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Heads we win, tails you lose

Why don't more fund managers offer symmetric performance fees?

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Abstract

In this paper we use Monte Carlo simulation techniques to gauge the impact of three mutual fund fee structures on the utility of investors and fund managers: a fee fixed as a proportion of AUM; an asymmetric performance-based fee; and a symmetric performance-based fee. Our study identifies a clear 'incentive mismatch' between the best interests of investors and managers, more specifically, there is no single structure that simultaneously maximises both the investors' and the managers' utility. In fact, the results show that the most prevalent fee structure currently in the UK market (a fixed fee as a proportion of AUM) is generally the best structure for the manager and the worst for the investor! To verify the robustness of our results, we stress-test the model parameters, however, none of these model variations change the base results and our main conclusion. The results in this paper give rise to a natural question: "Since investors would prefer symmetric performance-based fees, why don't more fund managers offer such fees?".

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1. Introduction

The Investment Management Association's (IMA) member firms manage around £4.5trn. This is equivalent to just under 3 times the UK's annual output. The IMA estimate that around £2.5trn of this asset base is managed on behalf of the UK's institutional clients, £1.8trn on behalf of overseas clients and around £660bn which is managed in UK authorised funds (OEICs and unit trusts). In 2012 the UK's fund management industry earned revenue of £13bn (net of commissions).

Given the scale of the investments it is clear that UK retail investors both directly, and indirectly via their pension investments and insurance contracts, place a great deal of faith in the industry, and have a clear interest in its essential output – investment returns. How can investors be sure that their own interests are aligned with those of the managers that have been entrusted as custodians of such a vast amount of wealth? In economics this is known as the 'principal and agent problem'. In this case investors (the principals) have passed over the responsibility of the management of their savings to fund managers (the agents). The problems involved in ensuring that agents always act in the best interest of their clients are not confined to fund management. But it is arguably one of the simpler principal-agent conundrums.

The predominant fee structure in the mutual fund industry is a charge based upon a fixed proportion of assets under management (see Golec (2003)). Many researchers have considered the impact of this fee structure on various aspects of the fund management industry. The structure arguably gives managers the predominant incentive to grow assets under management since, in this way, total fees will be maximised. Berk and Green (2004) show that the fixed fee structure encourages managers to grow their asset base beyond the level that is consistent with sustaining 'superior returns'. Given the competitive nature of the fund management industry, which is comprised of hundreds of fund management companies and thousands of individual funds, it may not be immediately obvious why fund managers would be willing to sacrifice return for fees, since investors are free to switch their

funds from poorly performing funds to those with superior performance. However, work by Sirri and Tufano (1998) and subsequently by others including Nando et al (2004)), identified a convex relationship between performance and fund flows, that is, good performance attracts capital inflows while equivalent poor performance tends not to lead to commensurate fund outflows. This convex relationship, combined with the fixed fee model, gives fund management companies every incentive to focus on growing assets under management as their primary objective.

Researchers have also investigated the impact that the fixed fee structure has on risk-taking behaviour. Brown, Harlow and Starks (1996) show that fund managers have an incentive to alter the risk profile of their funds in order to maximise fund inflows[2]. For example, a fund management company acting strategically may decide to protect or 'bank' good performance achieved in the early part of the investment period by reducing top funds' risk in the latter part of a particular investment period. Similarly, the convex performance/fund-flow relationship gives the company an incentive to transfer risk to funds with inferior performance. If the risks pay off, great; if not, the fund outflows are smaller than the inflows enjoyed by the better performing funds. Second, risk profiles across funds within a family may change over the year due to intra-firm competitive behaviour by funds rather than because of the strategic behaviour of the fund management company. Funds within a fund family may compete for resources including salaries, marketing budgets and, of course, performance bonuses. Because resources are likely to be skewed towards the top-performing funds, such internal competition may alter risk-taking behaviour by funds over the year in an effort to improve their ranking.

Guedj and Papastaikoudi (2005) suggest that funds within a fund management company – referred to as a 'fund family'– are more likely to have persistent performance than those not in a family. This is because the convex performance/fund-flow relationship provides fund management

[2] See also Kempf and Ruenzi (2004, 2008), or Gaspar et al (2006).

companies with an incentive to engage in strategic behaviour by supporting and resourcing their better-performing funds at the expense of their poorer-performing funds. This convexity may lead to a situation where, given a choice between operating two funds with median performance, or two funds, one a top-performing fund and the other a poorly performing fund, the company would choose the latter. The convex nature of fund flows and the fixed fee structure may combine to produce other phenomena that may not be in the best interests of investors. For example, a newly established fund management company has a greater incentive to focus on the performance of their managers as a way of building assets under management, while a well-established fund manager has a greater incentive to protect those assets that have been accumulated in the past[3].

The fixed fee structure clearly gives fund managers the incentive to grow AUM. In combination with the convex relationship between performance and flows, the fixed fee structure can give rise to some perverse behaviour on the part of fund managers that is not in the best interest of investors. Performance-related fees are often proposed as being a better way of aligning manager and investor interests. In this paper, using Monte Carlo techniques, we investigate the impact of three fee structures – the predominant fixed fee structure, an asymmetric fee structure common in hedge funds and, finally, a symmetric fee structure – on the utility of both a representative fund manager and investor, as a way of trying to understand the most appropriate structure for aligning the best interests of managers with those of their investors. The rest of this paper is organised as follows; in Section 2 we outline the asymmetric and symmetric fee structures that we utilise in our analysis; in Section 3 we briefly describe the utility function that we assume for fund managers and investors and which is used to compare their well-being under various fee scenarios and parameter choices; in Section 4 we present our base results and in Section 5 we present the results of some sensitivity tests where we vary loss aversion parameters, the investment horizon, investigate the impact of

[3] See Clare et al (2014) for a more recent investigation of this phenomenon in the US and European mutual fund markets.

high water marks, and explore issues around the reserving requirements in the case of the symmetric fee structure; and Section 6 concludes the paper.

2. Fund management fee structures and the finance literature

In this section of the paper we review three, generic mutual fund fee structures. We begin with the fixed fee structure, before moving on to describe the most common performance-related fee structure in Europe, the asymmetric fee structure, and also explore the impact of a symmetric fee structure.

2.1 The fixed fee based on AUM

The convex relationship between fund flows and manager performance, coupled with a fee structure that compensates managers as a fixed proportion of funds under management, can lead to some sub-optimal outcomes for investors as indicated in our introduction. We can represent this fixed fee structure as follows:

$$mf_j = \gamma A_j \qquad (1)$$

where mf_j represents the fee paid to manager j; A represents manager j's assets under management and γ represents the fixed fee proportion, which is always positive. This simple fee structure is presented in Figure 1 where, for the purposes of illustration, γ is set at 1.5%.

There is no explicit performance element to this remuneration structure. In addition, asset management firms earn higher fees in a bull market as asset prices rise, which has nothing to do with the abilities of their fund managers. The downside of course is that they earn less in a bear market as asset prices decline. However, although there is no explicit performance element to this fee structure, it does not mean that managers do not have an incentive to perform well. Fund

management companies whose managers perform well will tend to attract fund flows, which will in turn increase the fees earned on the basis of AUM. As such, the remuneration of most active fund managers within an asset management company tends to be performance-related, referenced either to a financial market index, or to a relevant peer group. But as far as the investor is concerned virtually the same annual fee is paid whether the fund manager outperforms or underperforms their benchmark and the fund management company itself is only compensated via AUM.

Using the Morningstar database we identified 21 unique, passive funds that tracked the FTSE-A All Share. The average and standard deviation of this annual fee is just under 0.50%pa and 0.35% respectively. We also identified 16 equity funds that tracked either the FTSE-100, 250 or 350 and the average annual fixed fee for these funds was just under 0.75% (standard deviation 0.48%). Of course the managers of tracking funds have no incentive to 'outperform', only an incentive to track their chosen indices efficiently and to gather AUM. Using the same database we then identified the annual management fee (that does not include entry or exit charges, etc) of all those funds in the IMA UK All Companies Sector; the average and standard deviation of this annual management fee were estimated to be 1.30% and 0.38% respectively; the modal average annual fee was 1.50%pa.

2.2 Fees with a performance-related element

Although a fee based upon a fixed proportion of AUM is clearly the dominant manager compensation structure in the mutual fund industry, some funds do have a fee structure that has a performance-related element. By performance-related we mean that the total management fee has a component that is linked to the performance of the fund, relative to a chosen benchmark. In the USA the structure of performance-related fees is specified by the "Fulcrum Rule". This rule requires that fund managers who wish to charge increased fees when they outperform their benchmark must compensate investors (i.e. reduce fees) when they underperform. However, in

other parts of the asset management industry performance-related fees can be of an asymmetric; now go on to explore these two performance-related fee structures.

2.2.1 Asymmetric performance fee structures

Arguably, the catalyst to the interest in performance-related fees has been the development and interest in the hedge fund industry. Although hedge funds are predominantly marketed to high net worth individuals and institutional investors, over the last few years a number of asset managers in the UK have made "hedge fund-like" investment vehicles available to investors – these are known collectively as Absolute Return Funds, or ARFs. Like hedge funds these funds typically target an absolute return above a cash benchmark such as LIBOR, and like hedge funds their performance-related fee structures are asymmetric. An asymmetric fee structure normally involves a fixed fee based upon AUM, as in the fixed fee model described in 2.1, plus a performance fee that is based upon any outperformance in excess of some benchmark. We can represent the typical asymmetric fee structure as follows:

$$mf_j = \gamma A_j + \delta A_j[\max((R_p - R_b),0)] \qquad (2)$$

where δ is the performance fee, that is paid out on occasions when the return on the portfolio, R_p, exceeds the benchmark, or return target, R_b, and on those occasions when $R_b > R_p$ then the performance fee is zero.

This fee structure is shown in Figure 2, where the fixed fee has been set at 1.0% and the asymmetric performance fee set at 15%. As the exhibit shows the manager's fee rises with positive performance, but is floored (in this case at 1.0% of AUM) in the event that the manager underperforms. This fee structure could be described as "heads we win, and tails you lose". The asymmetric fee structure gives managers an incentive to perform well – although they still have an

incentive to gather assets too. The asymmetric fee structure is usually accompanied with a "high water mark" (HWM). Figure 3 presents a stylised representation of how the management fee that the investor pays is affected by a HWM. In this example the investor pays a performance-related fee at the end of year 1, but does not pay one at the end of year 2 because the fund's value is below its level – its HWM – at the end of year 1. Performance-related fees are again payable at the end of year 3 because at this time the fund's value is higher than it was at the end of year 1; the performance fees payable at the end of year 3 are based upon the difference in the fund's value between the ends of years 3 and 1. And so on. Essentially the HWM ensures that investors only pay for outperformance once, rather than multiple times.

A number of researchers have addressed the impact of performance-related fees that incorporate a HWM from a theoretical standpoint. These papers consider the impact on fund manager behaviour of not only the explicit incentives provided by the asymmetric fee structure, but also 'implicit terms'. These implicit terms can include, for example, the costs to a manager's reputation that might arise in particular with poor performance, or the impact that co-investment can have on manager risk taking. The conflicting results of these theoretical models of fund manager behaviour in the presence of incentive fees and the importance of the implicit terms is clearly illustrated by contrasting the findings of Carpenter (2000), Goetzmann et al (2003), Hodder and Jackwerth (2007) and Panageas and Westerfield (2009). Carpenter (2000) examined the optimal risk taking behaviour of a risk-averse mutual fund manager who is paid with a call option on the assets they control (similar to hedge fund incentive fees). She found that a manager paid with an incentive fee increases the risk of the fund's investment strategy if the fund's return is below their HWM and decreases the risk if the fund is above the HWM. Carpenter's analysis is for a single evaluation period and does not consider the possibility of the fund being liquidated unless the value goes to zero. Goetzmann et al (2003) provide a closed-form solution to the cost of hedge fund fee contracts subject to a number of assumptions in a continuous time framework. They model incentive fees as

an option and find that the cost of the contract rises as the portfolio's return variance rises and hence conclude that the manager has the incentive to increase risk "provided other non-modelled considerations are not overriding". The authors include the possibility that the fund can be liquidated if its value falls below a specified boundary and show that as the fund's value approaches this boundary the manager will reduce risk. So whereas Carpenter's theoretical manager would increase (decrease) risk as the fund value falls (rises) Goetzmann et al's would decrease (increase) risk as it falls (rises).

Hodder and Jackwerth (2007) consider the optimal risk-taking behaviour of an expected-utility maximising manager of a hedge fund who is compensated by both a management fee and an incentive fee, in the presence of a HWM. The authors also examine the effect of several implicit terms including the manager's own investment in the fund, a liquidation barrier where the fund is shut down due to poor performance and the ability of the manager to voluntarily shut down the fund as well as to enhance the fund's Sharpe Ratio through additional effort. Using a numerical approach they find that seemingly slight adjustments to the compensation structure can have dramatic effects on managerial risk taking behaviour. Specifically, they find that the existence of a liquidation barrier and an assumption that the managers own a percentage of the fund (their co-investment) inhibits excessive risk taking as the fund value falls.

Panageas and Westerfield (2009) find that a manager compensated with an incentive fee and a high water mark will place a constant fraction in the risky asset if they are operating in an infinite horizon setting. The intuition behind this is that the manager does not optimise just one option but an infinite time series of options. A manager who is below the high water mark could increase the value of the current option by taking excessive risk today. However this will decrease the value of future options because it will also increase the probability of negative returns while the high water mark is still fixed.

Fewer papers have addressed the issue of fund manager incentives and fund performance from an empirical perspective. Using data on the performance of hedge funds, Clare and Motson (2009) examined the risk taking behaviour of hedge fund managers throughout the year. Any investor is paying a fund manager to take appropriate investment risks to achieve their agreed target consistently over time. However, Clare and Motson found that the risk taking behaviour of hedge fund managers was affected by how near or how far they were away from their high water marks. Their findings indicate that when a manager is close to their high water mark, say after the first six months of the year, (above or below) that risk taking did not change significantly over the remainder of the year. However, the further below their high water mark they were the more likely they would be to reduce risk taking, possibly as a way of protecting their assets under management for that year from further deterioration from bad investment decisions, but also to limit the likelihood of the fund experiencing significant outflows of investor capital, protect their reputation and to protect their own investment in the fund. Figure 4 presents a stylised version of their results. The Figure shows how risk taking also declines the further the fund is above its high water mark, presumably as managers try to protect the performance fee that they have earned in an earlier part of the investment period. These results demonstrate that, even in the presence of a performance-related fee element, the alignment of manager and investor interests is not always as straightforward as it might seem. Clare and Motson's empirical work essentially lends support to the theoretical model of Hodder and Jackwerth (2007).

Using the Morningstar database we identified all of those funds in the IMA's targeted absolute return sector. We identified just under 40 unique Absolute Return Funds (ARFs). Most had a primary benchmark that was cash-related, charged a fixed fee based on AUM, plus a performance fee. We estimated the average management fee to be around 1.43%pa (with a standard deviation of 0.53%), with individual management fees ranging between 0.5% and 2.75%. We estimated the

average performance fee to be just over 18.4%, with most funds having a performance fee of either, 10%, 15% or 20%. 76% of these funds charged a performance fee of 20%. We also identified a number of long/short equity funds in the Morningstar database that are available in mutual fund formats. The fixed and average performance fees for these funds were slightly higher at just over 1.6% (with standard deviation 0.47%) and 18.6% (with standard deviation of 4.6%) respectively.

It is clear then that the asymmetric fee structure that is a defining feature of the hedge fund industry, is also available to the UK's retail investors via ARFs and other funds (although it is important to stress that these funds represent only a tiny proportion of available funds, and manage an equally tiny proportion of total UK mutual fund assets). Nevertheless, this is arguably an important new option for investors looking to align their manager's interest with their own.

2.2.2 Symmetric performance fee structures

Although the asymmetric performance fee structure coupled with the fixed fee as a proportion of AUM and a high water mark provision rewards positive out-performance, the 'pain' of any underperformance is borne by the investor alone. An alternative to the asymmetric fee structure is to make the performance element symmetric.

We have already noted that in the UK retail funds, known as ARFs, have been launched with asymmetric fee structures similar to those offered by hedge funds. However, such structures are not permitted for mutual fund investors in the US (see Elton, Gruber and Blake (1999)). In the US mutual funds that wish to offer performance-based fees must comply with the "fulcrum rule" that was established in the 1940 Investment Company Act. According to this rule, any incentive fee must be benchmarked against a suitable index, where performance fees are payable only when performance above the index is greater than performance below the index. Essentially, this means that returns must exceed the returns on the benchmark and, in the event that they do not, the base

fee must be reduced. A fund manager would charge a performance fee whenever they outperform a pre-specified benchmark over a pre-agreed measurement period. But the same principle could be applied to underperformance. In other words, in the event that the fund manager underperforms the benchmark a proportion of that underperformance could be credited to the client's holdings. In this way the underperformance 'pain' is shared between the investor and the manager, rather than being borne predominantly by the investor. In practice the incentive component is normally offered so that the fee has an upper and lower limit.

We can represent a symmetric fee structure (with no upper or lower limits) as follows:

$$mf_j = \gamma A_j + \delta A_j[R_p - R_b] \qquad (3)$$

Figure 5 shows this fee structure in two possible cases. The [blue] line shows a symmetric fee structure for a case where no fixed fee is charged in addition to the symmetric performance fee. The [red] line shows the same performance-related fee structure, but where a fixed fee element as a proportion of AUM has been added. Under the former, any underperformance results in negative total fees for the manager; in the latter case negative total fees only begin to accrue once the negative performance fee is greater than the fixed fee and therefore in this case the manager's fee income has some 'protection'.

Figure 5 shows that the manager has a clear incentive to perform well, in all those circumstances where any fixed fee element is small, and in all cases where this fixed fee element is equal to zero. Clearly the higher the symmetric fee the more the manager earns from out-performance, and the less the investor receives of this outperformance, but on the other hand the more the investor receives in the form of a fee rebate in the case of underperformance and the greater the decline in the manager's total fee income. It is important to note that this fee structure while more egalitarian, does not guarantee that 'risk-shifting' will not take place. In the case of a fund's underperformance

since the loss of fee income is effectively immediate there is more incentive to do something about this, in other words, protecting the AUM in this case will not be as beneficial.

A number of researchers have looked at the impact of symmetric performance fees on fund performance. Starks (1987), Holmstrom and Milgrom (1987) and Ou-Yang (2003) all show that under certain conditions a symmetric fee contract of the form shown in expression (3) is sufficient to align manager with investor interests. However, the latter paper emphasises the importance of the choice of benchmark, as does Kyle et al (2011). Finally, Dybvig et al (2010) conclude that a symmetric fee structure gives a manager a strong incentive to maintain performance.

The theoretical literature is therefore largely supportive of symmetric fee structures as a way of aligning manager and investor interests. The small number of researchers that have studied the relationship in the US mutual fund market (which is subject to the fulcrum rule) also generally come to positive conclusions about the structure. Golec (1992) finds a positive relationship between the level of the performance fee and fund alpha, that is, they find more evidence of manager skill amongst managers that offer symmetric fee structures compared with those that do not. Elton et al (2003) find evidence to suggest that funds that are offered on a symmetric fee basis, tend to benefit from superior stock selection and tend to have lower total expense ratios. Elton et al's results provide a possible explanation for Golec's results, in other words that the superior alpha may go hand in hand with superior stock selection skills. Finally, Massa and Patgiri (2007) find evidence to suggest that positive performance tends to be more persistent for those funds that are offered on a symmetric fee basis.

Given the vast amount of the academic literature dedicated to analysing mutual fund performance, it is perhaps a bit surprising that relatively few researchers have investigated the impact of symmetric fees on performance in practice. The relative paucity of papers exploring this issue is probably due

to the equal scarcity of funds offering symmetric fee structures. A search of the Morningstar database indicated that 14,424 US funds were available to investors in Morningstar's "Global Broad Category Group" and only 357, or 2.5% of the total, operated a fulcrum-based fee structure[4]. We found that those US mutual funds in the Morningstar database that were available to investors on a symmetric fee basis charged, on average, a fixed annual fee of 0.65% based on AUM, and then an average, symmetric performance fee of ±0.20%. This structure requires some explanation. Essentially what it means is that: in the event that a manager neither under or outperforms a benchmark (within some performance bounds), the manager earns a fixed fee equal to 0.65% of the fund's AUM; in the event of outperformance, the manager earns a fixed fee equal to or up to 0.85% (ie. 0.65% + 0.20%) of the fund's AUM; and in the event of underperformance, the manager earns a fixed fee equal to or no less than 0.45% (i.e., 0.65% – 0.20%) of the fund's AUM. This fee structure satisfies the Fulcrum Rule, since outperformance is rewarded with an additional 0.20%, while underperformance is penalised with a reduction in fee of 0.20%. But this is really the combination of three fixed fees rather than being truly symmetric. In the event that the manager underperforms significantly, and continues to underperform, the manager still receives a fixed fee of 0.45%. In this interpretation of a symmetric performance fee structure the manager does not share the investors 'pleasure' or 'pain' across the full performance spectrum. In our simulations we explore the implications of a symmetric fee structure where the manager shares out and underperformance without limit.

2.3 Summary

The fixed fee model is easily the dominant compensation structure in the mutual fund industry. In Europe a small number of mutual funds offer the asymmetric fee structure pioneered originally by hedge funds. In the US mutual fund industry such asymmetric fee structures are ruled out by the

[4] Elton et al (2003) report that only 108 out of 6,716 available US mutual funds offered a performance-related fee in 1999, representing only 1.7% of the total number.

Fulcrum Rule. The small number of US mutual funds that do offer a performance-related fee structure do so on a symmetric basis, which is combined with a fixed fee element.

In the next section of this paper we outline our methodology for assessing the three, basic fee structures, from the perspectives of both managerial and investor utility.

3. Methodology

To evaluate the relative merits of the various fee structures we make use of recent developments in the behavioural finance literature and calculate the utility that each party experiences from the 'investment journey' under a variety of starting conditions and using a loss averse utility function. We begin this section of the paper by outlining the features of a loss averse utility function, before outlining the Monte Carlo experiments that generate the necessary comparative statistics.

3.1 Utility and loss aversion

The still relatively new discipline of behavioural finance has revealed a number of interesting insights into investor behaviour. Arguably among the most important findings is that investors like gains less than they dislike losses of an equivalent amount. In other words, a gain of say £10 will give a certain level of satisfaction, but a loss of £10 will give rise to much more dissatisfaction. This finding was first brought to our attention by Kahneman and Tversky (1979), and has become embedded in more modern ideas of finance. Indeed, the result was thought to be so important that this idea (and other related ideas) earned Kahneman a Nobel prize in 2002. Benartzi and Thaler (1995) use the loss averse framework to examine the bond/equity portfolio allocation decisions. Their results go some way to explaining the equity risk premium puzzle[5], that is, why the ex post equity risk premium is high.

[5] See Mehra and Prescott (1985) for the original exposition of the equity risk premium puzzle.

This work has led to the development of loss averse utility functions[6]. That is, a mathematical method of capturing the idea that human beings like gains, but really dislike losses. This is probably best explained with the aid of a diagram. Losses are represented on the left of the vertical axis in Figure 6 while investment gains are experienced to the right of the vertical axis. Above the horizontal axis an investor or manager experiences satisfaction (positive utility), below the horizontal axis they experience dissatisfaction (negative utility). The utility function represented by U0 shows how Kahneman and Tversky argued that gains and losses translate into satisfaction or dissatisfaction. They found that the loss aversion ratio was 2.25, meaning that a loss of £10 led to 2.25 times more dissatisfaction than a gain of £10 led to satisfaction. This is why the slope of the function for gains is shallower than the slope of the function for losses. The function is kinked.

The other utility functions in Figure 6 (U1, U2 and U3) show how gains and losses translate into different levels of satisfaction and dissatisfaction for investors or managers with different levels of loss aversion. The function U1 shows the relationship for a person that has a loss aversion ratio of 1.25, and so they are less loss averse than the person represented by U0; while the people represented by U1 and U2 are more loss averse with loss aversion ratios of 3.25 and 4.25 respectively.

3.2 Simulation framework for comparing fee structures

We begin by specifying a hypothetical fund manager and a hypothetical investor that invests with this manager. Both have loss averse utility functions as described above. The utility that the investor experiences is derived from the change in investor wealth between the initial investment date and the end of the investment period. This change in wealth depends on the performance of the manager and the performance of the benchmark portfolio. We assume, not unreasonably, that the investor cannot influence the manager's investment decisions.

[6] See Thaler (2005) for more discussion about this topic.

The manager in our model is benchmarked against a financial market index that has risk and return characteristics that are similar to those of the FTSE-100. The manager is therefore effectively representative of a UK equity fund manager. The return on the benchmark acts as a hurdle rate for the purposes of any performance fee (either negative or positive). The manager is endowed with a specific amount of skill, which we define through the information ratio. The information ratio tells us how much return a fund manager generates per unit of risk, and is defined as follows:

$$\text{Information ratio} = \frac{R_j - R_b}{\text{Stdev}(R_j - R_b)} \quad (4)$$

where R_j and R_b represent the average return generated by the jth fund and the benchmark respectively over a pre-specified investment horizon; and $Stdev(R_j - R_b)$ is the standard deviation of the difference between the fund's return and that of the benchmark over the same investment horizon, this is also referred to as tracking error. Via equation (4), and holding tracking error constant, a more skilled manager (one with high IR) will generate larger average returns relative to the benchmark than a less skilled manager (one with small IR). If we hold IR constant, as we increase the tracking error that a manager is allowed to demonstrate, the returns that they can generate in excess of the benchmark rise on average (intuitively as the manager is given more leeway to express his skill). We run simulations for a set of combinations of manager skill (i.e. IR) and tracking error targets. Modern fund managers will often target a certain tracking error in order to achieve their return goals. The adoption of a particular tracking error also helps them to communicate to investors the level of risk that they can expect to experience.

Figure 7 shows how the information ratio and tracking error of the manager combine in our model to produce manager alpha. In the Figure, the mean annualised manager alpha is measured on the vertical scale, ranging from around -2.5%pa to just over 4.5%pa. The horizontal scale measures

tracking error which ranges from 0%, indicating that the manager is running a passive portfolio, to 10%, which indicates that the manager is deviating substantially from the benchmark weights. The 'depth' axis measures the manager's skill level in terms of their information ratio, that is, the amount of return they generate per unit of risk relative to the benchmark. The information ratio ranges from -0.5% (significant 'negative skill') to 1.0 (significant skill). When we put these ingredients together we see that combinations of high manager skill and high tracking error, on average produce higher levels of alpha. It is worth noting that Figure 7 does not follow precisely the relationship laid out in equation (4). The equation says that, for fixed IR, the relationship between tracking error and alpha should be linear. But for any given positive IR level, Figure 6 shows this relationship to be concave. The concavity is due to the fact that when tracking error (and thus the size of active bets that managers take) is large, it becomes harder for managers to express their views efficiently and thus alpha does not rise as quickly with tracking error as it does when tracking error is low (this is because when tracking error is low there are few binding constraints on allocations). In all of our simulations we assume that high levels of tracking error lead to efficiency losses and thus a concaved relationship between tracking error and alpha[7].

In our empirical work we present results based upon a manager that has the FTSE-100 as their benchmark, where this manager has a range of skill defined, in turn, by the information ratio which ranges from -0.5 to 1.0. Using the Morningstar database we identified all of those UK mutual funds that were benchmarked against the FTSE-100. Of the 123 funds identified, the Morningstar database contains information ratios calculated over a three year horizon for 52 of these funds. The average information ratio was 0.11 (standard deviation 0.43); the largest information ratio was 1.0 and the lowest information ratio was -0.77. The average annual alpha was 0.10% (standard deviation 2.30%); and the alphas ranged from -6.5% to 6.5%. In our empirical work we therefore provide results for our hypothetical manager where the information ratio ranges from -0.5 to 1.0

[7] For more information on this relationship see Grinold and Kahn (2000).

which, when combined with tracking error range from 0% to 10%, produced a range of annualised average fund alphas from -3.0% to 5.0% (see Figure 7, and related explanation above). We therefore feel that our information ratio and tracking error simulation ranges can produce performance by the hypothetical managers that spans the majority of performances produced by actual fund managers. Finally, we should also point out that in our simulations, as in the real world, over a fixed investment horizon sometimes a good fund manager (high information ratio) will perform relatively badly, while on the other hand a less skilled fund manager (low or negative information ratio) might perform relatively well. In our simulations we have set the investment horizon to be three years – the sort of maximum period that an investor might tolerate underperformance.

Having defined the manager's benchmark, the distribution of benchmark returns, manager skill level (information ratio) and the level of risk they are willing to take over time (tracking error) we can use Monte Carlo techniques to generate the performance of managers with a range of skill and risk targets. The results that come from randomly simulating the experience of a fund manager with specific characteristics means that each 'simulated manager' will meet their target on average. More specifically the simulation process for the set of base results presented in Section 4, is made up of the following stages:

i. We begin by simulating the monthly performance of the benchmark 100,000 times over a three year investment horizon, based on the monthly risk and return characteristics of the FTSE-100.
ii. For a specific combination of information ratio and tracking error we then simulate 100,000 sets of excess returns, that is, we generate the performance of 100,000 managers relative to the benchmark.

iii. We then add the first benchmark return to the first manager excess return, and the second benchmark return to the second manager excess return etc, until we have created the total, gross return of 100,000 managers with the same theoretical information ratio and tracking error (although due to the random nature of the simulations, any particular manager will have information ratio and tracking error that diverge from the target).

iv. We can then impose any one of the fee structures on the gross return series to create the net of fee return that would be achieved by any investor in each of the 100,000 simulated funds.

v. From these net of fee returns we can calculate the terminal wealth and therefore the utility that the manager and investor experienced in each of the 100,000 cases and, finally, the average utility across the 100,000 simulations.

vi. This process can be repeated for any combination of manager skill and risk taking, and for a wide range of fee structures (fixed, asymmetric, symmetric) and characteristics (high water marks, investor loss aversion, etc).

3.3 A word on platform fees

The final step before implementing the methodology described in sections 3.1 and 3.2 involves the specification of some base level fees for the three fee structures – fixed, asymmetric and symmetric. In our simulations we use the risk characteristics of the FTSE-100 to generate returns. To be consistent with this we investigated typical management fees in the UK's equity mutual fund market, as reported in section 2. But before we use that information we should say a word about platform fees.

As well as the fee paid to fund managers for the management of their money, retail investors often invest in funds via a fund platform which is usually an on-line service that allows investors to hold their funds in one place, giving them the ability to switch between funds offered on the same

platform efficiently[8]. A range of investments, including individual stocks can be held on these platforms in tax efficient "wrappers" such as ISAs and personal pensions. The range of funds available on these platforms does vary from platform to platform, but many retail investors and their advisers find these platforms convenient since having all of one's investments, or all of one's clients' investments in one place which is easy to monitor and manage can cut down on paperwork and be an efficient means of managing changing financial circumstances.

However, unsurprisingly, these services are not offered free of charge. For those platforms that offer an execution only service where no advice is offered prior to an investment being made or any on-going discretionary management, a £100,000 investment in an ISA held on such platforms would cost the investor between 0.05% to 0.45%pa, with an average of 0.26%pa. Similarly, an equivalent investment held in a personal pension would incur an average annual platform charge of 0.35%pa ranging between 0.20% to 0.60%pa[9].

On the face of it, platform fees can be seen as being a simple addition to the fixed fees paid by investors for the privilege of investing in mutual funds – whether the underlying fund itself operates with a fixed, asymmetric or symmetric fee structure. The platforms generally argue that their greater buying power allows them to negotiate fee discounts from fund managers that individuals would not be able to negotiate, thus offsetting at least some of the additional fees paid to the platform. Nevertheless, for the purposes of our discussion the fees paid by investors to platforms, which are also based upon the size of the invested funds, are effectively a cost to the investor that does not provide a fund manager with incentives to perform well, since the money accrues to the platform providers and not to the fund manager. However, in the simulations below we assume that all fixed fees are payable to the manager rather than to any third party platform provider. In the simulations we exclude platform fees since we do not model the utility of the platform provider.

[8] RDR has shone a spotlight on platform fees since, as far as the investor is concerned, they represent an addition to fixed fee payable on overall AUM.
[9] Source Numis Research (2013).

3.4 Methodology summary

In the next section of this paper we present our base level results. These results, which are generated by endowing a hypothetical manager with various risk targets and skill levels, are conditioned on the following fee parameters, which were, in turn, informed by our investigations using the Morningstar database (see section 2):

Simulation fee parameters

	Fixed fee	**Asymmetric fee**	**Symmetric fee**
Fixed (% of AUM)	1.5%	1%	0%
Performance-related	0%	15%	50%

Given that we do not have infinite amount of time to analyse all the possibilities or an infinite amount of paper to describe them, in the results section below we have restricted the range of key variables of interest such as the information ratio and tracking error to a reasonable number of limited values.

4. Base Results

In this section of the paper we use the simulation framework described in Section 3 to demonstrate the key elements of the fund manager/fee structure problem.

4.1 Results for the investor

In Table 1 we present the utility derived by the investor from investing with managers with varying levels of skill, that is, a range of information ratios from -0.5 to 1; and varying levels of risk taking, that is, with tracking error ranging from 0% to 10%. Each value in the table is the average utility value derived from 100,000 simulations of each combination of information ratio and tracking error. So, for example, the cell in the top left corner of Panel A in the table, presents the average

utility derived by the investor from 100,000 simulations of a manager with an information ratio of -0.5 who runs their portfolio with a tracking error of 0.0, and so on.

4.1.1 Fixed fee results for the investor

Panel A of the table presents the results for the case of a fixed fee set at 1.5%. We can see that the first column in this panel produces an unchanged level of utility (23.4) regardless of the manager's information ratio (level of skill). This is because the tracking error is set equal to zero, which in turn means that the manager is effectively managing the fund as if it were an index-tracking, or passive fund. The utility that the investor derives from a manager that runs their portfolio with a tracking error of zero is therefore derived entirely from the average performance of the benchmark. The results in this column therefore serve as a useful basis for comparison[10]. In those instances where the manager has a negative information ratio – meaning that they have 'negative skill' and tend to underperform the benchmark – as the manager takes more and more active risk (as tracking error rises) the investor's utility declines. In other words, in those instances where a manager has negative skill, the investor is always better off when the manager does not deploy this 'negative skill'. A more interesting result can be seen when the average manager matches the performance of the benchmark thereby producing an information ratio of zero. As the manager with an information ratio of zero uses more and more active risk, or tracking error to achieve this result the utility of the investor declines. This happens even though on average the manager's performance matches the benchmark. This is because the higher the tracking error, the higher the variability of terminal investor wealth across the 100,000 simulations and, under a loss averse utility function, the greater the penalty on that proportion of 100,000 occasions when the manager underperforms. Finally the table also shows how, with the exception of the instance when the manager's tracking error is zero, investor utility rises as the manager's skill level (information ratio) rises. The investor achieves the greatest utility when the manager has the maximum (in our range) skill and takes the most active

[10] The same interpretation holds true for the results that we generate with an asymmetric and a symmetric fee structure, that is, a manager tracking error of zero is effectively running a completely passive fund.

risk, that is, when the manager has an information ratio of 1.0 and tracking error of 10%. In this case a skilful manager is given the greatest latitude to use this skill.

4.1.2 Asymmetric fee results for the investor

Panel B of Table 1 presents results that are comparable to those in Panel A, but where the fee structure is asymmetric, with a fixed fee of 1% and a performance-related fee of 15% above the benchmark. The numbers in the first column in the panel again do not vary, since the fund is effectively being run as a passive fund. The utility derived by the investor in this instance is greater than in column 1 of Panel A, which is simply due to the fact that the fixed fee element in this case (1%) is lower than the fixed fee in Panel A (1.5%). On average the manager earns no performance fees when the tracking error is set to 0.0%. The general pattern of results in Panel B are similar to those in Panel A: investor utility declines as tracking error rises for managers with negative information ratios; and the greatest investor utility is achieved when a manager has great skill (information ratio of 1.0) and greatest latitude to use this skill (tracking error of 10%). However, closer inspection of panels A and B indicate a smaller absolute rise in investor utility as the manager with an information ratio of 1.0 increases tracking error: in Panel A the increase in utility is 20.63; in Panel B it is 17.16. Allowing for differences in the fixed fee then between the two panels, this result shows that when an investor finds a 'good' fund manager (in our case the best manager has an information ratio of 1.0), the more this manager is allowed to express this skill in the form of a higher tracking error, the better off the investor will be under a fixed fee structure. This is because the investor is not sharing any of the performance upside with the manager.

4.1.3 Symmetric fee results for the investor

Panel C of Table 1 presents comparable results based on a symmetric fee structure, where the performance-related fee was set at 50%, above or below the performance of the benchmark (i.e. when the manager outperforms the benchmark they charge 50% of the outperformance as a fee and

when they underperform the benchmark they pay the investor 50% of the underperformance). The results in this Panel are very different from those in Panels A and B. First note that in the case where tracking error is zero the level of average investor utility for all levels of information ratio are higher than in the case of Panels A and B, this is because there is no fixed fee. To see how the fixed fee level affects investor utility one can therefore compare the first column in each panel.

Of more interest though is investor utility in those instances where the manager has negative skill. In these cases as tracking error rises investor utility falls far less than in the case of the fixed and asymmetric fee structures. For example, when the manager has an information ratio of -0.5, investor utility falls by 13.16 and 14.14 as tracking error rises from 0.0% to 10% for the fixed and asymmetric fee structures, but by only -5.92 with the symmetric structure. This is because the manager is 'sharing the investor's pain', absorbing half of the underperformance and because investors are loss averse the sharing of this pain leads to a disproportionately smaller decline in utility.

Another noteworthy feature of Panel C, is the narrower range of investor utility for any given level of manager risk taking (tracking error) as manager skill (information ratio) rises. For example, when tracking error is set at 5%, investor utility rises 23.05 and 21.45 under the fixed and asymmetric fee structures, but by only 11.53 under the symmetric structure. This narrower range of investor utility outcomes, across all manager skill levels, indicates that the investor is likely to experience a narrower range of utility outcomes when choosing a manager that offers this symmetric performance fee compared with the comparable fixed and asymmetric models considered in Panels A and B respectively. To some extent we can think of this as being analogous to the manager with a symmetric fee part-insuring investors, that is, providing compensation when the fund is experiencing a loss and covering the costs of doing this by charging a fee when the fund performs well.

Perhaps the final point to draw out of Panel C is that at the top end of manager performance – information ratio of 1.0 and tracking error of 10% – on average the investor would experience greater utility from a manager charging a fixed fee of 1.5%. The total utility derived from the symmetric fee structure for such a manger is 40.96 compared with 44.03 for the fixed fee structure. Once again this simply indicates that an investor has little incentive to engage a top-performing manager on a performance-related fee basis – far better to keep all of the performance for themselves. In practice of course, ex ante, it may be very difficult to spot a really good manager and to convince such a manager to work for a flat fee.

4.2 Results for the manager

In Table 2 we present the levels of utility derived by the manager for different combinations of manager skill and risk taking, for the three base fee structures. The first point to note is that manager utility is lower in all cases than in Table 1. This is not meaningful. It simply reflects the fact that the fees earned by the manager(s) are smaller than the wealth gains to investors, both because their fees are limited and also because the investor is benefitting in utility terms from the move in the benchmark which is on average positive. The absolute values of the two sets of results should not be compared directly. It is also worth noting that in reality most managers will have more than one investment client such that their utility will be magnified by earning fees from multiple sources. In section 4.3 below we will make a more meaningful comparison.

4.2.1 Fixed fee results for the manager

Focussing on the results in Panel A of Table 2, the results indicate very little variation in the utility of the manager in either the manager skill or the risk taking dimensions when fees are fixed. Manager utility rises for all levels of tracking error (except when it is equal to 0.0%) as manager skill levels rise. This is because the better the manager, the greater returns earned, the larger their

asset base grows and thus the higher the fee they earn. When manager skill is negative, on average the loss averse manager experiences less utility as tracking error rises, but the decline in utility is relatively slight. In the instance where average performance matches the benchmark (where the information ratio is 0.0) the fees earned under this fixed fee model does not change. The manager's utility is maximised with high manager skill (information ratio equals 1.0) and high levels of risk taking. However, because the marginal difference in terms of utility is small with regard to manager effort (proxied by tracking error) the fixed fee model does not reward the manager very highly for deviating a long way from the benchmark (that is, running a tracking error of 0.0). And of course, a manager with a negative information ratio would always maximise their utility by targeting a tracking error of 0.0%, that is, running a passive portfolio.

4.2.2 Asymmetric fee results for the manager

Panel B of Table 2 shows the levels of utility that the manager derives from the asymmetric fee structure (1.0% and 15%). First, the lower fixed fee means that utility derived from targeting a tracking error of 0.0% is lower than under the fixed fee model. As manager skill rises, over all levels of active risk (except where the tracking error is 0.0%) manager utility rises. And because the manager benefits from positive performance, earning 15% of any above benchmark performance, the manager's utility rises by more than the equivalent rise under the fixed fee structure. For example, when the targeted tracking error is 5% as the manager's information ratio rises from -0.5 to 1.0, manager utility rises by 0.86 under the fixed fee structure but by 2.15 under the asymmetric fee structure. Similarly, as the targeted risk taking (tracking error) rises for all levels of manager skill (information ratio) manager utility rises by more under the asymmetric fee structure compared with the fixed fee structure. This is because the higher the excess performance over the benchmark the greater the fee earned by the manager, and therefore the greater the utility. Perhaps the most interesting result is that when the manager has negative skill, they are still able to achieve higher levels of utility by increasing the risks in their portfolio. This is because the results

presented in the table are averages of 100,000 simulations so that when a manager with negative skill gets lucky – and some of the 100,000 will on occasion – this luck is rewarded with a performance fee. By contrast, when managers with negative skill get lucky when they charge a fixed fee, they receive no performance fee. The interesting conclusion from this then is that, regardless of skill, on average, an asymmetric fee structure always leaves a manager better off when they take investment risks on behalf of clients – "heads we win, tails you lose" – helping to explain in turn why performance-related fees have earned such a bad reputation with investors.

4.2.3 Symmetric fee results for the manager

Panel C of Table 2 presents the manager utility results under a symmetric fee structure. With no fixed fee and a tracking error of 0.0% the manager's utility is always zero. The manager therefore has an incentive to take risk but only if they have positive skill, in this case an information ratio of 0.3 or higher. When a manager has negative skill, they only reduce their own utility by targeting a positive tracking error, because they are committed to paying back 50% of the underperformance (with no compensating fixed fee) to the investor. This is in contrast to the asymmetric fee structure which, as we have seen, encourages managers with negative skill to take investment risk, even though the average investor would be worse off if they did.

Our results show that it is only when a manager has an information ratio of 0.3 that they manage to increase their average utility, relative to running a passive fund by increasing tracking error. This is a direct result of the loss averse utility function, which means that even for a manager with positive skill on average (for example, an information ratio of 0.2), the average 'pain' of those instances of underperformance outweigh the average 'pleasure' of those instances of positive performance. When the manager has an information ratio of 0.3 or greater, the positive skill combined with a positive tracking error, leads to an increase in utility, compared to that derived from a passive

portfolio. For information ratio levels between 0.30 and 0.70, utility at first rises at a decreasing rate as tracking error increases and then at some point begins to fall. In fact this is true in all instances, but this is not visible in the table when, for example, the information ratio equals 1.0; in this case the eventual decline in utility sets in at tracking error levels much higher than 10%. The rise and then eventual fall of utility as tracking error increases is again the result of the loss averse utility function and the assumed link between tracking error and alpha. As tracking error rises, the distribution of alphas across managers has a larger mean but also has a larger standard deviation (and the standard deviation increases faster than the mean). This means that for larger tracking errors there are still plenty of managers among the 100,000 who underperform the benchmark. Then, averaging across managers, for high tracking errors this can cause utility to fall as tracking error increases. These results also imply that there is a 'sweet spot' for any manager offering symmetric performance of this kind. For example, a manager with an information ratio of 0.5 would, on average maximise their utility from fee income, by running their fund with a targeted tracking error of between 6% and 7%.

Finally, the range of values in each column of Panel C, compared with the relatively narrow range in Panels A and B, emphasize that the symmetric fee structure represents the biggest risk to the manager in terms of utility outcomes derived from fee income. This means in turn that any manager contemplating offering a symmetric performance fee structure, with no fixed fee element, would need to be relatively confident in their ability to generate a positive information ratio.

4.3 Summary

The results presented in this section of the paper are based upon specific, though not unrealistic, starting parameters. Changing the starting parameters will of course change the results, but in an entirely intuitive way. For example, the lower the fixed fee, other things equal, the higher would be investor utility and the lower would be manager utility, and so on. However, to try and put the

results into a clearer perspective in Panel A of Table 3 we have presented the results for the full range of manager skill and risk taking, indicating which of the three fee structures the investor would prefer for each combination. Panel B of Table 3 provides the same information, but from the manager's perspective. Panel A shows clearly that under most circumstances the investor is better off with a symmetric fee structure. It is only when manager skill and targeted tracking error are high that the investor would prefer a fixed fee (although of course in practice the investor would not know a priori, the skill of the manager). There are some instances where an asymmetric fee structure would be preferred when a manager has high skill, this is largely due to the trade-off between an upside performance fee of 15% in the case of the asymmetric structure versus one of 50% in the symmetric structure. As one would expect, Panel B of Table 3 is almost a mirror image of Panel A. In the majority of instances the manager is better off offering a fixed fee. Where a performance-based fee structure is more beneficial for the fund manager it is, in most cases, the symmetric version that dominates, when manager skill levels and risk taking are both high. We find that the symmetric fee structure would be chosen by a manager only with high levels of skill (an information ratio of 1.0 or higher) – in fact only in those instances when the investor would prefer a fixed fee model!

Our base results here go some way to explaining why the predominant fee structure in the mutual fund industry is a based upon a fixed proportion of AUM. However, given that the symmetric fee model would, overwhelmingly, be the preference of investors, it is perhaps a surprise that such fee models are, thus far at least, entirely absent in the UK's mutual fund industry, and fairly scarce in the US mutual fund industry.

5. Model extensions

In this section of the paper we explore variations on the basic structures considered in section 4.

5.1 The impact of reducing the symmetric performance fee from 50% to 30%

The results in Section 4 showed that in utility terms, investors are nearly always better off with a symmetric fee structure. It is only when both the information ratio of the manager and the level of active risk taken by the manager is high that the investor, on average, would achieve higher utility with a fixed fee structure and in some cases with an asymmetric structure. Panel A of Table 4 presents the results of a comparison of investor utility derived from: a fixed fee of 1.5%; an asymmetric fee structure with a fixed fee of 1% and positive performance-related fee of 15%; and finally a symmetric, performance-related fee of 30%. From this panel we can see that the symmetric fee always produces the greatest utility for the investor of the three fee models. The base results show that investors should prefer a fixed fee structure for a manager with high levels of skill and risk taking; in such cases investors have to share 50% of the fund's outperformance with these 'good' managers. When we reduce the symmetric performance fee to 30%, the loss in utility from sharing 30% of this outperformance is not enough to offset the greater utility derived from this symmetric fee structure. Indeed, for the investor, reducing the symmetric fee below 50% gradually erodes the attractiveness of the fixed and asymmetric fee models when the tracking error and skill of the manager are high (see Panel A of Table 3) so that the investor prefers the symmetric model for the whole range of tracking error and skill encompassed in our simulations – as evidenced in Panel A of Table 4. This implies of course that as the symmetric fee rises – above 50% – that investors gradually begin to prefer the other two fee structures. We do not present the results where the symmetric fee structure is greater than 50% because it seemed unlikely to us that any manager would offer a fund with a symmetric fee of 60%, 70%, etc[11]. Overall, the results in Panel A of Tables 3 and 4 imply that as the performance-related fee for the symmetric model rises the fixed fee model becomes relatively more attractive to the investor, although even when the performance-related fee is set equal to 50%, the symmetric model still dominates in most cases (as Table 3 shows).

[11] However, the results of experiments where the symmetric fee was set at 60%, 70% and 80% are available on request.

For the manager the symmetric performance fee model tends to be preferred over the wide range of tracking error and skill considered in the simulations in the base case. Reducing the symmetric performance fee to 30% does not lead to any change in these preferences. The results in Panel B in Tables 3 and 4 are almost identical. However, in Panel B of Table 4 there are no instances when the manager's welfare would be highest from a symmetric fee structure, when that symmetric performance fee is set to 30%; with a symmetric performance fee set at 50% (Panel B of Table 3) the manager's welfare is highest with the symmetric fee structure when the manager's information ratio is equal to 1.0 and where tracking error is greater than 4.0%.

5.2 Changing the levels of investor loss aversion

The base results reported in Section 4 of this paper assume a loss aversion parameter of 2.25 as suggested by Kahneman and Tversky (1979). However, some investors will be more loss averse than others. In order to see how the loss aversion affects the investor's investment experience, we re-estimated the utility levels that the investor derives from the three base fee structures, but where the loss aversion parameter was set to 1.0 and then again where we set it to 5.0. A loss aversion parameter of 1.0 essentially implies that the investor is not loss averse at all, in other words, an investor with a loss aversion parameter of 1.0 gains as much utility from a dollar gain as they do disutility from the loss of a dollar. By contrast, an investor with a loss aversion parameter of 5.0 gains the same, positive utility from a five dollar gain as they do disutility from a one dollar loss.

The results of these sensitivity tests are presented in Table 5. Panel A presents the results for the case where the loss aversion parameter is set to 1.0 and Panel B where the same parameter has been set to 5.0. The results show again that the symmetric fee structure, with an under and outperformance fee of 50% and a 0% fixed fee, leads to the highest level of utility for the investor in the absence of loss aversion (Panel A) and at quite extreme levels of loss aversion (Panel B). The

difference between the two panels is fairly marginal. Essentially, when loss aversion is large, the region of high manager IRs and high tracking error in which the investor prefers a fixed fee shrinks. Intuitively, more loss averse investors are less keen on fixed fee structures as they derive great benefit from the sharing of risk with the manager that the symmetric fee allows.

5.3 Investment horizon

The results in Section 4 were based upon a three year investment horizon. The longer the horizon the less chance there is of 'bad' managers getting lucky and of 'good' managers being unlucky. To isolate the impact of the investment horizon on our results we re-estimated the utility levels for the investor and manager using ten years as the investment horizon. Table 6 show the fee structure preferences of the investor (Panel A) and the manager (Panel B). The results can be compared directly with the base results reported in Table 3.

The results Table 6 still show that the investor achieves greater levels of average utility with the symmetric fee structure in most instances. For very high levels of manager skill (information ratio) and risk taking (tracking error) the investor achieves greater utility under the fixed fee structure, because they benefit from the manager's outperformance, without having to pay performance-related fees. This result is very similar to the one presented in Panel A of Table 3. However, with the longer investment horizon, there is a slight increase in the number of times that the investor has higher utility with the asymmetric fee structure.

5.4 High Water Marks and Reserving

In this section of the paper we explore the sensitivity of our results to two features of the base case presented in Section 4, that is, the impact of the HWM on the asymmetric fee structure. We also explore the issue of reserving in the case of the symmetric fee structure. In the base case presented in Section 4 of this paper, we assumed that the manager always had enough reserves set aside to

compensate the investor in the event of benchmark underperformance. In section 5.4.2 below, we set the reserve equal to zero at the outset of the three year investment horizon, to see the role that a reserve could play in practice.

5.4.1 High Water Marks in the case of asymmetric performance fees

The inclusion of a high water mark (HWM) is common in the hedge fund industry, where the asymmetric fee structure is the predominant fee model. The HWM ensures that investors pay the performance-related fee only once (see Figure 3). The results relating to the asymmetric fee structure in Sections 4 , 5.1, 5.2 and 5.3 in this paper were all produced with the inclusion of a HWM. To determine the impact of the HWM we re-estimated the base results for the asymmetric fee structure excluding the HWM. The utility derived from the asymmetric fee structure encompassing a fixed fee of 1.0% and a performance fee of 15% without the HWM for the investor are presented in Panel A of Table 7, while the equivalent results are presented for the manager in Panel B of the same table.

Compared with the results shown in Panel B of Table 1, Panel A of Table 7 shows that in nearly all cases (except where the manager is running a passive portfolio, with a tracking error of 0.0) the investor's utility falls with the removal of the HWM. This indicates that there will have been times, on average, when the investor paid for the same performance more than once (which is not possible with the inclusion of the HWM). The utility loss rises as tracking error rises and falls as manager skill rises. However, in all cases the scale of the utility loss is relatively small. Turning to the impact of the removal of the HWM for the manager, compared with the results shown in Panel B of Table 2, Panel B of Table 7 shows that the manager's utility is higher in all cases and indeed that the managers utility gain is greater, relative to the base case, than the utility loss of the investor. Table 8 presents both the investor's (Panel A) and manager's (Panel B) preferred model, where the fee structures are otherwise identical to the base case presented in Tables 1 and 2, but where the

HWM has been removed for the asymmetric fee structure. Panel A of Table 8 shows that the investor derives most utility from the symmetric fee structure in nearly all cases. Panel B of the same table shows that the manager's utility is nearly always greatest with the fixed fee structure. For higher levels of skill and risk taking the asymmetric fee structure dominates, with the exception of the case where the manager has an information ratio of 1.0, and tracking error greater than 4.0% - in these cases the utility of the manager is greatest under the symmetric fee structure. Essentially, the set of fund manager performance parameters where the manager prefers the asymmetric fee grows with the removal of the HWM; the converse is true for investors.

5.4.2 Reserving in the case of symmetric performance fees

With a symmetric fee structure the manager may need cash at hand to repay investors in the event of benchmark underperformance. For example, assume that a manager has a symmetric compensation structure and that in the first month the fund underperforms the benchmark. The manager therefore owes the investor money but has not yet collected any fee income from which this compensation can be paid. This means that the manager will need a reserve of cash to cover such eventualities and, in practice, it implies that a fully symmetric fee structure is unattainable due to the fact that any investment manager has finite funds available. In the base results relating to the symmetric fee structure presented in Tables 1 to 3 we assumed (implicitly) that the manager always has the capacity to recompense investors when they underperform the benchmark. In Table 9 we present results that change this assumption. We assume that the manager starts with an initial reserve of zero and that when the manager's reserve is at this level he cannot pay any compensation to the investor. However, when the manager earns fee income it enters the reserve and is always available subsequently for payments to the investor. At any time that the reserve equals zero, any compensation that should be paid to the investor is accrued and paid when funds become available,

so that fees are not charged to the investor until all fees due have been repaid. Note that in some situations fees may never be fully repaid to the investor (for example if the manager was to underperform the benchmark in every period until the terminal date he would owe fees to the investor in every period, but would be unable to pay them), and this is reflected in the utility scores.

Table 9 shows the investor's (Panel A) and the manager's (Panel B) utility derived from the symmetric fee structure, with a symmetric performance fee of 50%, under the assumption that the manager has no cash reserve. Compared to Panel C of Table 1, the investor experiences a loss of utility with the imposition of no initial fee reserve. In contrast we can see that the manager experiences a fairly substantial increase in utility compared to the results presented in compared to Panel C of Table 2. Mechanically, when the manager has no reserve then there will be times where the investor is due a payment from the manager, but the manager cannot pay. Thus manager utility will rise and investor utility will fall. As the table shows, and as one would expect, a zero reserve benefits the manager most when they have low skill and high tracking error. Mathematically, the zero reserve in our model has the effect of creating a ceiling to the amount of fees that a manager can pay the investor and this non-linearity in the manager's payoff function leads to a preference for high tracking error.

When, as in practice, the manager has a finite level of reserve funds available from which payments to investors can be covered, this will tend to increase managerial utility and reduce investor utility relative to the base case. The key question, though, is whether investors are better off under a symmetric fee structure with a finite reserve or under one of the alternative fee structures (i.e. fixed or asymmetric). Table 10 presents both the investor's (Panel A) and manager's (Panel B) preferred model, where the fee structures are otherwise identical to the base case presented in Tables 1 and 2, but where the manager is assumed to have no initial reserve in the case of the symmetric fee structure. Panel A of the table shows that the investor's utility is highest, in most cases, with the

symmetric fee structure, at higher levels of skill and risk taking the investor's utility is highest with the fixed fee structure. Panel B of Table 10 shows that in most cases the manager's utility is highest with the fixed fee model. However, at higher levels of skill and risk taking the manager achieves highest utility from the symmetric, performance fee model because when the manager is extremely skilled and takes a lot of risk, the symmetric fee allows him to benefit from his own skill. Panel A of Table 10 also shows that relative to the infinite reserve case, there is a slightly larger set of cases of reasonable skill and tracking error where the investor prefers the asymmetric fee (presumably because the zero reserve is painful to investors and thus they are willing to invest with a scheme that has a fixed fee component but a smaller performance fee).

Thus, this change to the symmetric fee structure slightly erodes its appeal to investors, but in no way eliminates it. The symmetric structure still dominates for 80% of our parameter configurations. It is, however, worth noting two limitations of our reserve implementation. First we have assumed that every dollar of fee income earned by the manager is always available for repayment to the investor. This will, of course, not be true in practice, because fee income must be used to run the manager's business. If we were to assume that only a fraction of fees collected by managers were subsequently available to compensate investors, this would somewhat weaken the symmetric fee structure's appeal to investors. However, counter balancing this effect, our assumption of a zero reserve is the strictest initial condition that could be imposed. In reality it seems likely to us that any manager launching a fund with a symmetric performance-related fee structure would have an initial reserve larger than zero and that this will have the effect of expanding the range of parameters in which the symmetric fee structure dominates.

6. Concluding remarks

We build a simulation model that allows us to study the effects of three mutual fund fee structures on the utility of investors and fund managers. These fee structures are a flat fee on AUM, an

asymmetric fee structure (such as that commonly adopted by hedge funds) and a symmetric fee structure where investors pay managers for outperformance but managers repay investors when they underperform the benchmark (these are commonly called fulcrum structures in the US).

Our simulation setup has a benchmark return that is calibrated to the FTSE-100 and in which an investment manager is endowed with a particular level of skill (information ratio) and takes a pre-specified amount of active risk (tracking error). We simulate monthly returns of 100,000 managers with this setup over a total period of 3 years and compute, at the end of this period, the average utility of investors from their terminal invested wealth and the average utility of managers from their total fee income. Both investors and managers have loss averse utility functions. Varying the manager's information ratio and tracking error allows us to study the variation in investor and manager preferences for different fee structures across different scenarios for manager skill and risk-taking.

The key results from this experiment are as follows:

- Investors, in the majority of cases, would prefer symmetric fee structures. Only when an investor is certain (before investing) that an investment manager is very skilled and takes a lot of risk would investors prefer fixed fees.
- Conversely, managers, especially poor or mediocre managers, prefer flat fees. Only very skilled managers ever prefer symmetric fees (as very skilled managers are keen to share in the investment upside that they are capable of generating).
- Our benchmark symmetric fee structure is such that managers retain 50% of any outperformance but must repay 50% of any underperformance. As one varies the 50% proportion, investor utility and manager utility change in the obvious fashion i.e. if the symmetric fee falls (rises), investor preference for a symmetric fee structure further

strengthens (weakens), and manager preference for the symmetric structure weakens (strengthens).

- Robustness checks where we change the loss aversion parameter of the utility function and change the investment horizon from 3 to 10 years have small effects on the results but leave the basic comparatives unchanged.
- One important parameter in the symmetric fee case is the size of the reserve that the investment managers retain and out of which they pay investors for underperformance when they have not earned enough historical fee income to do so. When this reserve is small managers are better off in utility terms than if this reserve is assumed to be infinite. The converse holds for investors. The imposition of the zero reserve decreases the parameter range over which investors prefer symmetric fees, but symmetric fees still dominate around 80% of the parameter constellations we study and very clearly in situations where tracking error is low.

Hopefully the results in this paper give an answer to the question: "Since investors would prefer symmetric performance-based fees, why don't more fund managers offer such fees?". We find that in most cases manager utility is greatest with a fixed and, to a lesser extent, an asymmetric fee structure. It is only when the manager has a high information ratio and runs their portfolio with a relatively high tracking error that they would be better off in utility terms, offering investors a symmetric fee structure.

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Figure 1: Fees as a fixed proportion of AUM (1.5%)

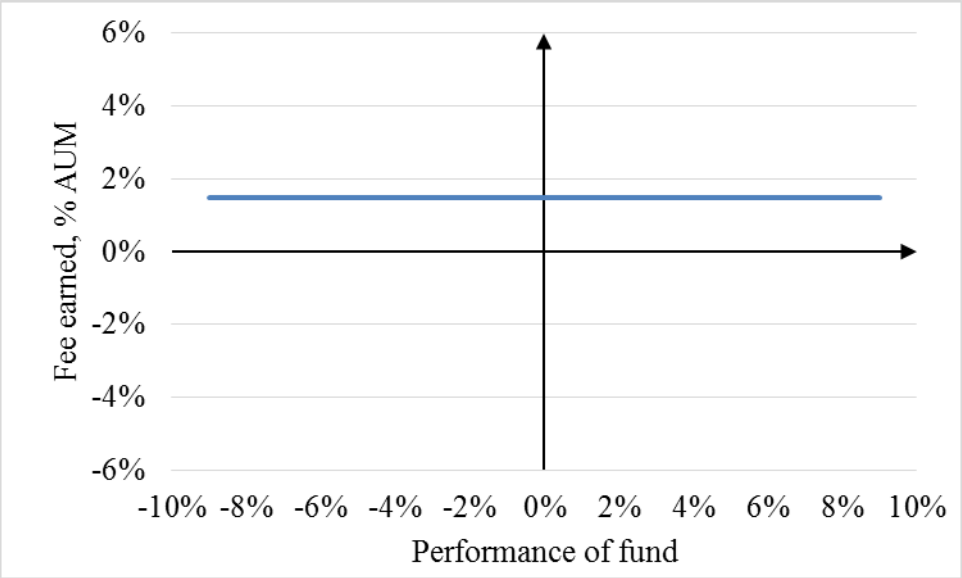


Figure 2: A typical asymmetric fee structure (1.0%, 15%)

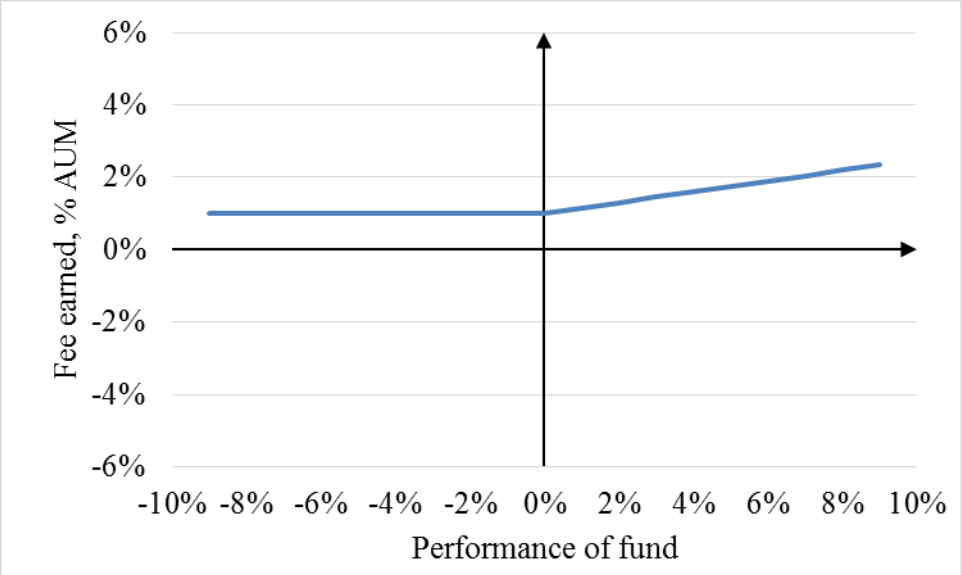


Figure 3: Performance fees and high water marks

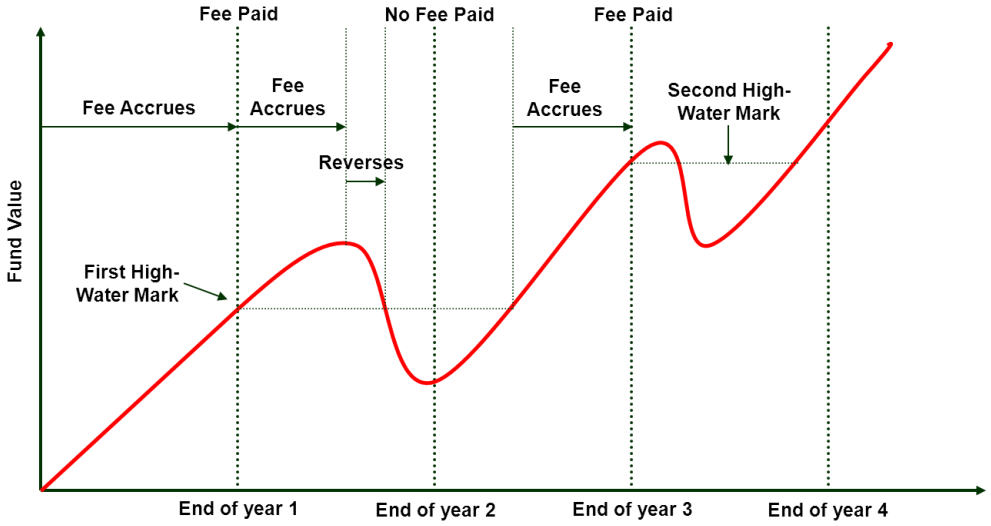
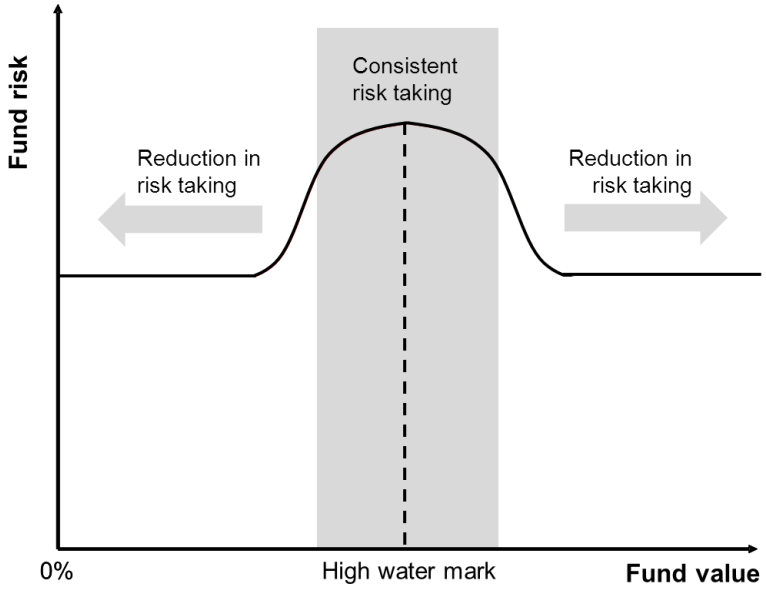


Figure 4: High water marks and risk taking



Source: Stylised representation of results found in "Locking in the profits or putting it all on black? An empirical investigation into the risk-taking behaviour of hedge fund managers", A. Clare and N. Motson, Journal of Alternative Investing, 2009.

Figure 5: Symmetric performance fee (50%)

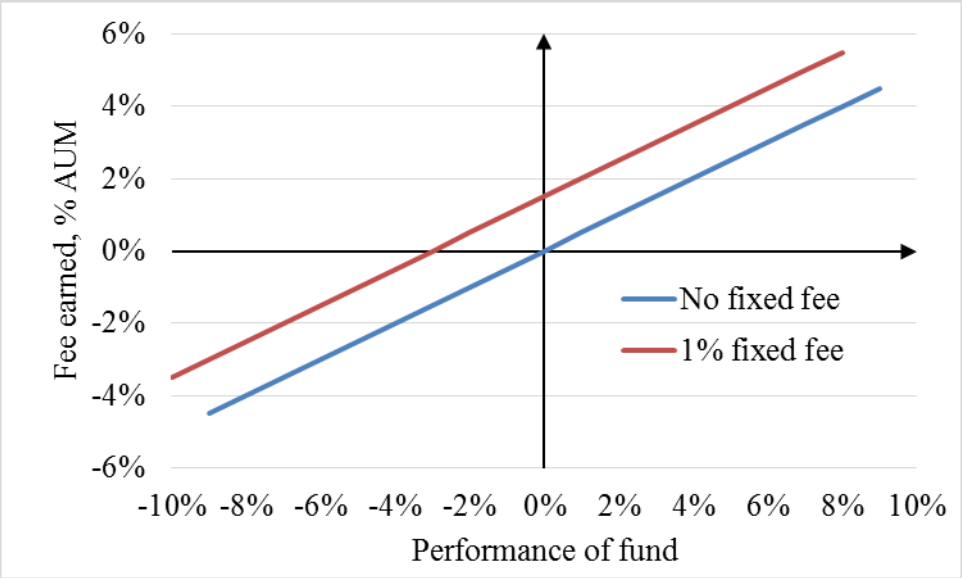


Figure 6: The loss averse utility function

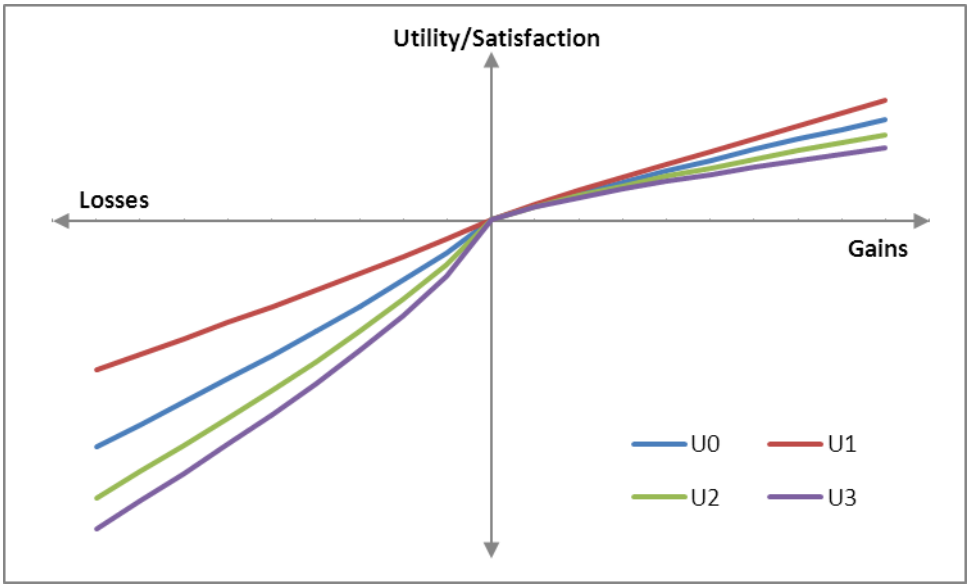


Figure 7: Information ratio, tracking error and alphas

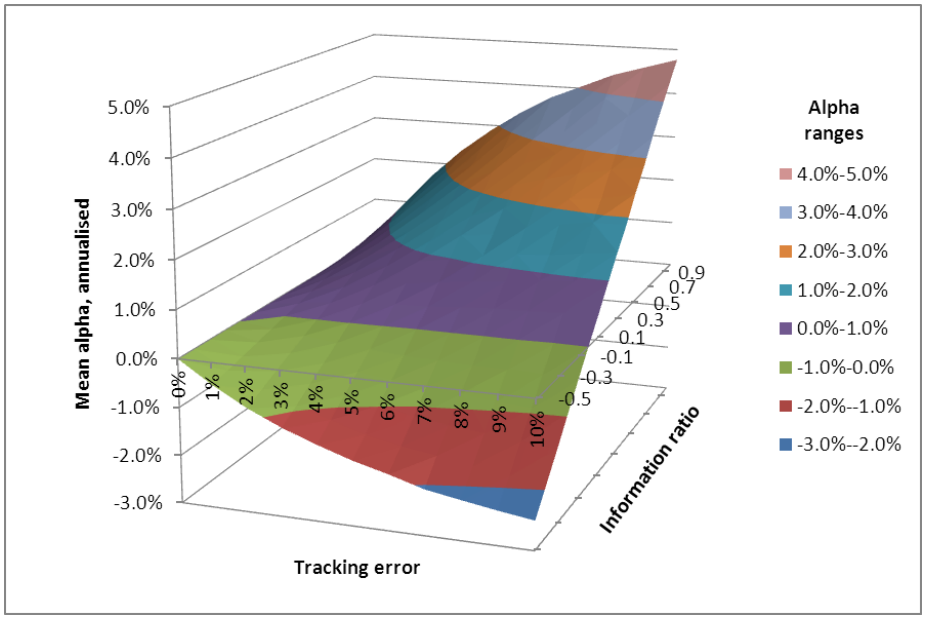


Table 1: Investor utility - base results

Notes: Each value in the table represents the average utility that 100,000 investors derive from the performance of a manager with predetermined tracking error target (columns) and information ratio (I.R.) (rows).

	Tracking Error										
	0%	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
I.R.	**Panel A: Fixed fee (1.5%)**										
-0.5	23.40	21.29	19.45	17.89	16.54	15.28	14.18	12.95	12.02	11.11	10.24
-0.4	23.40	21.70	20.22	18.93	17.82	16.72	15.74	14.97	14.11	13.26	12.43
-0.3	23.40	22.12	21.01	20.04	19.18	18.40	17.44	16.78	16.14	15.40	14.62
-0.2	23.40	22.55	21.80	21.08	20.44	19.84	19.27	18.78	18.12	17.45	16.96
-0.1	23.40	22.96	22.58	22.13	21.72	21.29	20.94	20.50	20.17	19.64	19.23
0.0	23.40	23.39	23.33	23.25	23.07	22.85	22.63	22.38	22.14	21.70	21.40
0.1	23.40	23.81	24.09	24.29	24.37	24.29	24.33	24.27	24.10	23.93	23.62
0.2	23.40	24.21	24.85	25.31	25.67	25.93	26.12	26.16	26.21	26.15	25.91
0.3	23.40	24.63	25.64	26.41	27.06	27.42	27.85	28.02	27.97	28.14	28.19
0.4	23.40	25.04	26.42	27.49	28.41	29.10	29.37	30.00	30.28	30.50	30.20
0.5	23.40	25.45	27.14	28.52	29.68	30.49	31.23	31.83	32.27	32.38	32.73
0.6	23.40	25.87	27.90	29.64	30.99	32.07	33.00	33.69	34.27	34.59	34.88
0.7	23.40	26.28	28.73	30.66	32.30	33.65	34.71	35.60	36.35	36.84	37.35
0.8	23.40	26.71	29.46	31.71	33.65	35.26	36.59	37.49	38.35	39.07	39.59
0.9	23.40	27.12	30.20	32.82	34.96	36.77	38.19	39.42	40.49	41.08	41.82
1.0	23.40	27.56	31.01	33.90	36.28	38.33	40.03	41.27	42.47	43.28	44.03
	Panel B: Asymmetric fee (1.0% fixed and 15% of benchmark out-performance)										
-0.5	25.67	23.56	21.66	20.02	18.57	17.20	15.99	14.63	13.58	12.54	11.53
-0.4	25.67	23.96	22.42	21.04	19.81	18.60	17.49	16.58	15.58	14.60	13.61
-0.3	25.67	24.37	23.19	22.11	21.12	20.21	19.12	18.31	17.51	16.63	15.71
-0.2	25.67	24.80	23.97	23.11	22.33	21.58	20.86	20.20	19.40	18.57	17.91
-0.1	25.67	25.21	24.72	24.13	23.56	22.97	22.44	21.84	21.33	20.63	20.06
0.0	25.67	25.63	25.45	25.19	24.84	24.44	24.05	23.61	23.19	22.57	22.09
0.1	25.67	26.05	26.17	26.18	26.07	25.80	25.64	25.38	25.03	24.66	24.17
0.2	25.67	26.45	26.91	27.15	27.29	27.33	27.31	27.15	26.99	26.73	26.30
0.3	25.67	26.85	27.65	28.18	28.59	28.72	28.92	28.88	28.62	28.58	28.40
0.4	25.67	27.26	28.39	29.19	29.84	30.27	30.33	30.70	30.75	30.75	30.27
0.5	25.67	27.65	29.07	30.14	31.01	31.56	32.04	32.39	32.59	32.48	32.59
0.6	25.67	28.06	29.77	31.18	32.21	33.00	33.65	34.08	34.42	34.51	34.56
0.7	25.67	28.45	30.54	32.11	33.41	34.44	35.22	35.82	36.31	36.55	36.81
0.8	25.67	28.86	31.21	33.06	34.63	35.89	36.91	37.52	38.12	38.57	38.84
0.9	25.67	29.25	31.88	34.06	35.81	37.26	38.35	39.27	40.04	40.38	40.84
1.0	25.67	29.66	32.61	35.03	37.00	38.65	40.00	40.93	41.82	42.35	42.83
	Panel C: Symmetric fee (50% of benchmark under and out-performance)										
-0.5	30.22	29.17	28.27	27.52	26.90	26.34	25.87	25.33	24.97	24.63	24.31
-0.4	30.22	29.38	28.66	28.05	27.53	27.04	26.63	26.32	25.99	25.68	25.37
-0.3	30.22	29.59	29.05	28.60	28.21	27.88	27.47	27.22	26.98	26.73	26.45
-0.2	30.22	29.80	29.45	29.12	28.84	28.59	28.37	28.21	27.98	27.74	27.59
-0.1	30.22	30.01	29.84	29.64	29.48	29.32	29.20	29.06	28.98	28.81	28.71
0.0	30.22	30.22	30.21	30.20	30.15	30.09	30.05	29.99	29.94	29.83	29.78
0.1	30.22	30.44	30.60	30.73	30.80	30.81	30.89	30.92	30.93	30.93	30.86
0.2	30.22	30.64	30.98	31.24	31.45	31.63	31.78	31.88	31.98	32.03	32.00
0.3	30.22	30.85	31.37	31.79	32.16	32.38	32.65	32.80	32.84	33.02	33.13
0.4	30.22	31.06	31.77	32.34	32.84	33.23	33.41	33.79	34.00	34.18	34.11
0.5	30.22	31.26	32.13	32.85	33.47	33.92	34.35	34.70	34.99	35.12	35.37
0.6	30.22	31.48	32.51	33.42	34.13	34.72	35.23	35.63	35.99	36.21	36.43
0.7	30.22	31.68	32.93	33.93	34.79	35.51	36.09	36.58	37.03	37.33	37.65
0.8	30.22	31.90	33.30	34.46	35.47	36.32	37.03	37.53	38.02	38.44	38.77
0.9	30.22	32.10	33.68	35.02	36.13	37.08	37.84	38.50	39.09	39.44	39.86
1.0	30.22	32.32	34.08	35.57	36.80	37.86	38.76	39.42	40.08	40.53	40.96

Table 2: Manager Utility – base results

Notes: Each value in the table represents the average utility that 100,000 manager derive from their performance with predetermined tracking error target (columns) and information ratio (I.R.) (rows).

	Tracking Error										
	0%	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
I.R.	**Panel A: Fixed fee (1.5%)**										
-0.5	5.82	5.75	5.68	5.63	5.59	5.55	5.52	5.49	5.47	5.45	5.43
-0.4	5.82	5.76	5.71	5.67	5.63	5.60	5.57	5.56	5.54	5.52	5.51
-0.3	5.82	5.78	5.74	5.71	5.68	5.66	5.63	5.62	5.61	5.60	5.58
-0.2	5.82	5.79	5.77	5.74	5.73	5.71	5.70	5.69	5.68	5.67	5.66
-0.1	5.82	5.81	5.80	5.78	5.77	5.76	5.76	5.75	5.75	5.75	5.74
0.0	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82
0.1	5.82	5.84	5.85	5.86	5.87	5.87	5.88	5.89	5.90	5.90	5.90
0.2	5.82	5.85	5.88	5.90	5.92	5.93	5.95	5.96	5.97	5.98	5.99
0.3	5.82	5.87	5.91	5.94	5.97	5.99	6.02	6.03	6.04	6.06	6.07
0.4	5.82	5.88	5.94	5.98	6.02	6.05	6.07	6.10	6.13	6.15	6.15
0.5	5.82	5.90	5.97	6.02	6.07	6.11	6.14	6.18	6.20	6.22	6.24
0.6	5.82	5.92	5.99	6.06	6.12	6.17	6.21	6.25	6.28	6.30	6.33
0.7	5.82	5.93	6.03	6.10	6.17	6.23	6.28	6.32	6.36	6.39	6.42
0.8	5.82	5.95	6.05	6.14	6.22	6.29	6.35	6.40	6.44	6.48	6.51
0.9	5.82	5.96	6.08	6.19	6.28	6.35	6.42	6.47	6.52	6.56	6.59
1.0	5.82	5.98	6.11	6.23	6.33	6.41	6.49	6.55	6.60	6.64	6.68
	Panel B: Asymmetric fee (1.0% fixed and 15% of benchmark out-performance)										
-0.5	3.91	3.87	3.87	3.91	3.97	4.04	4.13	4.22	4.33	4.45	4.58
-0.4	3.91	3.88	3.90	3.96	4.04	4.12	4.23	4.34	4.46	4.59	4.73
-0.3	3.91	3.89	3.93	4.01	4.11	4.22	4.33	4.46	4.60	4.75	4.88
-0.2	3.91	3.90	3.97	4.07	4.19	4.32	4.45	4.61	4.75	4.90	5.06
-0.1	3.91	3.92	4.01	4.13	4.27	4.42	4.58	4.74	4.91	5.07	5.24
0.0	3.91	3.93	4.05	4.21	4.37	4.54	4.71	4.89	5.07	5.25	5.43
0.1	3.91	3.95	4.10	4.28	4.47	4.65	4.85	5.05	5.24	5.45	5.62
0.2	3.91	3.97	4.15	4.36	4.57	4.79	5.01	5.22	5.44	5.64	5.84
0.3	3.91	3.98	4.20	4.45	4.70	4.93	5.17	5.40	5.61	5.84	6.08
0.4	3.91	4.01	4.26	4.54	4.83	5.09	5.33	5.60	5.86	6.09	6.28
0.5	3.91	4.03	4.32	4.64	4.95	5.24	5.53	5.80	6.06	6.29	6.56
0.6	3.91	4.05	4.39	4.75	5.10	5.41	5.72	6.01	6.28	6.55	6.80
0.7	3.91	4.08	4.47	4.86	5.24	5.60	5.92	6.23	6.53	6.82	7.09
0.8	3.91	4.11	4.54	4.98	5.40	5.79	6.15	6.48	6.79	7.09	7.37
0.9	3.91	4.14	4.63	5.12	5.57	5.98	6.36	6.72	7.06	7.35	7.67
1.0	3.91	4.17	4.72	5.25	5.74	6.19	6.61	6.97	7.33	7.65	7.97
	Panel C: Symmetric fee (50% of benchmark under and out-performance)										
-0.5	0.00	-2.20	-4.12	-5.73	-7.11	-8.39	-9.53	-10.69	-11.61	-12.49	-13.30
-0.4	0.00	-1.86	-3.49	-4.89	-6.12	-7.31	-8.37	-9.23	-10.14	-10.97	-11.79
-0.3	0.00	-1.52	-2.86	-4.04	-5.09	-6.05	-7.12	-7.92	-8.70	-9.49	-10.30
-0.2	0.00	-1.18	-2.25	-3.24	-4.16	-5.00	-5.83	-6.52	-7.29	-8.07	-8.72
-0.1	0.00	-0.87	-1.66	-2.49	-3.24	-3.99	-4.62	-5.30	-5.89	-6.56	-7.20
0.0	0.00	-0.56	-1.14	-1.70	-2.28	-2.87	-3.45	-4.00	-4.55	-5.17	-5.71
0.1	0.00	-0.28	-0.61	-0.98	-1.40	-1.92	-2.30	-2.74	-3.22	-3.70	-4.25
0.2	0.00	-0.01	-0.10	-0.29	-0.52	-0.81	-1.11	-1.49	-1.85	-2.25	-2.75
0.3	0.00	0.25	0.38	0.42	0.38	0.16	0.03	-0.25	-0.67	-0.95	-1.27
0.4	0.00	0.50	0.87	1.08	1.22	1.22	1.00	0.98	0.80	0.55	0.03
0.5	0.00	0.74	1.30	1.70	1.99	2.09	2.15	2.15	2.07	1.75	1.67
0.6	0.00	0.97	1.73	2.34	2.77	3.05	3.23	3.29	3.29	3.15	3.00
0.7	0.00	1.18	2.18	2.92	3.53	3.98	4.26	4.45	4.56	4.54	4.52
0.8	0.00	1.40	2.57	3.50	4.28	4.89	5.37	5.57	5.79	5.89	5.91
0.9	0.00	1.61	2.95	4.09	5.01	5.76	6.28	6.70	7.05	7.09	7.22
1.0	0.00	1.82	3.37	4.66	5.73	6.62	7.33	7.80	8.20	8.38	8.58

Table 3: The preferred fee model – Base results

Notes: This table presents the preferred fee model for the investor (Panel A) and the manager (Panel B), based upon the results presented in Tables 1 and 2. "Fixed" indicates that either the investor or the manager achieves greatest utility from the fixed fee structure. "Asym" indicates that either the investor or the manager achieves greatest utility from the asymmetric fee structure. "Sym" " indicates that either the investor or the manager achieves greatest utility from the symmetric fee structure.

	Tracking Error										
	0%	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
I.R.	**Panel A: 'Most appropriate' model for investor**										
-0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.0	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.6	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.7	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.8	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Fixed	Fixed	Fixed
0.9	Sym	Sym	Sym	Sym	Sym	Asym	Asym	Fixed	Fixed	Fixed	Fixed
1.0	Sym	Sym	Sym	Sym	Asym	Asym	Fixed	Fixed	Fixed	Fixed	Fixed
	Panel B: 'Most appropriate' model for manager										
-0.5	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.4	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.3	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.2	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.1	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.0	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.1	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.2	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.3	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym
0.4	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym
0.5	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym
0.6	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym
0.7	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym
0.8	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym	Asym
0.9	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym	Asym
1.0	Fixed	Fixed	Fixed	Fixed	Fixed	Sym	Sym	Sym	Sym	Sym	Sym

Table 4: The preferred fee model – With performance-related fee for the symmetric fee structure set to 30%

Notes: This table presents the preferred fee model for the investor (Panel A) and the manager (Panel B). The Fixed fee structure is 1.5%; the Asymmetric fee structure is 1.0% and 15%; and the performance-related fee for the symmetric fee structure is set at 30%. "Fixed" indicates that either the investor or the manager achieves greatest utility from the fixed fee structure. "Asym" indicates that either the investor or the manager achieves greatest utility from the asymmetric fee structure. "Sym" indicates that either the investor or the manager achieves greatest utility from the symmetric fee structure.

	Tracking Error										
	0%	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
I.R.	**Panel A: 'Most appropriate' model for investor**										
-0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.0	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.6	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.7	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.8	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.9	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
1.0	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
	Panel B: 'Most appropriate' model for manager										
-0.5	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.4	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.3	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.2	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.1	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.0	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.1	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.2	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.3	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym
0.4	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym
0.5	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym
0.6	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym
0.7	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym
0.8	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym	Asym
0.9	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym	Asym
1.0	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym	Asym	Asym

Table 5: The impact of the investor loss aversion parameter

Notes: This table presents the preferred fee model for the investor in the case where the investor's loss aversion parameter is 1.0 (Panel A) and 5.0 (Panel B) where, in each case, the fee structures are the same as those presented in the base model results (Table 3). "Fixed" indicates that either the investor or the manager achieves greatest utility from the fixed fee structure. "Asym" indicates that either the investor or the manager achieves greatest utility from the asymmetric fee structure. "Sym" indicates that either the investor or the manager achieves greatest utility from the symmetric fee structure.

	Tracking Error										
	0%	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
I.R.	**Panel A: Investor loss aversion parameter = 1.0**										
-0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.0	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.6	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.7	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Fixed	Fixed	Fixed
0.8	Sym	Sym	Sym	Sym	Sym	Sym	Asym	Fixed	Fixed	Fixed	Fixed
0.9	Sym	Sym	Sym	Sym	Sym	Asym	Asym	Fixed	Fixed	Fixed	Fixed
1.0	Sym	Sym	Sym	Sym	Asym	Asym	Fixed	Fixed	Fixed	Fixed	Fixed
	Panel B: Investor loss aversion parameter = 5.0										
-0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.0	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.6	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.7	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.8	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.9	Sym	Sym	Sym	Sym	Sym	Sym	Asym	Asym	Fixed	Fixed	Fixed
1.0	Sym	Sym	Sym	Sym	Sym	Asym	Asym	Fixed	Fixed	Fixed	Fixed

Table 6: The preferred fee model – Extending horizon from three to ten years

Notes: This table presents the preferred fee model for the investor (Panel A) and the manager (Panel B), where the base model has been adjusted by extending the investment horizon to ten years. The Fixed fee structure is 1.5%; the asymmetric fee structure is 1.0% and 15%; and the performance-related fee for the symmetric fee structure is set at 50%. "Fixed" indicates that either the investor or the manager achieves greatest utility from the fixed fee structure. "Asym" indicates that either the investor or the manager achieves greatest utility from the asymmetric fee structure. "Sym" indicates that either the investor or the manager achieves greatest utility from the symmetric fee structure.

	Tracking Error										
	0%	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
I.R.	**Panel A: 'Most appropriate' model for investor**										
-0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.0	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.6	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.7	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Asym	Asym	Asym	Fixed
0.8	Sym	Sym	Sym	Sym	Sym	Asym	Asym	Asym	Asym	Fixed	Fixed
0.9	Sym	Sym	Sym	Sym	Asym	Asym	Asym	Asym	Fixed	Fixed	Fixed
1.0	Sym	Sym	Sym	Sym	Asym	Asym	Asym	Fixed	Fixed	Fixed	Fixed
	Panel B: 'Most appropriate' model for manager										
-0.5	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.4	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.3	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.2	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.1	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.0	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.1	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.2	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.3	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.4	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.5	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.6	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.7	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym
0.8	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Sym	Sym	Sym	Sym
0.9	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Sym	Sym	Sym	Sym	Sym
1.0	Fixed	Fixed	Fixed	Fixed	Fixed	Sym	Sym	Sym	Sym	Sym	Sym

Table 7: Investor and Manager utility from removing the HWM in the asymmetric fee structure

Notes: This table shows both investor (Panel A) and manager (Panel B) utility from the asymmetric fee structure with no HWM.

	Tracking Error										
	0%	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
I.R.	**Panel A: Investor**										
-0.5	25.67	23.54	21.59	19.89	18.38	16.96	15.68	14.27	13.15	12.04	10.98
-0.4	25.67	23.95	22.34	20.90	19.61	18.33	17.17	16.19	15.14	14.08	13.04
-0.3	25.67	24.36	23.11	21.96	20.91	19.93	18.78	17.91	17.05	16.10	15.12
-0.2	25.67	24.78	23.88	22.95	22.11	21.30	20.51	19.79	18.93	18.04	17.31
-0.1	25.67	25.19	24.62	23.96	23.33	22.67	22.08	21.42	20.84	20.09	19.45
0.0	25.67	25.60	25.34	25.01	24.60	24.14	23.67	23.18	22.69	22.02	21.48
0.1	25.67	26.01	26.06	26.00	25.82	25.48	25.26	24.95	24.53	24.10	23.55
0.2	25.67	26.41	26.79	26.96	27.04	27.02	26.93	26.71	26.49	26.17	25.67
0.3	25.67	26.81	27.53	27.99	28.34	28.40	28.54	28.44	28.12	28.01	27.78
0.4	25.67	27.21	28.26	29.00	29.59	29.96	29.95	30.27	30.25	30.19	29.65
0.5	25.67	27.60	28.94	29.95	30.76	31.24	31.66	31.95	32.09	31.93	31.97
0.6	25.67	28.00	29.64	30.99	31.97	32.69	33.28	33.65	33.93	33.95	33.95
0.7	25.67	28.39	30.41	31.92	33.16	34.14	34.85	35.40	35.82	36.00	36.20
0.8	25.67	28.80	31.09	32.88	34.39	35.60	36.56	37.11	37.64	38.04	38.24
0.9	25.67	29.18	31.76	33.89	35.58	36.98	38.01	38.87	39.58	39.86	40.26
1.0	25.67	29.59	32.50	34.87	36.78	38.38	39.66	40.54	41.37	41.84	42.25
	Panel B: Manager										
-0.5	3.91	3.88	3.92	4.01	4.12	4.25	4.39	4.53	4.68	4.85	5.03
-0.4	3.91	3.89	3.96	4.07	4.20	4.34	4.50	4.67	4.83	5.01	5.19
-0.3	3.91	3.91	4.00	4.14	4.29	4.45	4.61	4.80	4.99	5.18	5.36
-0.2	3.91	3.92	4.05	4.20	4.38	4.56	4.75	4.96	5.15	5.34	5.55
-0.1	3.91	3.94	4.09	4.27	4.47	4.67	4.88	5.09	5.32	5.53	5.74
0.0	3.91	3.96	4.14	4.36	4.57	4.80	5.03	5.26	5.48	5.71	5.94
0.1	3.91	3.98	4.19	4.44	4.68	4.91	5.17	5.42	5.67	5.92	6.14
0.2	3.91	4.00	4.25	4.52	4.79	5.06	5.34	5.60	5.87	6.12	6.37
0.3	3.91	4.02	4.31	4.61	4.92	5.20	5.50	5.77	6.04	6.32	6.60
0.4	3.91	4.05	4.37	4.71	5.05	5.37	5.65	5.98	6.29	6.57	6.81
0.5	3.91	4.07	4.43	4.81	5.17	5.51	5.85	6.18	6.49	6.77	7.10
0.6	3.91	4.10	4.50	4.92	5.31	5.68	6.04	6.38	6.71	7.03	7.33
0.7	3.91	4.13	4.58	5.02	5.45	5.86	6.23	6.60	6.96	7.29	7.62
0.8	3.91	4.16	4.65	5.14	5.61	6.05	6.46	6.83	7.21	7.56	7.90
0.9	3.91	4.19	4.73	5.27	5.77	6.23	6.66	7.07	7.47	7.81	8.18
1.0	3.91	4.23	4.82	5.40	5.93	6.43	6.90	7.31	7.72	8.10	8.47

Table 8: Preferred fee model for investor and manager utility from removing the HWM in the asymmetric fee structure

Notes: This table shows the preferred fee model for the investor (Panel A) and manager (Panel B) where the HWM has been removed from the asymmetric fee structure. The Fixed fee structure is 1.5%; the asymmetric fee structure is 1.0% and 15% without a HWM; and the performance-related fee for the symmetric fee structure is set at 50%. "Fixed" indicates that either the investor or the manager achieves greatest utility from the fixed fee structure. "Asym" indicates that either the investor or the manager achieves greatest utility from the asymmetric fee structure. "Sym" indicates that either the investor or the manager achieves greatest utility from the symmetric fee structure.

	Tracking Error										
	0%	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
I.R.	**Panel A: Investor**										
-0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.0	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.6	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.7	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.8	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Fixed	Fixed	Fixed
0.9	Sym	Sym	Sym	Sym	Sym	Sym	Fixed	Fixed	Fixed	Fixed	Fixed
1.0	Sym	Sym	Sym	Sym	Sym	Asym	Fixed	Fixed	Fixed	Fixed	Fixed
	Panel B: Manager										
-0.5	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.4	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.3	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.2	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.1	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.0	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym
0.1	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym
0.2	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym
0.3	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym
0.4	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym
0.5	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym	Asym
0.6	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym	Asym
0.7	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym	Asym
0.8	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym	Asym	Asym
0.9	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Asym	Asym	Asym	Asym	Asym
1.0	Fixed	Fixed	Fixed	Fixed	Fixed	Sym	Sym	Sym	Sym	Sym	Sym

Table 9: Investor and manager utility for symmetric fee structure when initial reserve is zero

Notes: This table shows both investor (Panel A) and manager (Panel B) utility in the case of the symmetric fee model with no initial reserve.

	Tracking Error										
	0%	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
I.R.	**Panel A: Investor**										
-0.5	30.22	27.93	25.86	24.06	22.46	20.92	19.53	18.00	16.76	15.53	14.31
-0.4	30.22	28.28	26.54	24.97	23.55	22.15	20.84	19.74	18.52	17.32	16.14
-0.3	30.22	28.64	27.20	25.91	24.69	23.56	22.26	21.23	20.19	19.08	17.94
-0.2	30.22	29.00	27.87	26.76	25.72	24.71	23.73	22.83	21.81	20.73	19.80
-0.1	30.22	29.33	28.49	27.59	26.74	25.87	25.06	24.21	23.40	22.45	21.60
0.0	30.22	29.66	29.06	28.45	27.78	27.07	26.38	25.63	24.93	24.05	23.28
0.1	30.22	29.97	29.62	29.22	28.76	28.15	27.65	27.08	26.41	25.71	24.98
0.2	30.22	30.26	30.17	29.97	29.70	29.36	28.96	28.46	27.95	27.38	26.66
0.3	30.22	30.54	30.71	30.73	30.67	30.40	30.19	29.81	29.22	28.82	28.29
0.4	30.22	30.81	31.23	31.46	31.59	31.55	31.24	31.16	30.82	30.46	29.74
0.5	30.22	31.07	31.70	32.13	32.42	32.48	32.49	32.41	32.19	31.77	31.48
0.6	30.22	31.32	32.16	32.83	33.25	33.51	33.64	33.63	33.54	33.24	32.94
0.7	30.22	31.56	32.66	33.46	34.07	34.49	34.74	34.85	34.88	34.73	34.57
0.8	30.22	31.81	33.09	34.07	34.87	35.48	35.90	36.03	36.15	36.15	36.03
0.9	30.22	32.04	33.51	34.72	35.64	36.38	36.86	37.22	37.47	37.39	37.39
1.0	30.22	32.27	33.96	35.33	36.41	37.28	37.95	38.33	38.66	38.74	38.78
	Panel B: Manager										
-0.5	0.00	0.17	0.36	0.58	0.82	1.10	1.39	1.67	1.98	2.32	2.67
-0.4	0.00	0.21	0.45	0.71	1.00	1.30	1.62	1.95	2.30	2.67	3.02
-0.3	0.00	0.26	0.56	0.86	1.20	1.55	1.88	2.25	2.64	3.03	3.40
-0.2	0.00	0.33	0.68	1.04	1.42	1.82	2.21	2.64	3.01	3.42	3.87
-0.1	0.00	0.41	0.82	1.24	1.65	2.09	2.55	2.97	3.45	3.88	4.33
0.0	0.00	0.49	0.99	1.48	1.95	2.43	2.91	3.42	3.87	4.35	4.83
0.1	0.00	0.59	1.16	1.73	2.26	2.76	3.32	3.84	4.36	4.90	5.33
0.2	0.00	0.70	1.36	2.00	2.60	3.19	3.78	4.34	4.92	5.45	5.96
0.3	0.00	0.82	1.59	2.31	3.00	3.62	4.27	4.84	5.41	5.99	6.62
0.4	0.00	0.95	1.83	2.64	3.41	4.13	4.73	5.45	6.11	6.72	7.18
0.5	0.00	1.08	2.07	2.97	3.83	4.59	5.33	6.04	6.73	7.30	7.99
0.6	0.00	1.23	2.34	3.36	4.29	5.12	5.94	6.67	7.39	8.05	8.69
0.7	0.00	1.38	2.64	3.74	4.76	5.71	6.55	7.36	8.13	8.83	9.54
0.8	0.00	1.55	2.93	4.16	5.29	6.31	7.27	8.09	8.89	9.66	10.35
0.9	0.00	1.72	3.23	4.61	5.82	6.93	7.91	8.82	9.71	10.44	11.24
1.0	0.00	1.90	3.57	5.05	6.37	7.58	8.67	9.59	10.52	11.31	12.09

Table 10: Preferred model for investor and manager for symmetric fee structure when initial reserve is zero

Notes: This table shows the preferred fee model for both investor (Panel A) and manager (Panel B) in the case where the symmetric fee model has no initial reserve. The Fixed fee structure is 1.5%; the asymmetric fee structure is 1.0% and 15%; and the performance-related fee for the symmetric fee structure is set at 50%. "Fixed" indicates that either the investor or the manager achieves greatest utility from the fixed fee structure. "Asym" indicates that either the investor or the manager achieves greatest utility from the asymmetric fee structure. "Sym" indicates that either the investor or the manager achieves greatest utility from the symmetric fee structure.

	Tracking Error										
	0%	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
I.R.	**Panel A: Investor**										
-0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
-0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.0	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.1	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.2	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym
0.3	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Asym
0.4	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Asym	Asym
0.5	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Asym	Asym	Fixed
0.6	Sym	Sym	Sym	Sym	Sym	Sym	Asym	Asym	Asym	Fixed	Fixed
0.7	Sym	Sym	Sym	Sym	Sym	Sym	Asym	Asym	Fixed	Fixed	Fixed
0.8	Sym	Sym	Sym	Sym	Sym	Asym	Asym	Asym	Fixed	Fixed	Fixed
0.9	Sym	Sym	Sym	Sym	Asym	Asym	Asym	Fixed	Fixed	Fixed	Fixed
1.0	Sym	Sym	Sym	Sym	Asym	Asym	Fixed	Fixed	Fixed	Fixed	Fixed
	Panel B: Manager										
-0.5	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.4	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.3	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.2	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
-0.1	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.0	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.1	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.2	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
0.3	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Sym
0.4	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Sym	Sym
0.5	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Sym	Sym	Sym
0.6	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Sym	Sym	Sym	Sym
0.7	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Sym	Sym	Sym	Sym	Sym
0.8	Fixed	Fixed	Fixed	Fixed	Fixed	Sym	Sym	Sym	Sym	Sym	Sym
0.9	Fixed	Fixed	Fixed	Fixed	Fixed	Sym	Sym	Sym	Sym	Sym	Sym
1.0	Fixed	Fixed	Fixed	Fixed	Sym	Sym	Sym	Sym	Sym	Sym	Sym