year, respectively. It is positive for both U.K. bonds and international equities. The average post-fee benchmark-adjusted return before the switch, reported in the online appendix, is negative for all asset classes, at -75, -24 and -39 bps/year for U.K. equities, U.K. bonds and international equities, respectively. This finding is consistent with Dangl, Wu and Zechner (2008), who predict a negative relationship between investment performance and manager turnover.

It is the poor relative performance in the dominant asset class of U.K. equities (which has a sufficiently large weight that it can affect the return on the total portfolio), much more than in any other asset class, that appears to be the chief factor motivating the CIO to switch from balanced to specialist mandates. The switch is justified, on average, since there is a statistically significant improvement in pre-fee performance after the switch in both U.K. equities and the total portfolio of 89 and 72 bps/year, respectively. There is a smaller improvement of 55 bps/year in the U.K. bond portfolio, while the post-switch performance of the international equities portfolio deteriorates, although the deterioration is not statistically significant (and, this asset class is, on average, a relatively small portion of the overall pension fund portfolio over our sample period). The improvement in post-fee performance is qualitatively similar to that of the pre-fee results, with the exception that

[29] We compute the asset class return for a fund, regardless of whether there is a second manager change during the four subsequent quarters. This process avoids a selection bias, since new managers who are unsuccessful might be fired during the first year (although this is very rare).

[30] We benchmark-adjust rather than compute a regression alpha, since we have only one return observation for each event-quarter. For U.K. and international equities, the benchmarks are the *FTSE All-Share Total Return* and the *MSCI World ex-U.K. Total Return Indices*, respectively, while, for U.K. bonds, it is the *FTSE All-Gilts Total Return Index.* These are also the benchmark indices used by *CAPS* in its annual performance reports.

U.K. bonds do not display a significant improvement in post-fee performance following the switch.

V.B. Single-to-Multiple Manager Switches

Panel B1 of Table 5 examines the performance during the eight quarters surrounding the switch from a single- to a multiple-manager mandate within the three main asset classes.[31] Specifically, the panel shows, for each asset class where a sponsor made a switch, mean benchmark-adjusted returns during both the four quarters prior to and following the switch quarter. Benchmark-adjusted returns are value-weighted, and if the former manager is retained, that fund is included in the post-switch pool of "new managers".

The results show evidence of underperformance during the four quarters prior to the switch among U.K. equity and international equity funds, followed by significantly improved performance during the four quarters following the switch – a total improvement of 62 bps/year in the case of U.K. equity managers – although this does not significantly impact overall pension fund performance. To explore if the industry has certain size breakpoints where sponsors switch from single to multiple managers before performance deteriorates substantially, we examine the distribution of fund sizes during the quarter of a switch from a single manager to multiple managers (within an asset class). To control for the upward trend in asset class sizes over our period of study, we measure the quarterly size as the log of the fund size relative to the average fund size across all funds at the end of that quarter. The results, presented in Figure 3, show that funds that replace a single manager (in an asset class) with multiple managers are, on average, much larger (during the replacement quarter) than single-managed funds, but a little smaller than other multiple-managed funds. This again indicates that sponsors switch in response to *anticipated* diseconomies-of-scale. Within both single-managed and multiple-managed funds, there are fairly tight distributions of fund sizes, again confirming the idea that there are size breakpoints, above which the industry generally employs multiple managers.

[Figure 3 about here]

We have explained that hiring multiple managers should induce an internal yardstick competition. We might expect that this competitive effect would be especially strong in motivating an incumbent

[31] Over our sample period, there were 418, 515, and 432 such switches in U.K. equities, U.K. bonds, and international equities, respectively.

manager who is *not* fired to improve his performance. In panel B2 of Table 5, we compute the performance of the incumbent manager (across all events where the incumbent is retained) around a switch to a multiple manager system. We find evidence of a competition effect: the incumbent's performance around the event quarter improves slightly more than that of all managers (in panel B1), with the improvement being statistically significant in the case of U.K. equities–although still not sufficient to (statistically) significantly influence the overall portfolio return.[32]

To more clearly explore whether competition drives performance improvement (after controlling for fund size and fund manager intrinsic skills), as a first stage, we estimate the time-series risk-adjusted returns for each fund/manager pairing. From this estimated performance level, we subtract the average performance of that manager across all the (same asset class) funds managed by him during the sample (we call this "manager-adjusted performance"). In a second stage, we regress this manager-adjusted performance on (i) the fund/manager relative size (defined as the total net assets for the fund/manager pairing divided by the average fund/manager size in that asset class during the same quarter), and (ii) the total number of managers in that asset class of the same pension fund, including the subject fund/manager. This pooled regression is implemented for each asset class across all funds managed by all managers across all time periods. This specification captures any diseconomies-of-scale at the fund level, controlling for the intrinsic skill of a particular manager – which we would expect to be common across all funds managed by the same FMC – as measured by the average manager skill. Note that we use relative fund size, as we would expect fund-level diseconomies-of-scale, principally caused by market impact costs, to be driven by fund size relative to the size of capital markets.[33]

The results from this analysis are mixed. There is some evidence of pre-fee diseconomies-of-scale at the fund level for seven of nine asset-class/mandate types, but the effect is economically small–again suggesting (as in section IV.B) that the CIO (i) anticipates diseconomies-of-scale and

[32]When we examine the pre-fee returns surrounding (reverse) switches from multiple to single managers, we find no statistically significant underperformance prior to the switch, and no superior performance after the switch. This suggests that such a switch is prompted by a different explanation, such as a desire to reduce fund management costs (including monitoring costs), although the number of switches from multiple to single managers is too small to draw reliable conclusions.

[33]We do not have data on the total capitalization of each market for each period, therefore, we use the median fund size in a given quarter as a proxy.

introduces multiple managers before performance degrades significantly, and (ii) retains significant assets with the incumbent manager for some time following the introduction of additional managers. For instance, a fund/balanced manager pairing in U.K. equities that is 10 times the size of another such pairing exhibits an estimated relative alpha decrease of only about 16 bps/year. Furthermore, the regression coefficients on the number of managers are largely negative, suggesting little evidence that a larger number of managers results in increased pre-fee performance.

However, it is possible that this specification does not capture FMC scale-economies. Specifically, we might expect there to be scale-economies at the FMC level, even though there are scale-diseconomies at the pension fund level, similar to the findings of Chen et al. (2004) among mutual funds. At the FMC level, economies might arise from spreading fixed costs (e.g., a large research team of security analysts) among a greater number of funds; further, large FMCs are able to recruit and retain the best, and correspondingly most expensive, fund managers. Accordingly, we employ an alternative specification that uses the same first-stage regression as the first model, but applies a second-stage regression that captures the size of the FMC in a particular asset class as measured by the aggregate assets (in a particular asset class) overseen by the manager across all funds.[34] Here, among the nine asset class/mandate combinations, we find five positive and significant coefficients on the FMC size variable–supporting that large FMCs generate better performance. We also find evidence of a positive competition effect among specialists, as the slope coefficient on the number of managers is positive and economically large for each asset class (and is highly significant in the case of U.K. bonds, where a fund moving from a single to two managers experiences an increase in risk-adjusted return of 52 bps/yr). However, there is no consistent positive competition effect among multiple managers operating under either multi-asset or balanced mandates, again indicating that skills, even under competition, are only prevalent among specialist managers.

To summarize, we have documented the motives for sponsors moving to a multiple-manager structure: there is a complex trade-off between competition, specialization, and fees. Small pension funds employ only one manager within a given asset class, in order to maximize scale-economies in fees. As the fund size increases, the sponsor is able to employ a larger pool of managers to benefit

[34]Here, we do not fund/manager size as an explanatory variable in the second stage, since this is highly correlated with FMC size. Thus, we would expect the coefficient on FMC size to be a downward-biased estimate of the economies-of-scale at the FMC level, controlling for fund/manager size, since it also captures diseconomies at the fund level.

from competition and specialization, and to avoid scale-diseconomies at the fund level. However, the sponsor pays higher total fees when employing multiple managers, which somewhat offsets the avoided scale-diseconomies. Consistent with the first prediction of our theoretical model, the somewhat small improvement in post-fee performance is sufficient to motivate the CIO to make the switch.

V.C. Decentralization and Risk

We have shown that the appointment of multiple managers results in higher pre- and post-fee performance. Our theoretical model predicts that, if a sponsor perfectly knows the skill levels of the decentralized managers, he will allocate larger risk budgets to the more skilled managers, and this will result in a greater level of overall sponsor portfolio risk after shifting to multiple managers. Alternatively, if the CIO is uncertain about the skills of a new manager, he may decide, in the interests of prudence, to reduce the total level of risk in an asset class or in the pension fund (or both) after the switch.

To test the effect of decentralization on the pension fund's risk budget, we decompose fund risk according to the number of managers within an asset class. For each pension fund, we compute the value-weighted average returns across all managers within a given asset class. We then perform a 3×3 double sort in which we divide the funds into terciles according to their $SIZE_{ft}$ (small, medium, large) and $NMAN_{ft}$ (1, 2, 3 or more) characteristics. We subdivide by fund size, since portfolio return volatility is highly negatively correlated with fund size, implying that small funds are generally much less diversified than large funds.

For each period, we compute the cross-sectional sample variance in returns for each size/manager tercile portfolio. We then average this over time to get a summary measure of the time-series-averaged cross-sectional return variance across funds included in each of the nine terciles. Hence, our analysis is based on the following measure of variance (within an asset class):

$$\overline{\sigma}^2_{SIZE,NMAN} = \frac{1}{T}\sum_{t=1}^{T}\left(\frac{1}{NMAN_t - 1}\sum_{f=1}^{NMAN_t}(r_{ft} - \overline{r}_t)^2\right), \tag{4}$$

where $\overline{r}_t$ is the (cross-sectional) average return within a given size/manager tercile, $NMAN_t = \sum_{f=1}^{F} NMAN_{ft}$ is the total number of managers in the same size/manager tercile, and $T = 81$ is the total number of quarters in the dataset. In a setting with homogeneity across funds in exposure to multiple risk factors, (4) gives the average idiosyncratic variance across the funds.

The empirical results are shown in Table 6. They reveal a clear pattern relating fund size, the number of fund managers employed, and return variance (risk). Specifically, the larger the fund and the greater the number of managers, the lower the dispersion of returns. This finding is very significant, since it provides strong support for the version of our model that assumes uncertainty about new manager skills.

[Table 6 about here]

The results are strongest for the total portfolio and for U.K. equities, but also hold for the largest U.K. bond and international equity funds. To test formally if risk is declining in the number of managers, the size of the fund or both, we adopt the monotonic relation (MR) test developed by Patton and Timmermann (2010). The null of this test is that there is no particular pattern in the return variances as a function of, say, the number of managers, while the alternative is that the variance is a declining function of the number of managers, regardless of fund size. This must hold separately for small, medium and large funds, giving rise to six inequalities that are jointly tested. Similarly, we can also test whether return variance declines as a function of fund size, and is jointly decreasing in both fund size and the number of managers. Panel A of Table 6 reports results showing small p-values, indicating that the return variance is decreasing as a function of the sorting variable(s). For U.K. equities and the total portfolio, we find statistically significant evidence that the return variance declines both in the number of managers and in the size of the fund, whereas for U.K. bonds and international equities, the relationships are generally not statistically significant.

As a second test, we compute time-series variances of returns for single- and multiple-managed funds for the full sample, as well as for three sub-samples. Each quarter, we group funds according to whether they are single- or multiple-managed, omitting the quarter of any switch. Then, for each fund, f, we compute its time-series variance of returns over the sample period, τ_f, for which we have quarterly return observations for that fund. Only funds with a minimum of 12 quarterly observations are included in the analysis, and funds that switch from being single-managed to being multiple-managed (and vice versa) are treated as separate samples. The average variance measure is:

$$\overline{\sigma}_{\phi}^{2} = \frac{1}{F_{\phi}} \sum_{f=1}^{F_{\phi}} \left(\frac{1}{\tau_f - 1} \sum_{t=1}^{\tau_f} (r_{ft} - \overline{r}_f)^2 \right), \tag{5}$$

where $\phi \in (SINGLE, MULTI)$ represents the single- or multiple-manager sample, and F_ϕ is the number of funds in the corresponding sample. The results are shown in Panel B of Table 6. Clearly, multiple-managed funds have, on average, a lower volatility than single-managed funds. This finding is not just the result of multiple-managed funds becoming more prevalent in the latter part of the sample, since the multiple-managed funds have a statistically significantly lower return variance than the single-managed funds in two out of three sub-periods. When we repeat the exercise using fund/manager pairings rather than funds as the unit of observation, we find that the risk is greater for multiple-managed funds. This indicates that, while sponsors allocate greater risk budgets to each manager, the effect of diversification across managers dampens the overall risk of multi-managed funds.

An important question that arises from our analysis is whether hiring multiple managers can help diversify the risk relating to manager alphas, a question which becomes more important as the size of a pension fund grows. To help provide an answer, we estimate the alphas for both single- and multiple-managed funds using the earlier factor specifications for the three asset classes in Equations (1), (2), and (3). Table 7 shows the distribution of the estimated alphas, along with the standard deviations of these alpha estimates across single- and multiple-managed funds. Alpha estimates are far more widely dispersed for single-managed funds than for multiple-managed funds across all three asset classes and across all mandate types. This confirms that alpha-diversification is an important reason why funds employ multiple managers.

[Table 7 about here]

Another way to illustrate this effect is to study volatility at the manager level and compare this with the fund-level volatility within a given asset class. For single-managed funds, these two measures will be identical. However, for multiple-managed funds, the fund-level volatility might be lower due to diversification effects. We confirm this conjecture. The average (multiple-managed) U.K. equity volatility at the manager level is 18.4% per annum, compared with only 17.9% at the fund level. The corresponding figures for U.K. bonds (8.0% versus 7.9%) and international equities (20.4% versus 19.9%) show a similar diversification effect. Moreover, the fund-level volatility for multiple-managed portfolios tends to be lower than the corresponding volatility for single-managed funds (which is, respectively, 18.2%, 8.6% and 19.9% for the three asset classes). Again, this suggests that, although individual fund managers that operate as part of a multiple-managed portfolio might have more generous risk budgets than those of single-managed funds due to their higher perceived skills, diversification effects operating across managers result in lower overall risk for the multiple-managed portfolios, which is exactly in alignment with our model's prediction of the CIO's desire to reduce total portfolio risk due to uncertainty about manager skills.

V.D. Evidence of CIO Uncertainty in Manager Skills

The sections above have produced evidence of rationality in the manager switching decisions of CIOs: managers are replaced following poor performance. Further, small funds tend to replace a sole asset class manager with another, while larger funds tend to add more managers (within an asset class). More difficult to understand is why the CIO chooses a lower level of risk, within an asset class, when adding new managers (e.g., when switching from a single specialist to multiple specialists within an asset class). Indeed, our theoretical model predicts that the CIO will optimally choose a higher asset class risk level if he perfectly knows the true level of manager skills.

An extension of our theoretical model explains this finding. Specifically, when we assume that the skills of new managers are uncertain to the CIO, our model predicts, under plausible parameters for skill levels and uncertainty, that the CIO might well choose a lower level of portfolio risk after decentralization. If CIO uncertainty about manager skills is important, we should also observe an increasing allocation toward the new manager, on average, over time, as the CIO learns more about the real skill level of the manager.

We indeed find evidence that supports a learning process by the CIO about manager skills. First, in a majority of cases (81% for the U.K. equity asset class), the CIO retains an allocation to the incumbent (balanced) manager after adding one or more new specialist or multi-asset managers. This finding confirms our earlier conjecture that the CIO prefers to keep some money with the incumbent, whose skills may be lower than a new manager's expected skills, but are more precisely known.[35] In addition, using an event-study analysis, we find evidence consistent with the CIO maintaining the same risk budget for the incumbent manager after one or more new managers are added. Specifically,

[35]Part of the reason for retaining the incumbent may also be due to an avoidance of excessive trading costs in the transition of the portfolio to the new manager. However, the CIO can hire a transition manager if he wishes to fire the old manager immediately.

the incumbent manager does not appear to be constrained by a tighter risk budget following the event, as his average returns do not appear to suffer. We find that the return of the incumbent, minus that of his benchmark, exhibits, on average, a positive (but statistically insignificant) change surrounding a switch to multiple managers. This finding indicates that the CIO, already familiar with the skills of the incumbent, does not reduce the incumbent's risk allocation following the addition of other managers.

Particularly significant is the observation that the portfolio allocation to new managers generally increases over time. For U.K. equities, the top panel in Figure 4 shows the allocation to new managers, as a proportion of total U.K. equity pension fund investment (aggregated across only funds with a manager change event) during the 16 calendar quarters following a decentralization event. The proportion allocated to new managers increases almost monotonically over time. For instance, when a CIO adds at least one specialist to an existing single balanced-manager mandate, the new specialist(s) is (are) initially allocated only 37% of the U.K. equity portfolio. Over the course of 16 quarters, this allocation, on average, grows to 60%. Note, also, that specialist skills are, on average, higher – eventually receiving a larger allocation than balanced managers – but that the greater uncertainty in specialist skills result in a lower initial allocation. The bottom panel confirms this by showing the standard deviation of allocations across different pension funds. Most notably, the allocation is relatively similar across funds directly after a new specialist is added, when little is known about the skill of a particular specialist. Over time, the CIO learns about the true ability of his particular specialist, and differences in allocations to the specialist increase across funds (as high- and low-skilled specialists become identified more precisely).

[Figure 4 about here]

In some cases, especially for single-to-single manager changes, our empirical findings support the view that the CIO changes managers only when performance is expected to improve substantially. For example, we find an average improvement of 89 bps/year in the four-factor alpha in the U.K. equity asset class of pension funds after a change from balanced to specialist management. Although this reluctance to change managers could be driven entirely by the uncertainty inherent in hiring a new manager with untested skills, it could also be driven partly by career concerns of the CIO.

VI. Conclusions

This paper used a proprietary dataset to study decentralization in investment management in the U.K. pension fund industry from 1984 to 2004. Over this time period, most pension fund sponsors shifted from employing balanced managers, who invest across all asset classes, to more specialist managers, who specialize in a small number of asset classes, often just one; and from a single manager (typically, balanced) to competing multiple managers (balanced, specialist, multi-asset or combinations thereof) within each asset class.

We have investigated whether these shifts have been rational: that is, whether fund sponsors have experienced increased performance to compensate for the suboptimal diversification that results. We found evidence to support the conjecture that competition between multiple managers produces better performance, and that pension fund sponsors react to the coordination problem from using multiple managers by controlling risk levels: total pension fund risk (and, in particular, alpha risk) is lower under decentralized investment management. We also found that the switch from balanced to more specialist mandates, and the switch from single to multiple managers were preceded by poor performance; in the latter case, part of the poor performance was due to the fund becoming too large for a single manager to manage effectively.

Overall, our findings help to explain both the shift from balanced to specialist managers over the sample period – pension funds benefited from superior performance as a result of the shift – and the shift from single to multiple managers – pension funds benefited from risk reduction, via alpha diversification (reducing the variability in the portfolio-weighted alpha), and from avoiding fund-level diseconomies-of-scale by employing multiple managers within an asset class. We interpret these shifts as being rational by pension fund sponsors, despite the greater coordination problems and diversification loss associated with increased decentralization.

We note that, following the end of our sample period in 2004, further specialization of skills in pension fund management has occurred. One example is the emergence of diversified growth strategies which, in addition to the standard asset classes considered in our paper, offer investments in such "alternatives" as private equity, hedge funds, commodities, infrastructure, currencies and emerging market debt. While the primary objective of such strategies is to generate stable absolute returns over an investment cycle with lower volatility than an all-equity strategy, it is clear that the trend documented in this paper of pension funds employing multiple asset managers with specialist knowledge is still continuing. It is also clear that the continual search by pension funds for new asset classes in which to invest is, in part, a response to the scale-diseconomies – and consequential dampening of returns – that ultimately and inevitably emerge in existing asset classes (see Andonov, Bauer and Cremers (2011) for a recent discussion of this issue).

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Appendix: The Theoretical Asset Allocation Model

This appendix describes a simple theoretical model that generalizes the results in van Binsbergen, Brandt and Koijen (2008, hereafter BBK) to allow for skilled fund managers (BBK assume that all managers are unskilled). We first derive the individual fund managers' optimal portfolio weights as well as the capital that they will be allocated by the chief investment officer (CIO) who has overall responsibility for the fund being managed. These weights are then used to measure the variance (risk) of the optimal portfolio under centralized and decentralized decision making when the skill level of the fund manager is known with certainty. Finally, we consider the case where there is uncertainty over whether a manager is skilled or not.

A.1 Optimization Problem

Unskilled fund managers face the same investment opportunity set as in BBK. There is a single riskless asset with a constant rate of return, r, and $2k$ risky assets whose prices follow the process

$$\frac{dS_{jt}}{S_{jt}} = (r + \sigma_j'\Lambda)dt + \sigma_j dZ_t, \quad j = 1, ..., 2k, \tag{A1}$$

where Λ is a vector of risk prices, σ_j is a vector of volatility weights, and Z_t is a vector of uncorrelated, standard Brownian motions. Following BBK, we assume that there are two managers (indexed by $i = 1, 2$) and one CIO (indexed by $i = C$). We denote the matrices of volatility parameters of the subsets of assets managed by the two managers by $\Sigma_1 = (\sigma_1, ..., \sigma_k)'$, $\Sigma_2 = (\sigma_{k+1}, ..., \sigma_{2k})'$, and collect these in the matrix $\Sigma = (\Sigma_1', \Sigma_2')'$.

Both managers (plus the CIO) have power utility over wealth, W, and so solve a problem of the form

$$\max_{\{x_{is}\}_{s\in(t,\tau_i)}} E_t\left[\frac{1}{1-\gamma_i} W_{\tau_i}^{1-\gamma_i}\right], \tag{A2}$$

where x_{is} are the optimal portfolio weights chosen by manager i, $i \in \{1, 2, C\}$, γ_i is his coefficient of relative risk aversion, and $\tau_i = T_i - t$ is his investment horizon.

A.2 Optimal Centralized Asset Allocation

A CIO who decides not to delegate the asset allocation problem can select from all the $2k+1$ assets. As shown by BBK, the CIO's optimal portfolio weights take the form

$$x_C^* = \frac{1}{\gamma_C}(\Sigma\Sigma')^{-1}\Sigma\Lambda, \tag{A3}$$

while $1 - x_C^{*\prime}\iota$ goes to cash. The CIO's indirect utility function, $J(W_C, \tau_C)$, is

$$\begin{aligned} J_C(W_C, \tau_C) &= \frac{1}{1-\gamma_C} W_C^{1-\gamma_C} \exp(a_1 \tau_C), \\ a_1 &= (1-\gamma_C)r + \frac{1-\gamma_C}{2\gamma_C}\Lambda'\Sigma'(\Sigma\Sigma')^{-1}\Sigma\Lambda. \end{aligned} \tag{A4}$$

The resulting variance of the CIO's portfolio is given by

$$Var_C = x_C^{*\prime}\Sigma\Sigma' x_C^* = \frac{1}{\gamma_C^2}\Lambda'\Sigma'(\Sigma\Sigma')^{-1}\Sigma\Lambda. \tag{A5}$$

A.3 Optimal Decentralized Asset Allocation With Unskilled Fund Managers

Next, suppose the CIO decides to divide the portfolio between two unskilled asset managers, the first of whom holds risky assets $j = 1, ..., k$, while the second holds assets $j = k+1, ..., 2k$. Consistent with BBK, each manager's optimal portfolio is given by

$$x_i^* = \frac{\hat{x}_i}{\gamma_i} + \left(1 - \frac{\iota'\hat{x}_i}{\gamma_i}\right) x_i^{MV}, \quad i = 1, 2,$$

where $\hat{x}_i = (\Sigma_i\Sigma_i')^{-1}\Sigma_i\Lambda$ and $x_i^{MV} = (\Sigma_i\Sigma_i')^{-1}\iota/(\iota'(\Sigma_i\Sigma_i')^{-1}\iota)$.

The variance of each manager's portfolio is given by

$$Var_i = x_i^{*\prime}\Sigma_i\Sigma_i' x_i^* = \frac{1}{\gamma_i^2}\left[\hat{x}_i' + \left(\gamma_i - \iota_i'\hat{x}_i\right) x_i^{MV\prime}\right]\Sigma_i\Sigma_i'\left[\hat{x}_i + \left(\gamma_i - \iota'\hat{x}_i\right) x_i^{MV}\right]. \tag{A6}$$

In this delegated decision problem, the CIO allocates capital to the two asset managers and to the riskless asset (cash). Compared with the centralized decision, there are now only two (composite) risky assets with covariance matrix $\bar{\Sigma} = (\Sigma_1' x_1^*, \Sigma_2' x_2^*)'$ and one riskfree asset. Hence from Equation (A3), the CIO's optimal asset allocation to the two risky asset managers becomes

$$\bar{x}_C^* = \frac{1}{\gamma_C}(\bar{\Sigma}\bar{\Sigma}')^{-1}\bar{\Sigma}\Lambda, \tag{A7}$$

while again $(1 - \bar{x}_C^{*\prime}\iota)$ gets allocated to cash. The CIO's indirect utility is now

$$\begin{aligned} J_C(W_C, \tau_C) &= \frac{1}{1-\gamma_C} W_C^{1-\gamma_C} \exp(a_2 \tau_C), \\ a_2 &= (1-\gamma_C) r + \frac{1-\gamma_C}{2\gamma_C} \Lambda' \bar{\Sigma}' (\bar{\Sigma}\bar{\Sigma}')^{-1} \bar{\Sigma} \Lambda, \end{aligned} \tag{A8}$$

while the total variance of the CIO's portfolio becomes

$$\overline{Var}_C = \bar{x}_C^{*\prime} \bar{\Sigma} \bar{\Sigma}' \bar{x}_C^* = \frac{1}{\gamma_C^2} \Lambda' \bar{\Sigma}' (\bar{\Sigma}\bar{\Sigma}')^{-1} \bar{\Sigma} \Lambda. \tag{A9}$$

A.4 Optimal Decentralized Asset Allocation With Skilled Fund Managers

Skill among managers is modeled as an improvement in the risk prices available to the managers. Hence, for skilled managers, asset prices evolve according to the equations

$$\frac{dS_{jt}}{S_{jt}} = (r + \sigma_j' \theta_i \Lambda) dt + \sigma_j dZ_t, \quad j = 1, ..., 2k, \tag{A10}$$

where θ_i is a scalar with $\theta_i > 1$ ensuring that the risk-return trade-off of skilled manager i is better than that of either the CIO or the unskilled managers, and skills can be heterogeneous across managers.[36] Now the two skilled managers' optimal weights are

$$x_i^{\theta *} = \frac{\hat{x}_i^\theta}{\gamma_i} + \left(1 - \frac{\iota' \hat{x}_i^\theta}{\gamma_i}\right) x_i^{MV}, \tag{A11}$$

where $\hat{x}_i^\theta \equiv (\Sigma_i \Sigma_i')^{-1} \Sigma_i \theta_i \Lambda$. The resulting variances of the individual manager portfolios are

$$Var_i^\theta = x_i^{\theta * \prime} \Sigma_i \Sigma_i' x_i^{\theta *} = \frac{1}{\gamma_i^2} \left[\hat{x}_i^{\theta\prime} + \left(\gamma_i - \iota' \hat{x}_i^\theta\right) x_i^{MV\prime}\right] \Sigma_i \Sigma_i' \left[\hat{x}_i^\theta + \left(\gamma_i - \iota' \hat{x}_i^\theta\right) x_i^{MV}\right]. \tag{A12}$$

Comparing Equation (A12) with Equation (A6), we see that, assuming equivalent levels of risk aversion, the individual skilled managers tend to hold riskier portfolios than the unskilled managers in the same asset classes. This is the second prediction in Section I.A.

From the CIO's perspective, the expected (excess) return and volatility of the two portfolios are now given by

$$\begin{aligned} \bar{\mu}^\theta &= \begin{pmatrix} \theta_1 \Sigma_1' x_1^{\theta *} & \theta_2 \Sigma_2' x_2^{\theta *} \end{pmatrix}' \Lambda \equiv \hat{\Sigma}^\theta \Lambda, \\ \bar{\Sigma}^\theta &= (\Sigma_1' x_1^{\theta *}, \Sigma_2' x_2^{\theta *})', \end{aligned} \tag{A13}$$

[36] The analysis can be generalized to allow θ_i to vary across assets, j.

The CIO's optimal asset allocation to the two skilled asset managers becomes

$$\bar{x}_C^{\theta*} = \frac{1}{\gamma_C}(\bar{\Sigma}^{\theta}\bar{\Sigma}^{\theta\prime})^{-1}\hat{\Sigma}^{\theta}\Lambda. \tag{A14}$$

As in the earlier case, we can derive the CIO's indirect utility function:

$$\begin{aligned} J_C^{\theta}(W_C,\tau_C) &= \frac{1}{1-\gamma_C}W_C^{1-\gamma_C}\exp(a_3\tau_C), \\ a_3 &= (1-\gamma_C)r + \frac{1-\gamma_C}{2\gamma_C}\Lambda'\hat{\Sigma}^{\theta\prime}(\bar{\Sigma}^{\theta}\bar{\Sigma}^{\theta\prime})^{-1}\hat{\Sigma}^{\theta}\Lambda. \end{aligned} \tag{A15}$$

The total portfolio variance with decentralized management and skilled managers becomes

$$\overline{Var}_C^{\theta} = \bar{x}_C^{\theta*\prime}\bar{\Sigma}^{\theta}\bar{\Sigma}^{\theta\prime}\bar{x}_C^{\theta*} = \frac{1}{\gamma_C^2}\Lambda'\hat{\Sigma}^{\theta\prime}(\bar{\Sigma}^{\theta}\bar{\Sigma}^{\theta\prime})^{-1}\hat{\Sigma}^{\theta}\Lambda. \tag{A16}$$

The CIO will only rationally engage in a switch from a single unskilled manager to multiple skilled managers if he expects higher utility under the latter arrangement, i.e., $J_C^{\theta}(W_C,\tau_C) > J_C(W_C,\tau_C)$, which, from Equations (A15) and (A4) implies that

$$\Lambda'\hat{\Sigma}^{\theta\prime}(\bar{\Sigma}^{\theta}\bar{\Sigma}^{\theta\prime})^{-1}\hat{\Sigma}^{\theta}\Lambda > \Lambda'\Sigma'(\Sigma\Sigma')^{-1}\Sigma\Lambda. \tag{A17}$$

It is easily verified that this condition holds for relatively small levels of skill, θ: this is the first prediction in Section I.A.

From Equations (A16) and (A5), (A17) is equivalent to $\overline{Var}_C^{\theta} > Var_C$, i.e., the total portfolio variance under multiple skilled managers exceeds the total portfolio variance under a single unskilled manager: this is the third prediction in Section I.A.. The main driver of this result is the fact that the expected utility is proportional to the amount of risk taken in the BBK framework.

A.5 Optimal Decentralized Asset Allocation When Fund Manager Skills Are Uncertain

Finally, suppose that the CIO does not know for sure which managers are skilled and which are unskilled. With probability p_1, managers are unskilled ($\theta = 1$), while, with probability $(1 - p_1)$, managers are skilled, $\theta > 1$. For simplicity, we assume that θ is a scalar, and we ignore the α-diversification arising from hiring, say, a skilled stock manager and an unskilled bond manager. This latter case expands the set of possible manager skill scenarios from two to four at the cost of complicating the algebra considerably, but the qualitative results continue to hold.

Using the earlier results, with probability p_1, the CIO chooses from a portfolio with covariance matrix $\bar{\Sigma} = (\Sigma_1' x_1^*, \Sigma_2' x_2^*)'$, and, with probability $(1 - p_1)$, from a portfolio with a covariance matrix $\bar{\Sigma}^\theta = (\Sigma_1' x_1^{\theta *}, \Sigma_2' x_2^{\theta *})'$.

For this case, the CIO's optimal portfolio weights are now formed as averages of the optimal weights on the two managers in the unskilled and skilled cases:

$$\tilde{x}_C^* = \frac{1}{\gamma_C} \left[p_1 \bar{\Sigma} \bar{\Sigma} + (1 - p_1) \bar{\Sigma}^\theta \bar{\Sigma}^{\theta \prime} \right]^{-1} \left(p_1 \bar{\Sigma} + (1 - p_1) \hat{\Sigma}^\theta \right) \Lambda. \tag{A18}$$

The resulting expected utility is given by

$$\begin{aligned}
\tilde{J}_C^u(W_C, \tau_C) &= \frac{1}{1 - \gamma_C} W_C^{1 - \gamma_C} \left(p_1 \exp(a_5 \tau_C) + (1 - p_1) \exp(a_6 \tau_C) \right), && \text{(A19)} \\
a_5 &= \exp((1 - \gamma_C) r + (1 - \gamma_C) \left[\tilde{x}_C^* \bar{\Sigma} \Lambda - \frac{1}{2} \tilde{x}_C^{*\prime} \bar{\Sigma} \bar{\Sigma}' \tilde{x}_C^* \right] + \frac{(1 - \gamma_C)^2}{2} \tilde{x}_C^{*\prime} \bar{\Sigma} \bar{\Sigma}' \tilde{x}_C^*), \\
a_6 &= \exp((1 - \gamma_C) r + (1 - \gamma_C) \left[\tilde{x}_C^* \bar{\Sigma}^\theta \Lambda - \frac{1}{2} \tilde{x}_C^{*\prime} \bar{\Sigma}^\theta \bar{\Sigma}^{\theta \prime} \tilde{x}_C^* \right] + \frac{(1 - \gamma_C)^2}{2} \tilde{x}_C^{*\prime} \bar{\Sigma}^\theta \bar{\Sigma}^{\theta \prime} \tilde{x}_C^*),
\end{aligned}$$

while the average variance is given by

$$Var_u = p_1 \tilde{x}_C^{*\prime} \bar{\Sigma} \bar{\Sigma}' \tilde{x}_C^* + (1 - p_1) \tilde{x}_C^{*\prime} \bar{\Sigma}^\theta \bar{\Sigma}^{\theta \prime} \tilde{x}_C^* + p_1 (1 - p_1) \tilde{x}_C^{*\prime} \Lambda' (\bar{\Sigma} - \hat{\Sigma}^\theta)' (\bar{\Sigma} - \hat{\Sigma}^\theta) \Lambda \tilde{x}_C^*. \tag{A20}$$

Unlike the case where it is known whether the manager is skilled or not, we can now simultaneously have the results that (i) the expected utility under multiple managers with uncertain skills (Equation (A19)) can exceed the expected utility under a single centralized manager (Equation (A4)), so that it is optimal for the CIO to hire multiple managers, and (ii) the multi-managed portfolio has a lower variance (Equation (A20)) than the portfolio under centralized management (Equation (A5)).

Table 1. Summary Statistics for Funds and Fund Managers

Panel A: Fund Size and Asset Allocation

	Jan 1984		Jan 1994		Jan 2004	
Asset Class	Amount (£bn)	Percentage	Amount (£bn)	Percentage	Amount (£bn)	Percentage
UK Equities	64.4	50.7	266.3	57.9	150.8	42.7
UK Bonds	23.0	18.1	9.7	2.1	59.6	16.9
Int. Equities	21.4	16.9	121.3	26.4	94.7	26.8
Int. Bonds	0.2	0.1	15.9	3.5	3.7	1.0
Index-Linked	1.8	1.4	10.8	2.4	32.1	9.1
Cash	2.8	2.2	21.8	4.7	5.4	1.5
Property	13.3	10.5	14.0	3.0	7.0	2.0
Total	126.9	100.0	459.7	100.0	353.3	100.0

Panel B: Distribution of Funds by Number of Managers

		Jan 1984		Jan 1994		Jan 2004	
Asset Class	Managers	Mean Size	Percentage	Mean Size	Percentage	Mean Size	Percentage
	1	30.87	80.42	72.06	72.99	42.44	56.83
UK Equities	2	32.01	14.76	62.25	19.83	45.76	26.19
	3 or more	38.06	4.82	129.13	7.18	71.51	16.98
	1	12.33	82.18	8.66	87.27	35.45	72.55
UK Bonds	2	11.98	13.47	7.80	11.35	46.05	21.41
	3 or more	14.64	4.35	24.01	1.38	51.51	6.05
	1	9.83	81.34	29.19	75.37	35.96	64.27
Int. Equities	2	13.10	14.05	27.03	17.76	33.01	23.92
	3 or more	13.58	4.61	56.69	6.87	62.35	11.80
	1	2.49	98.65	5.03	77.27	6.13	79.52
Int. Bonds	2	1.77	1.35	8.89	18.79	13.42	17.62
	3 or more	-	-	26.96	3.94	12.37	2.86
	1	2.23	87.89	9.31	88.30	33.40	75.97
Index-Linked	2	2.88	10.46	19.98	11.11	34.45	19.90
	3 or more	1.01	1.65	21.11	0.58	47.69	4.13
	1	1.84	82.67	4.63	79.04	2.03	68.25
Cash	2	1.22	13.35	4.79	14.46	3.13	21.17
	3 or more	2.73	3.98	9.05	6.50	4.72	10.58
	1	16.03	86.21	14.88	90.79	26.09	88.36
Property	2	5.43	11.56	7.89	8.66	13.62	10.34
	3 or more	6.38	2.23	2.63	0.55	12.78	1.29

Panel C: Distribution of Funds by Mandate Type

		Jan 1984		Jan 1994		Jan 2004	
Asset Class	Mandate	Funds (Count)	Managers (Average)	Funds (Count)	Managers (Average)	Funds (Count)	Managers (Average)
	Specialist	12	2.33	119	2.03	284	2.17
UK Equities	Multi-Asset	2	2.00	173	1.36	384	1.67
	Balanced	952	1.26	821	1.36	83	1.46
	Specialist	10	1.80	46	1.35	203	1.56
UK Bonds	Multi-Asset	2	2.00	103	1.19	399	1.37
	Balanced	938	1.24	516	1.14	76	1.34
	Specialist	10	2.00	98	1.90	275	1.89
Int. Equities	Multi-Asset	2	2.00	157	1.31	365	1.57
	Balanced	907	1.25	815	1.34	81	1.36
	Specialist	3	1.00	25	1.48	63	1.22
Int. Bonds	Multi-Asset	0	0.00	71	1.15	90	1.22
	Balanced	71	1.01	676	1.29	64	1.36
	Specialist	6	1.33	30	1.37	139	1.47
Index-Linked	Multi-Asset	2	1.50	112	1.12	286	1.32
	Balanced	540	1.14	378	1.12	24	1.29
	Specialist	26	1.92	129	2.09	236	1.80
Cash	Multi-Asset	2	1.50	122	1.20	204	1.37
	Balanced	766	1.23	631	1.29	63	1.43
	Specialist	30	1.27	87	1.21	83	1.13
Property	Multi-Asset	1	1.00	66	1.12	98	1.19
	Balanced	692	1.17	402	1.10	53	1.06

Note: This table reports summary statistics for the funds and fund managers in our data set. For each of the seven asset classes, Panel A shows the total size of funds under management in real billions of pounds sterling (using the 2004 consumer price index as the base-year deflator) along with the portfolio allocation to each asset class. Panel B sorts the funds according to the number of managers they employ, i.e., a single manager, two managers, or three or more managers. For each of these categories, we report the average size of the funds in real millions of pounds sterling (using the 2004 consumer price index as the base-year deflator). We also show the percentage of all funds in a given asset class that employ one, two or three or more managers. Panel C sorts the funds according to the managers' mandate type: specialist, multi-asset (managing more than one asset class, but fewer than all asset classes) and balanced (managing all asset classes). We report the number of funds as well as the average number of managers operating under each mandate type.

Table 2. Pre- and Post-Fee Return Performance by Asset Class

Panel A: Mean Returns

Panel A1: Pre-Fee Mean Returns

Asset Class	1%	5%	10%	25%	50%	75%	90%	95%	99%	mean
UK Equities	-2.21%	5.75%	9.55%	13.15%	16.20%	18.97%	22.70%	25.06%	31.01%	15.96%
UK Bonds	4.90%	6.63%	8.09%	9.89%	11.07%	12.06%	13.24%	14.04%	15.83%	10.87%
Int. Equities	-2.04%	3.26%	5.98%	9.88%	13.08%	15.72%	18.61%	20.89%	24.67%	12.64%

Panel A2: Post-Fee Mean Returns

Asset Class	1%	5%	10%	25%	50%	75%	90%	95%	99%	mean
UK Equities	-4.39%	1.83%	6.76%	10.97%	14.28%	17.82%	21.92%	24.49%	30.13%	14.17%
UK Bonds	4.78%	6.39%	7.96%	9.43%	10.60%	11.57%	12.75%	13.41%	15.88%	10.44%
Int. Equities	-6.09%	2.13%	5.23%	8.67%	11.25%	14.13%	17.37%	19.65%	23.89%	11.12%

Panel B: Alpha Estimates

Panel B1: Pre-Fee Alpha Estimates

Asset Class	1%	5%	10%	25%	50%	75%	90%	95%	99%	mean
UK Equities	-6.74%	-3.98%	-2.62%	-1.16%	0.07%	1.05%	2.43%	3.59%	6.54%	-0.05%
UK Bonds	-2.56%	-1.22%	-0.61%	0.00%	0.65%	1.40%	2.07%	2.59%	3.88%	0.70%
Int. Equities	-13.64%	-7.60%	-4.77%	-0.97%	1.21%	3.28%	5.91%	8.19%	14.74%	0.94%

Panel B2: Post-Fee Alpha Estimates

Asset Class	1%	5%	10%	25%	50%	75%	90%	95%	99%	mean
UK Equities	-6.58%	-3.61%	-2.65%	-1.33%	-0.35%	0.55%	1.73%	2.74%	5.14%	-0.40%
UK Bonds	-2.87%	-1.38%	-0.86%	-0.27%	0.32%	0.91%	1.45%	2.03%	3.56%	0.34%
Int. Equities	-12.69%	-7.94%	-5.07%	-1.47%	0.25%	1.91%	3.95%	5.66%	12.82%	-0.04%

Panel C: Beta Estimates

Panel C1: Pre-Fee Beta Estimates

Asset Class	1%	5%	10%	25%	50%	75%	90%	95%	99%	mean
UK Equities	0.72	0.88	0.93	0.98	1.01	1.05	1.10	1.13	1.24	1.01
UK Bonds	0.47	0.73	0.84	1.01	1.13	1.23	1.32	1.39	1.58	1.10
Int. Equities	0.24	0.64	0.76	0.87	0.97	1.05	1.16	1.26	1.53	0.96

Panel C2: Post-Fee Beta Estimates

Asset Class	1%	5%	10%	25%	50%	75%	90%	95%	99%	mean
UK Equities	0.82	0.91	0.94	0.99	1.01	1.05	1.09	1.12	1.22	1.02
UK Bonds	0.44	0.82	0.93	1.07	1.15	1.23	1.30	1.34	1.50	1.13
Int. Equities	0.46	0.71	0.81	0.89	0.94	1.01	1.11	1.19	1.45	0.95

Note: This table presents the pre- and (simulated) post-fee raw return performance as well as the risk-adjusted return performance for the three main asset classes held by the pension funds, namely U.K. equities, U.K. bonds and international equities. All results are based on quarterly data over the period from 1984-2004. Panel A reports percentiles for the distribution of mean returns measured across funds. Panels B and C present the distributions of alpha and beta estimates. For U.K. equities, we use a four-factor model that includes the return on a broad market portfolio, a size factor, a value factor and a momentum factor. For U.K. bonds, we use a two-factor model that includes the returns on a broad market portfolio of U.K. government bonds and on U.K. government perpetual bonds (consols). Finally, for international equities, we use a four-factor model based on return indices for North America and the Europe Australasia Far Eastern Ex U.K. (EAFEX) area, augmented by a size and a small cap factor. All returns are measured in percent per annum.

Table 3. Pre- and Post-Fee Measures of Security Selection and Market Timing Skills by Mandate Type

Specialist Mandates

	UK Equities Pre-Fee	UK Equities Post-Fee	UK Bonds Pre-Fee	UK Bonds Post-Fee	International Equities Pre-Fee	International Equities Post-Fee
Jensen's Alpha	0.67%**	0.35%	1.17%***	1.03%***	2.26%***	1.79%***
Market Timing Beta	0.093*	0.093*	-0.206	-0.196	-0.138	-0.138
TM Total Performance	0.91%***	0.59%**	0.98%***	0.83%***	1.55%**	1.16%**

Multi-Asset Mandates

	UK Equities Pre-Fee	UK Equities Post-Fee	UK Bonds Pre-Fee	UK Bonds Post-Fee	International Equities Pre-Fee	International Equities Post-Fee
Jensen's Alpha	0.46%***	0.12%	0.81%***	0.46%**	1.91%***	1.58%**
Market Timing Beta	-0.005	-0.006	0.767*	0.778*	-0.331	-0.331
TM Total Performance	0.43%***	0.09%	0.55%***	0.20%	1.04%*	0.69%

Balanced Mandates

	UK Equities Pre-Fee	UK Equities Post-Fee	UK Bonds Pre-Fee	UK Bonds Post-Fee	International Equities Pre-Fee	International Equities Post-Fee
Jensen's Alpha	-0.24%	-0.54%	0.62%**	0.29%	0.48%	0.16%
Market Timing Beta	0.091***	0.090***	-0.253	-0.250	-0.563	-0.563
TM Total Performance	0.09%	0.21%	0.65%**	0.28%	-1.85%	-2.23%

Note: This table reports evidence of security selection and market timing skills (pre- and post-fee) for three types of manager, namely specialists, multi-asset managers (managing more than one asset class, but fewer than all asset classes) and balanced managers (managing all asset classes). For each mandate type, we show the average estimates of Jensen's alpha from the factor models for each asset class described in the note to Table 2, augmented to include the squared excess return on the associated market portfolio. Finally, we report the beta coefficient on the market-timing term along with the Treynor-Mazuy (TM) total performance measure. Asterisks report the significance levels (*=10%, **=5%, and ***=1%) of p-values computed using a non-parametric bootstrap that uses a one-sided test for the ability of funds to generate alphas, betas or TM measures in excess of the mean values estimated using the actual data sample under the null of no-skills. Jensen's alphas and the TM measures are reported in percent per annum. All results are based on quarterly data over the period from 1984-2004.

Table 4. Transition Matrix for Mandate and Number of Managers

Panel A. Single-to-Single Manager Switches

		Specialist	Multi-Asset	Balanced
Specialist	**Num**	9	NA	NA
	Size	0.40	NA	NA
	ΔFees	0.02%	NA	NA
	ΔReturns	1.95%	NA	NA
Multi-Asset	**Num**	5	36	1
	Size	0.46	0.42	0.01
	ΔFees	0.14%**	0.02%	0.06%
	ΔReturns	4.18%	0.38%	-8.10%
Balanced	**Num**	12	42	206
	Size	0.14	0.19	0.67
	ΔFees	0.15%***	0.03%***	0.03%***
	ΔReturns	4.34%***	0.92%**	1.69%***

Panel B. Single-to-Multiple Manager Switches

		Specialist	Multi-Asset	Balanced
Specialist	**Num**	42	10	5
	Size	1.66	1.40	0.92
	Δ Fees	0.03%	0.00%	-0.03%
	Δ Returns	1.31%*	3.60%	-1.56%
Multi-Asset	**Num**	18	31	6
	Size	1.42	1.02	1.56
	ΔFees	0.08%**	0.05%**	0.00%
	ΔReturns	1.34%	-0.05%	2.21%
Balanced	**Num**	30	14	218
	Size	1.32	0.67	1.01
	ΔFees	0.09%***	0.06%**	0.02%***
	ΔReturns	1.53%**	2.19%*	0.63%**

Note: This table reports two transition matrices for funds that switched their mandates over the period 1984-2004. The rows of each matrix report the mandates the funds switch from and the columns the mandates they switch to. Each cell of the transition matrices contains the number of funds that completed the switch, "Num", their relative size compared to all the other funds during the same quarter, "Size", the change in fees associated with the switch, "ΔFees", and the 4-quarters pre-fee average returns differential associated with the switch, "ΔReturns". The significance of the change in fees and returns is computed using bootstrapped p-values and the asterisks represent the significance levels: $^{*}=10\%$, $^{**}=5\%$, $^{***}=1\%$. Panel A reports the results for the funds that do not combine the change in mandate with a change in the number of managers, while Panel B reports the results for the funds that combine the change in mandate with an increase in the number of managers, but do not replace the incumbent manager. NA stands for "Not Available" and is associated with switches that never occur in the dataset.

Table 5. Pre-Fee Return Performance Around Changes in Mandate and Manager Number

A. Balanced-to-Specialist Mandate Switches

Quarters Before/ After Switch	UK Equities Returns	UK Equities t-stat	UK Bonds Returns	UK Bonds t-stat	Int. Equities Returns	Int. Equities t-stat	Total Portfolio Returns	Total Portfolio t-stat
-4	-0.23%	-0.52	0.21%	0.49	2.87%	1.92	0.02%	0.04
-3	-0.79%	-1.57	0.63%	1.37	2.00%	1.37	0.05%	0.14
-2	-1.08%	-2.67	0.17%	0.33	0.62%	0.46	-0.52%	-1.46
-1	0.59%	0.90	0.08%	0.15	2.08%	1.38	-0.22%	-0.65
1	1.00%	1.73	0.61%	1.20	0.29%	0.20	0.62%	1.42
2	0.81%	1.93	1.60%	3.51	2.24%	1.77	0.48%	1.37
3	0.56%	1.06	0.84%	1.82	3.57%	2.48	0.83%	2.12
4	-0.34%	-0.87	0.18%	0.36	-1.50%	-1.12	0.24%	0.58
Performance Before	-0.36%		0.27%		1.89%		-0.17%	
Performance After	0.53%		0.82%		1.16%		0.55%	
P-value	0.0060		0.0544		0.7664		0.0040	

B. Single-to-Multiple Manager Switches

B1. Fund Performance

Quarters Before/ After Switch	UK Equities Returns	UK Equities t-stat	UK Bonds Returns	UK Bonds t-stat	Int. Equities Returns	Int. Equities t-stat	Total Portfolio Returns	Total Portfolio t-stat
-4	-0.57%	-1.18	-0.63%	-1.52	-1.55%	-1.10	-0.69%	-1.42
-3	-0.59%	-1.10	-0.02%	-0.05	1.90%	1.44	0.39%	0.83
-2	-1.24%	-2.59	-0.81%	-1.68	-0.65%	-0.48	-0.28%	-0.58
-1	0.22%	0.33	1.18%	2.04	-1.74%	-1.25	0.08%	0.13
1	0.28%	0.74	0.09%	0.21	-0.40%	-0.28	-0.26%	-0.70
2	0.54%	1.78	0.20%	0.50	0.08%	0.06	0.22%	0.65
3	-0.61%	-1.43	0.53%	1.27	-0.63%	-0.53	-0.51%	-1.30
4	0.11%	0.24	-0.45%	-1.09	-0.24%	-0.17	0.44%	0.81
Performance Before	-0.53%		-0.04%		-0.54%		-0.11%	
Performance After	0.09%		0.10%		-0.30%		-0.03%	
P-value	0.0345		0.3329		0.4028		0.4039	

B2. Performance of the Incumbent Manager

Quarters Before/ After Switch	UK Equities Returns	UK Equities t-stat	UK Bonds Returns	UK Bonds t-stat	Int. Equities Returns	Int. Equities t-stat	Total Portfolio Returns	Total Portfolio t-stat
-4	-1.09%	-1.77	-0.89%	-1.47	-3.93%	-2.04	0.44%	0.62
-3	0.31%	0.53	0.33%	0.56	2.06%	1.13	0.38%	0.73
-2	-1.13%	-2.23	-0.83%	-1.07	-0.43%	-0.26	-0.32%	-0.52
-1	-0.16%	-0.25	1.04%	1.76	-1.65%	-0.93	-0.03%	-0.04
1	0.23%	0.37	-0.48%	-0.75	-1.06%	-0.50	0.71%	0.99
2	1.51%	2.01	0.91%	1.32	-0.83%	-0.45	-0.13%	-0.16
3	-0.30%	-0.49	0.21%	0.36	-0.54%	-0.34	0.88%	1.07
4	-0.34%	-0.55	-0.95%	-1.57	0.63%	0.31	0.20%	0.33
Performance Before	-0.51%		-0.06%		-0.99%		0.11%	
Performance After	0.28%		-0.07%		-0.46%		0.41%	
P-value	0.0374		0.5064		0.3452		0.2716	

Note: This table shows the mean pre-fee returns in excess of the benchmark, and the associated t-statistics, around the quarters where a fund switches from balanced to specialist mandates (Panel A) or from single to multiple managers (Panel B). In Panels A and B1 returns are value-weighted and computed at the portfolio level, i.e., across all managers employed. In Panel B2, returns are value-weighted and computed for the incumbent managers: the managers that are already employed when the second manager is hired. In the first six columns, the analysis is conducted for the three major asset classes U.K. equities, U.K. bonds and international equities. In the last two columns, the analysis is conducted at the total portfolio level. The last three rows of each panel report the average performance before and after the switch and the p-value for a difference-in-mean test for the null of equal average returns against the alternative that the performance in the year following the switch from a balanced to a specialist mandate is better than the one over the year before the switch. All numbers are in percent per annum and are based on the full sample from 1984-2004.

Table 6. Decentralization and Risk

A. Portfolio Return Variance Sorted by Number of Fund Managers and by Fund Size

Total Portfolio

	Size tercile		
Nman	Small	Medium	Large
1	0.471	0.335	0.310
2	0.393	0.255	0.224
3	0.240	0.221	0.189

		p-value
MR	**Size**	0.054
	Nman	0.000
	Joint	0.015

UK Equities

	Size tercile		
Nman	Small	Medium	Large
1	0.344	0.270	0.208
2	0.318	0.188	0.161
3	0.279	0.187	0.127

		p-value
MR	**Size**	0.000
	Nman	0.016
	Joint	0.000

UK Bonds

	Size tercile		
Nman	Small	Medium	Large
1	0.184	0.107	0.119
2	0.128	0.133	0.083
3	0.441	0.121	0.085

		p-value
MR	**Size**	0.883
	Nman	0.902
	Joint	0.907

International Equities

	Size tercile		
Nman	Small	Medium	Large
1	0.853	0.615	0.622
2	0.847	0.422	0.379
3	1.301	0.514	0.378

		p-value
MR	**Size**	0.005
	Nman	0.484
	Joint	0.283

B. Return Variance for Single- and Multiple-Managed Funds

	Full Sample		1984-1990		1990-1997		1997-2004	
	Fund	**Fund/Manager**	**Fund**	**Fund/Manager**	**Fund**	**Fund/Manager**	**Fund**	**Fund/Manager**
Single-Managed Funds	5.54	5.51	8.30	8.33	2.29	2.34	5.63	5.62
Multiple-Managed Funds	5.01	5.84	8.28	8.60	2.10	2.52	5.01	6.46
T-test	4.18	-3.21	0.07	-1.68	3.70	-2.48	4.65	-5.25

Note: Panel A shows the average return variance for funds sorted by the number of managers "Nman" (one, two, or three or more), and by size terciles (small, medium and large) and computes a monotonic relationship (MR) test. Each quarter, we sort the funds into nine categories according to the number of managers employed and the size of the fund's portfolio. We then compute the cross-sectional variance of fund returns for each category and finally calculate the time-series mean of this variable. The null of the MR test is that there is no systematic relationship between the portfolio return variance and size, number of managers, or both, while the alternative is that the portfolio return variance declines monotonically as a function of size or number of managers or both variables together. The statistics reported are *p*-values. All variances are annualized before being multiplied by one thousand and are based on the full sample from 1984-2004. Panel B shows the average variance of total portfolio returns for single- and multiple-managed funds for the full sample (1984-2004) as well as for three sub-samples. Each quarter, we group funds according to whether they are single- or multiple-managed. Only funds with a minimum of 12 quarterly observations are included in the analysis. Funds that switch from being single-managed to becoming multiple-managed (or vice versa) are categorized as separate funds. Columns labelled "Fund" conduct the analysis using funds as units of observation, while columns labelled "Fund/Manager" conduct the analysis using fund/manager pairings as units of observation. Single-managed funds do not have identical numbers when the analysis is conducted at the fund and fund/manager levels because of the 12-quarter requirement mentioned above. Average variances are annualized before being multiplied by one thousand.

Table 7. Risk and the Number of Managers

Specialist Mandates

		S.D. (α)	$\alpha < -4$	$-4 < \alpha < -2$	$-2 < \alpha < 0$	$0 < \alpha < 2$	$2 < \alpha < 4$	$4 < \alpha$	p-value	I.R.
UK Equities	**Single-Managed**	4.14	3.78%	5.88%	27.31%	40.76%	11.76%	10.50%	0.0000	0.25
	Multiple-Managed	3.33	0.00%	0.00%	26.92%	61.54%	7.69%	3.85%		0.42
UK Bonds	**Single-Managed**	1.45	0.67%	2.01%	17.45%	59.73%	19.46%	0.67%	0.3242	0.67
	Multiple-Managed	1.31	0.00%	0.00%	10.53%	57.89%	26.32%	5.26%		1.14
Int. Equities	**Single-Managed**	6.66	5.14%	6.54%	16.82%	27.10%	19.63%	24.77%	0.0000	0.54
	Multiple-Managed	3.46	4.48%	1.49%	13.43%	32.84%	23.88%	23.88%		0.70

Multi-Asset Mandates

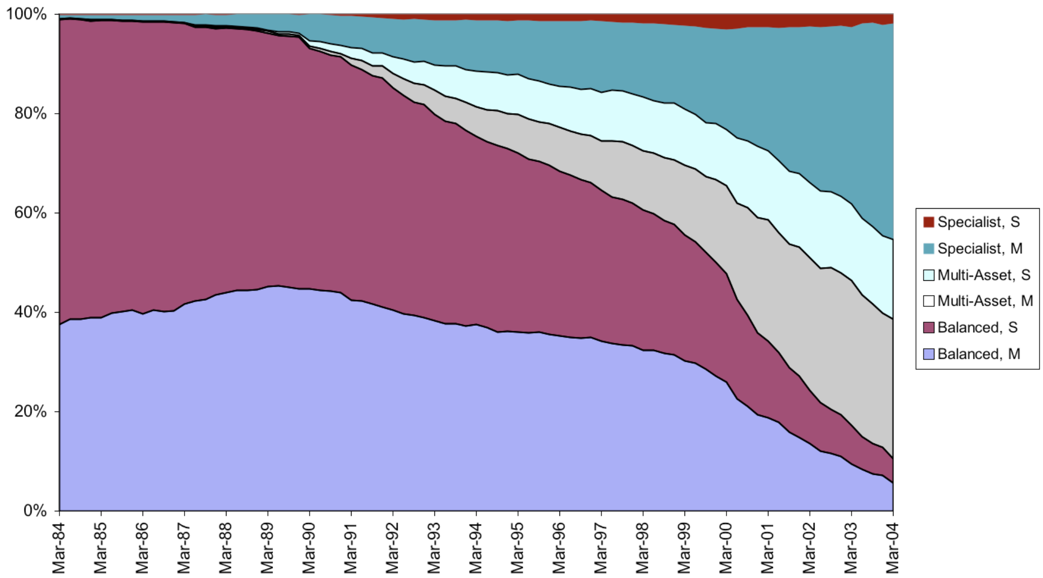
		S.D. (α)	$\alpha < -4$	$-4 < \alpha < -2$	$-2 < \alpha < 0$	$0 < \alpha < 2$	$2 < \alpha < 4$	$4 < \alpha$	p-value	I.R.
UK Equities	**Single-Managed**	1.82	0.75%	3.51%	33.33%	47.87%	10.28%	4.26%	0.0002	0.30
	Multiple-Managed	1.31	1.15%	4.60%	22.99%	65.52%	5.75%	0.00%		0.38
UK Bonds	**Single-Managed**	1.48	0.28%	0.28%	19.94%	66.10%	11.40%	1.99%	0.0000	0.64
	Multiple-Managed	0.93	0.00%	0.00%	20.00%	67.14%	12.86%	0.00%		0.83
Int. Equities	**Single-Managed**	3.14	2.61%	5.22%	19.58%	30.55%	27.94%	14.10%	0.0000	0.51
	Multiple-Managed	2.10	0.00%	1.30%	15.58%	45.45%	25.97%	11.69%		0.77

Balanced Mandates

		S.D. (α)	$\alpha < -4$	$-4 < \alpha < -2$	$-2 < \alpha < 0$	$0 < \alpha < 2$	$2 < \alpha < 4$	$4 < \alpha$	p-value	I.R.
UK Equities	**Single-Managed**	2.57	4.77%	11.48%	36.32%	35.38%	8.52%	3.54%	0.0000	-0.08
	Multiple-Managed	1.66	2.93%	5.61%	47.56%	40.24%	2.44%	1.22%		-0.13
UK Bonds	**Single-Managed**	1.37	0.37%	2.93%	24.74%	62.96%	8.42%	0.59%	0.0000	0.33
	Multiple-Managed	1.04	0.29%	0.29%	14.29%	80.47%	4.08%	0.58%		0.56
Int. Equities	**Single-Managed**	4.78	14.83%	7.82%	19.41%	28.71%	15.13%	14.10%	0.0000	0.03
	Multiple-Managed	4.07	10.83%	9.57%	20.91%	28.21%	19.90%	10.58%		0.10

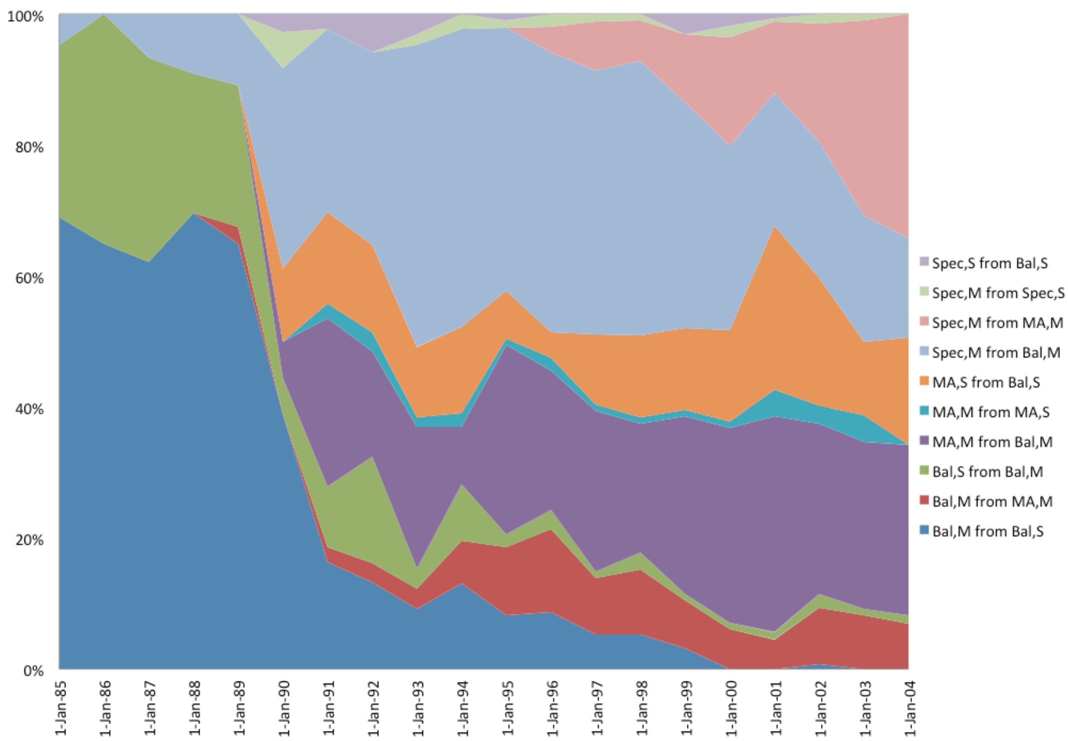
Note: This table compares the distribution of annualized alpha estimates for single- and multiple-managed funds. The alphas are obtained using the factor models for each asset class described in the note to Table 2. Each column reports the proportion of funds within a given annualized alpha range. S.D. (α) is the standard deviation of the annualized alphas. The second to last column reports the p-value for a variance test of the null of equal variances against the alternative that the variance of single-managed funds is greater than that for multiple-managed funds. The final column presents the information ratio (I.R.), which is defined as the ratio of alpha to the standard deviation of alpha.

Figure 1: Distribution of U.K. Equity Mandates by Mandate Type and by Number of Managers: 1984-2004



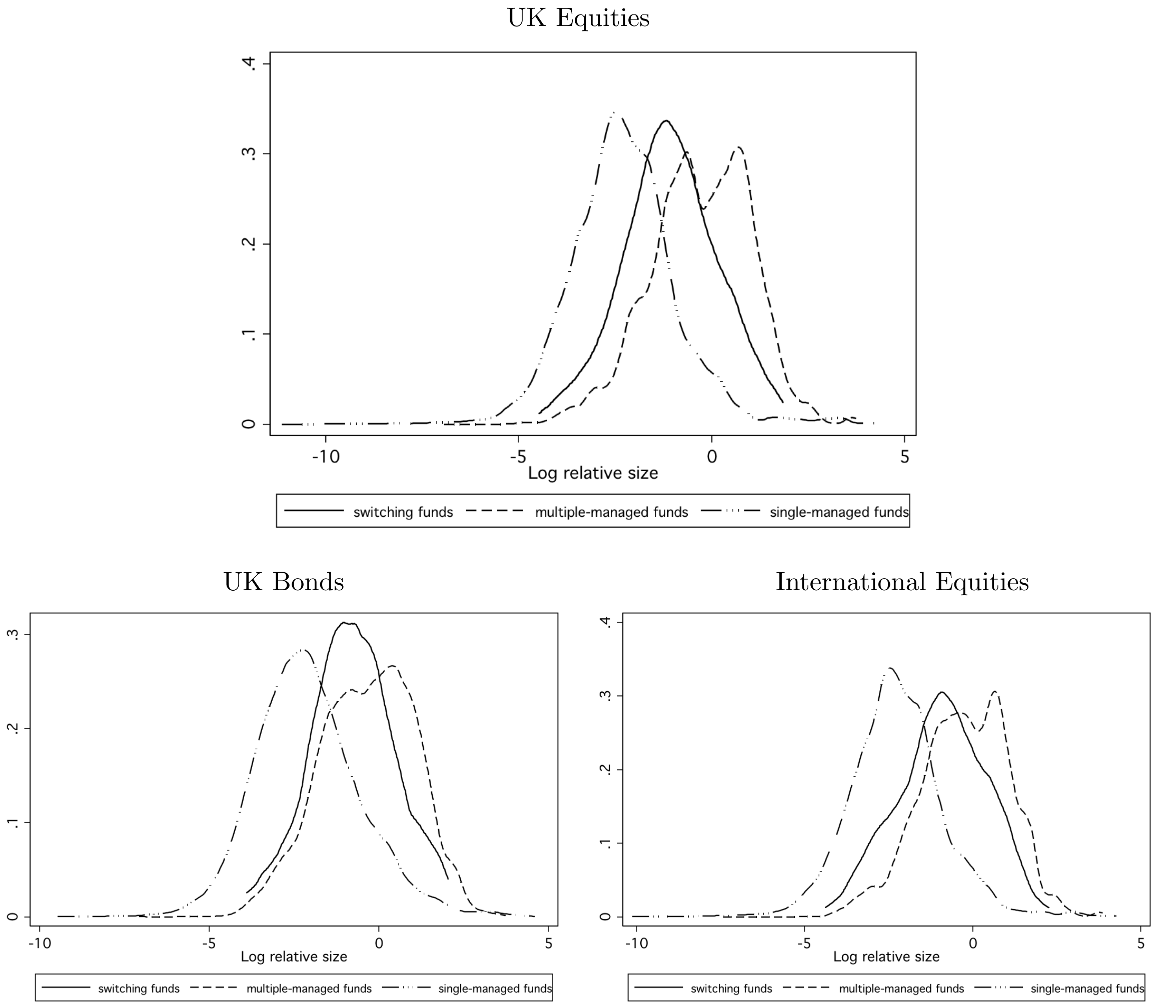
Note: This figure shows the evolution through time in the percentages of types of U.K. equity manager mandates, namely specialists, multi-asset managers (who manage more than one asset class, but fewer than all asset classes) and balanced managers (who manage across all asset classes), and whether these mandates were managed within the U.K. equity asset class by a single (S) or by multiple (M) fund managers. To compute these percentages, we count the number of sponsor asset classes managed under each type of arrangement. For instance, a pension fund with a single balanced manager across all seven asset classes would count as having seven balanced manager accounts, while a pension fund with a single balanced manager and seven specialists (one in each asset class) would count as having seven balanced and seven specialist manager contracts. Also, in the first case, the balanced manager would count as seven single management contracts, while, in the second case, the mandates would count as seven multiple balanced manager contracts and seven multiple specialist contracts, reflecting the fact that they are part of a system of competitive managers within individual asset classes. A virtually identical figure results if proportions by value are used in place of proportions by number.

Figure 2: Distribution of U.K. Equity Mandate Switches by Number of Managers



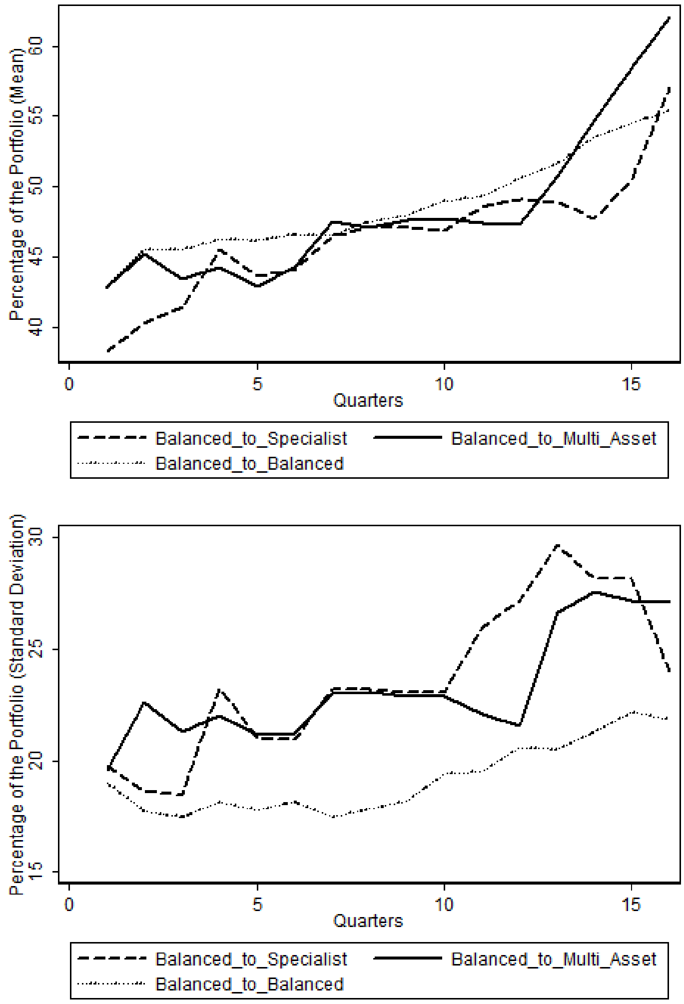
Note: This figure shows the evolution through time in the proportion of switches in a given quarter between types of U.K. equity manager mandates, namely specialists, multi-asset managers (who manage more than one asset class, but fewer than all asset classes) and balanced managers (who manage across all asset classes), and also whether these were single (S) or multiple (M) manager mandates both before and after the switch. To compute these percentages, we count the number of sponsor asset classes managed under each type of arrangement at the time of the switch. For instance, a pension fund with a single balanced manager across all seven asset classes would count as having seven balanced manager accounts, while a pension fund with a single balanced manager and seven specialists (one in each asset class) would count as having seven balanced and seven specialist manager contracts. Also, in the first case, the balanced manager would count as seven single management contracts, while, in the second case, the mandates would count as seven multiple balanced manager contracts and seven multiple specialist contracts, reflecting the fact that they are part of a system of competitive managers within individual asset classes. A virtually identical figure results if proportions by value are used in place of proportions by number.

Figure 3: Distribution of Relative Fund Size for Single- and Multiple-Managed Funds



Note: These figures present kernel density estimates of the distribution of size for single-managed funds, multiple-managed funds and funds that switch from a single manager to multiple managers in the following quarter. Size is measured as the log fund size relative to the average fund size across all funds in existence at a given point in time. The analysis is conducted separately for the three asset classes U.K. equities, U.K. bonds and international equities.

Figure 4: Mean and Standard Deviation of the Percentage of the Portfolio Allocated to New Managers in U.K. Equities



Note: These figures present the mean (top panel) and standard deviation (bottom panel) of the percentage of the portfolio allocated to new managers in U.K. equities.