# A Loss Aversion Performance Measure

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## Abstract

The purpose of this paper is to propose an innovative method of evaluating the performance of active fund managers, by introducing to the field of performance measurement the more appealing loss aversion utility theory. We combine the latter to an already established performance measure developed by Grinblatt and Titman (1989), to construct a new and improved method of performance evaluation and then apply it for two distinct risk preference scenarios. The new methodology is used to evaluate the performance of a sample of UK pension funds over a 10-year period using the Knight, Satchell and Tran (1995) family of distributions for the excess returns. The results vary depending on the assumption of risk preferences: the results obtained in the first scenario are controversial, whereas for the second scenario, the new measure does seem to pick up on the timing skills exhibited by active fund managers and then reward them accordingly.



**JEL** classification: C16, C20, C61, G11, G23

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## 1. Introduction

The quest for active portfolio managers that can deliver abnormal excess returns and beat a specified benchmark has been crucial for the portfolio management industry.

Indeed, finding an accurate and reliable measure that is able to assess and compare the performance of various fund managers has been stimulating the finance literature for a long period.

Since the tremendous growth that the mutual and pension fund industry experienced –in the U.S. for example over 5.5 trillion dollars are currently managed by the mutual fund industry, with roughly 3 trillion dollars managed in equity funds (Chen et al., 2000) - there has been a lot of attention directed towards portfolio performance measurement. On the one hand, investors sought a method that could value the service rendered by active management and justify the fees and expenses they were paying. On the other hand, fund managers wanted to illustrate the importance of their role and justify why one should use active, rather than passive, strategies.

Academic studies found this subject fascinating and tried to devise diverse methods to tackle the number of issues at stake: measuring any abnormal performance and assessing the superior ability of fund managers[1], examining whether there is any persistence in the performance of the actively managed funds[2] and finally constructing appropriate benchmarks that allow a genuine comparison of active versus passive management[3]. The importance of these issues lies in the fact that it is also a test of the efficient market hypothesis: managers making abnormal returns contradict this crucial hypothesis.

Indeed, from the Jensen measure (Jensen 1968,1969) to the more recent and elaborate measures, the literature has offered fund managers and investment consultants a wide range of assessment methods[4] to choose from. These measures aim at evaluating the overall performance of a fund as well as its manager's specific talents, whether his timing or selection abilities.

This article's contribution to this field is to propose a new method of performance evaluation that combines the widely acceptable and very intuitive loss aversion theory (Fishburn and Kochenberg (1979), Kahneman

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[1] Blake, Lehmann and Timermann (1999), Carhart (1997), Chen et al. (2000), Grinblatt and Titman (1989a,1993,1994), Gruber (1996), Jegadeesh and Titman (1993), Sharpe (1992)…

[2] Christopherson and Turner (1991), Hendricks et al. (1993), Elton et al. (1996), Grinblatt and Titman (1992)…

[3] Grinblatt and Titman (1988), Lehmann and Modest (1987)…

[4] Treynor (1965), Treynor and Mazuy (1966), Sharpe (1966), Henriksson and Merton (1981), Admati et al. (1986), Grinblatt and Titman (1989b, 1993), Sharpe (1992), Elton,

and Tversky (1979,1992)) with an already established performance measure, the Positive Period Weighting Measure (Grinblatt and Titman, 1989b), in the aim of constructing an improved way of assessing the results of active fund managers. We apply our methodology to a cross-sectional study of the performance of 44 British pension fund managers and attempt to assess their contri-butions and answer the ultimate question: Are these managers actually capable of outperforming the benchmark?

The paper proceeds as follows. Section two discusses first the key concepts pertaining to the Positive Period Weighting Measure, hereafter PW measure, as developed by Grinblatt and Titman (1989b) and then presents the loss aversion utility function and its importance to the theory of utility representation. The third section examines our model in a more formal and detailed manner, and moves to a description of the methodology and assumptions behind the construction of the newly modified version of the PW measure, hereafter the LPW. Section four introduces the data available for analysis and attempts to study the cross-sectional performance of its fund managers by using five traditional measures as well as the PW measure performance evaluation using the power utility function, as applied by Grinblatt and Titman (1994). The results of a simple but quite effective two-beta model regression are also reported in this section in order to pick up any evidence of timing behaviour exhibited by the managers. Having analysed the data via the traditional means, section five applies the LPW to our sample of fund managers and analyses their performance for two different scenarios of risk preferences. Finally, this paper performs a comparison and

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Gruber and Blake (1996), Carhart (1997), Daniel et al. (1997), Blake, Lehmann and Timmermann (1999), Christopherson, Ferson and Turner (1999), Chen et al. (2000)…

study of these results, in the attempt to assess whether the new LPW measure does actually provide the analyst with an edge.

## 2. Theoretical Background

### *2.1 Our contribution*

In this study, we examine the concept of loss aversion, in the aim of providing the literature with an innovative method of assessing the performance of active fund managers.

The loss aversion utility function was developed as an alternative utility representation that captures better the decision making process of individuals when facing uncertainty. This theory has been proven to be a fairly accurate model of individual choice and many empirical studies have reported various evidence that support it. Much of this literature is reviewed in Fishburn and Kochenberger (1979). Combining it with the positive period weighting measure (PW) developed by Grinblatt and Titman (1989), we shall construct a new and improved method of performance evaluation.

### *2.2 The Positive Period Weighting Measure (PW)*

In response to the well documented timing related biases of the Jensen Measure[5], Grinblatt and Titman (1989) proposed a new measure, the Positive Period Weighting Measure (PW), defined to be a weighted sum of the period by period excess returns of the portfolio being evaluated, in the

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[5] Indeed, Jensen (1972) showed that the Jensen measure, due to the bias in its estimate of the systematic risk of a market timing strategy, could provide biased conclusions about market timers and assign them negative performance.

aim of overcoming these problems. Indeed, this measure possesses some very crucial advantages over any other performance measure: its data requirements are quite simple and it is not subject to any biases.

In their article, Grinblatt and Titman (1989) proved the PW measure to be very useful. Indeed, they showed that with the PW measure, an uninformed investor would generate zero performance while an informed investor, with selectivity and/or timing abilities, would generate positive performance if "the selectivity and timing information is independent and the investor is a positive market timer".

Moreover, the authors pointed out that "an interesting interpretation" of their measure would be to choose as weights the investor's marginal utilities. In this case, the PW would measure the incremental change in an investor's utility from adding "a small amount" of the evaluated portfolio's excess return to his "unconditionally optimal" portfolio. As a result, in a subsequent paper, Grinblatt and Titman (1994) implemented this notion, using for weights the marginal utilities of an investor with a power utility function. As a note, Grinblatt and Titman (1994)' results showed that the Jensen and Positive Period Weighting Measures were almost identical irrespective of the benchmark used. However, the authors attributed this to the fact that "most mutual funds fail to successfully time the market".

What this article proposes is to follow the methodology of the PW measure outlined by Grinblatt and Titman (1994) to assess fund performance, with one crucial difference. Instead of using the constraining and undesirable assumption of a power utility function, it suggests the use of the more academically satisfying and appealing assumption of a loss aversion utility function.

### 2.3 Loss aversion utility theory

Loss aversion utility theory was first developed by Fishburn and Kochenberger (1979) and Kahneman and Tversky (1979, 1992) and has since been used in a wide range of applications. It was put forward as an answer to the wide dissatisfaction with traditional expected utility theory, which was systematically criticised over recent years for not being an adequate representation of an individual's decision-making process when confronted with uncertainty. Indeed, Kahneman and Tversky (1979) discussed in their article major problems that traditional expected utility theory face, showing how the latter implied a behaviour that was inconsistent with empirical evidence that they had collected. As a response, the authors proposed an alternative utility theory, prospect theory, which overcame these shortcomings and was able to explain all the deviations from, and inconsistencies of, expected utility theory. Prospect theory proposed various important modifications to the utility theory, by first recognising that "the carriers of value are gains and losses, not final assets" (Tversky and Kahneman, 1992), meaning that individuals value more changes in wealth than the final outcomes and second by devising a nonlinear transformation of the probabilities to be used as "decision weights". However, one of the most crucial products of the prospect theory was picking up on the existence of the most intuitive notion of loss aversion.

Loss aversion theory stems from the observation that investors are more sensitive to losses than to gains and reflects this asymmetry between losses and gains by presenting a utility function that is "concave for gains, convex for losses and steeper for losses than for gains" (Kahneman and Tversky, 1992). Indeed, as Shalev (2000) points out, many empirical studies[6], whether in the domain of economic or psychology, have provided evidence of this behaviour: it was evident that "people are more motivated to minimise losses than they are motivated to maximise gains". This model of utility representation was crucial in helping to solve many of the problems encountered by traditional expected utility theory, such as the major "equity premium puzzle" pointed out by Mehra and Prescott (1985) that is the tendency to overinvest in equity if we assume power utility.

Loss aversion utility function used in most of the literature, including this article, is based on the first two-piece utility representation of individual preferences, which was developed by Fishburn and Kochenberger (1979). Indeed, having noted this separation between gains and losses, Fishburn and Kochenberger (1979) made of use of this discovery to empirically analyse the individual's utility reactions to various cases of changes in wealth. Their findings presented one of the first empirical evidences of the loss aversion behaviour, by reporting that the slope of the utility function for losses was on average five times steeper than the one for gains. The implications of these results to the actual loss aversion utility function are discussed in a more detailed manner in section five. A precise distinction however between the two piece Von-Neumann Morgenstern utility function and loss aversion depends on the role of the target rate that divides the "gains" from the "losses"; in expected utility theory, this is typically a fixed parameter, where as in loss aversion utility theory, it is variable dependent upon initial wealth and/or other factors.

Hwang and Satchell (2003) used this utility representation, combined with the previous discussion, to improve on the loss aversion theory by providing

[6] Thaler et al. (1997) and Gneezy and Potters (1997)…

a solution to the asset allocation problem faced with such a setting. Indeed, in their article, the authors derive a closed form expression, which can be easily used and applied, for the optimal position in equity for an investor who is characterised by a loss aversion utility function and a one period world.

As mentioned previously, this study makes use of all the above intuitive and theoretically appealing theories and combines them with the field of performance measurement, attempting to construct a new method of evaluating the skills of active fund managers that is more consistent with individual preferences and risk attitudes.

## 3. The model

### *3.1 The PW performance measure in more details*

We begin our discussion in this section by presenting a formal presentation of the Positive Period Weighting measure (PW) as developed by Grinblatt and Titman (1989). This measure, of which the Jensen Measure is shown to be a special case[7], is defined by the authors to be a weighted sum of the period by period excess returns of the portfolio being evaluated and is formulated as follows:

$$\alpha^{*} = \sum_{t=1}^{T} \tilde{w}_t \tilde{r}_{pt} \qquad (1)$$

such as:

[7] The authors show that the Jensen measure is a "period weighting measure" by setting the weights to be equal to $w_t = \frac{v_I - (r_{It} - r_I^{*})r_I^{*}}{Tv_I}$, where $\tilde{r}_{It}$ is the period $t$ excess return of the benchmark portfolio, $v_I$ is the maximum likelihood sample variance of $r_{I1},...,r_{IT}$ and $r_I^{*}$ the sample mean, and replacing them in equation (1) above.

$$\tilde{w}_t = w(\tilde{r}_{It}, T)$$

$$p\lim\left[\sum_{t=1}^{T} \tilde{w}_t \tilde{r}_{It}\right] = 0$$

$$\left|p\lim[Tw_t]\right| < \infty$$

$$\sum_{t=1}^{T} \tilde{w}_t = 1$$

$$\tilde{w}_t > 0, \quad t = 1, \ldots, T$$

where $\tilde{r}_{pt}$ is the period *t* excess return of the portfolio being evaluated and $\tilde{r}_{It}$ is the period *t* excess return on the efficient portfolio chosen as benchmark. Hence, to obtain this measure, one has to first choose a nonnegative vector of weights that has the property of making the weighted sum of the excess returns of the benchmark portfolio sum to 0 and then calculate the dot product of this vector and the vector of excess returns of the portfolio being evaluated. The performance scores, which result from this procedure, attribute to each fund a positive or negative performance, thus placing it as either an out- or an under-performer relative to the chosen benchmark.

It is evident that this measure, combined with an appropriate and meaningful vector of weights, presents the investor with a simple and appealing method of performance evaluation that is, most importantly, devoid of any biases that the traditional measures could be subject to. Consequently, in an attempt to capture these advantages and use this measure to construct a more accurate performance evaluation method, this study tries to add to it a vector of weight that is most representative of the investor's preferences and risk aversion. Indeed, instead of using, as Grinblatt and Titman (1994) did, the marginal utilities of a power utility function for the weight vector, this study proposes to combine the PW measure with a more appealing utility representation scheme, the loss aversion utility function.

### 3.2 *The optimal portfolio choice using Loss Aversion*

As Hwang and Satchell (2003) asserted, "dissatisfaction with power utility functions has been a re-occurring theme in modern financial economics". Indeed, power utility function has been subject to various criticisms on different levels in the recent years (Mehra and Prescott (1985) and Campbell and Viceira (1999)), a fact that motivated this article to search for a more satisfactory and realistic utility representation for investor preferences.

Indeed, being interested in the PW measure where marginal utilities are used as weights for assessing fund performance, this study sought however a different utility function to employ than the power utility function, the loss aversion utility function.

Given that $W$ is final wealth, $W_0$ initial wealth and $B$ the benchmark return, it is formulated as follows:

$$u(W-B)=\frac{(W-B)^{v_1}}{v_1},\ \ if \quad (W-B)\geq 0$$

$$=-\lambda\frac{[-(W-B)]^{v_2}}{v_2},\ \ if \quad (W-B)<0 \tag{2}$$

where the parameters $v_1, v_2$ and $\lambda$ are assumed positive.

Different values for $v_1, v_2$ and $\lambda$ can generate different representations of investor preferences. Indeed, as Hwang and Satchell (2003) note, if $0<v_1<1$ and $0<v_2<1$, then the investor would be risk averse with respect to gains and risk loving with respect to losses while it is the opposite case if $v_1$>1 and $v_2$>1.

Having introduced the loss aversion utility function, the next step is to make use of it to derive the utility optimal investment position, which for the purpose of this study is between the risk-free asset and the benchmark.

The final wealth can be written as:

$$W = W_0(1+r_f) + \theta W_0 y \tag{3}$$

where:

$\theta$ is defined to be the proportion of wealth held in equity

$y = r_B - r_f$ is the excess return on the index.

This implies that the gains are expressed as follows:

$$X = W - W_0(1+r_f) = W_0\theta y \tag{4}$$

Consequently, the first step toward deriving the expression for $\theta$ would entail solving the following maximisation problem:

$$\theta = \arg\max_{\theta}\{E(u(X)\}$$

where:

$$u(X) = \frac{X^{v_1}}{v_1},\ \ if \quad X > 0$$

$$= -\lambda\frac{(-X)^{v_2}}{v_2},\ \ if \quad X \leq 0$$

where the parameters $v_1, v_2$ and $\lambda$ are assumed positive.

Following Hwang and Satchell (2003), we obtain that:

$$\theta = \left(\frac{u^+ pW_0^{\ v_1-v_2}}{\lambda u^-(1-p)}\right)^{\frac{1}{v_2-v_1}} = \frac{1}{W_0}\left(\frac{u^+ p}{\lambda u^-(1-p)}\right)^{\frac{1}{v_2-v_1}}$$

(5)

where $u^+ = E[y^{v_1} \mid y > 0]$, $u^- = E[(-y)^{v_2} \mid y \le 0]$ and $p = prob(y > 0)$.

In order to evaluate the above expression for $\theta$, it is essential to attribute a distribution function to the excess returns. However, Hwang and Satchell (2003) realised that assuming that excess returns are normally distributed is very often not "appropriate", a claim which many papers have agreed upon and presented evidence for. For instance, using Fama and Macbeth (1973)'s results, Fama (1965) and Blume (1970) suggest that distributions of common stock returns are 'thick-tailed' relative to the normal distribution and probably conform better to nonnormal symmetric stable distributions than to the normal". As a result, Hwang and Satchell (2003) evaluated this expression for $\theta$ using instead of the normal distribution, the KST distribution.

In the aim of covering as well a more general aspect of this problem, this article also, in calculating the value for $\theta$, uses this broad family of distribution presented in Knight, Satchell and Tran (1995). The benefit behind using this distribution is that it also allows the model to "capture the fundamental asymmetry in upwards versus downwards returns…by using scale gamma distributions for the conditional distributions of positive and negative returns" (Knight et al, 1995).

The authors define their distribution as follows:

$$X_t = \mu + X_{1t}(1 - Z_t) - X_{2t} Z_t \qquad (6)$$

where

$X_t$ is in our case is equivalent to $y = r_I - r_B = R_I - R_B$, the excess returns at time *t*, with mean $\mu$ equal to 0 since in the expression for $\theta$, $u^+$ and $u^-$ are conditional on the excess returns y being ≥ or < 0 respectively,

$$Z_t = \begin{cases} 1 & \textit{with probability } p \\ 0 & \textit{with probability } 1-p, \end{cases}$$

and finally $X_{1t}$ and $X_{2t}$ are independent positive random variables with density function denoted as $f_1$ and $f_2$.

As mentioned before, in order to capture the asymmetric risk pertaining to excess returns, Knight et al. (1995) assumed the conditional distributions of positive and negative returns to be scale gamma distributions:

$$f_i(X_t, \alpha_i, \lambda_i) = \begin{cases} \dfrac{\lambda_1^{\alpha_1}}{\Gamma(\alpha_1)}(X_t-\mu)^{\alpha_1-1}\exp(-\lambda_1(X_t-\mu)) & \textit{if} \quad X_t \geq \mu \\ \dfrac{\lambda_2^{\alpha_2}}{\Gamma(\alpha_2)}(X_t-\mu)^{\alpha_2-1}\exp(-\lambda_2(X_t-\mu)) & \textit{if} \quad X_t < \mu \end{cases} \tag{7}$$

for $i = 1,2.$

Using the above expression, Hwang and Satchell (2003) obtain analytical results for the expression of $u^+$ and $u^-$:

$$u^+ = E(y^{v_1} \mid y > 0) = \int_0^\infty y^{v_1} f_1(y)dy = \frac{\Gamma(v_1+\alpha_1)}{\lambda_1^{v_1}\Gamma(\alpha_1)} \tag{8}$$

and

$$u^- = E((-y)^{v_2} \mid y \leq 0) = \int_0^\infty y^{v_2} f_2(y)dy = \frac{\Gamma(v_2+\alpha_2)}{\lambda_2^{v_2}\Gamma(\alpha_2)} \tag{9}$$

Replacing these results in the expression for $\theta$ gives a closed form solution for the optimal allocation of assets between the benchmark and the managed fund.

The final step needed to be able to calculate the optimal allocation of assets between the risk-free rate and the benchmark is the estimation of the KST parameters ($\alpha_1, \alpha_2, \lambda_1$ and $\lambda_2$) for the benchmark. This is done by maximum likelihood estimation.

Now that the expression for the optimal position in the benchmark has been derived, this article proceeds to finding the expression of the PW measure while using the above loss aversion utility function; this will result in a new modified measure that we will refer to henceforth as the LPW.

### *3.3 The framework behind the new performance measure (LPW)*

To construct this new LPW measure, this section combines the PW measure and the loss aversion function as presented in the previous two sections.

In doing so, we follow the five-step procedure outlined in the appendix of Grinblatt and Titman (1994), adapting it to this new setting. This model will only consider a world with two assets, a risk-free asset with return $r_f$ and the index fund with return $r_B$.

Now that the first step was completed in section 3.2 and the value of $\theta$ was determined, the time series of returns of the optimal portfolio is calculated, $\theta W_0(r_{Bt} - r_{ft})$, where for simplicity, the initial wealth is set at one for each observation.

Using the loss aversion utility function, the marginal utility of this wealth level can hence be calculated at time *t*:

$$
\begin{aligned}
U'_{LA}(X_t) &= X_t^{\nu_1 - 1} && \text{if } X_t > 0 \\
&= \lambda(-X_t)^{\nu_2 - 1} && \text{if } X_t \leq 0
\end{aligned}
\tag{9}
$$

where $X_t = \theta W_0(r_{Bt} - r_{ft})$.

In order to calculate the weight vector needed for the LPW measure, the above marginal utilities are rescaled so that they satisfy the condition that requires them to sum to one:

$$
w_t = \frac{U'_{LA}(X_t)}{\sum_t U'_{LA}(X_t)} = \frac{X_t^{\nu_1 - 1} I_t + \lambda(-X_t)^{\nu_2 - 1}(1 - I_t)}{\sum_t \left( X_t^{\nu_1 - 1} I_t + \lambda(-X_t)^{\nu_2 - 1}(1 - I_t) \right)} \tag{10}
$$

where:

$$I_t = \begin{cases} 1 & if \ X_t > 0 \\ 0 & if \ X_t \leq 0 \end{cases}$$

Then, as presented earlier, the LPW measure is computed as the dot product of the weight vector calculated above and the excess return vector of the portfolio being evaluated, i.e.,

$$LPW = \sum_t w_t R_{pt} \tag{11}$$

Having detailed the methodology behind the derivation of the newly modified performance measure, this article can now move to the empirical application of the results derived in the above sections. However, before doing that, the next section will introduce the data available to this study and then analyse its properties by evaluating the cross-sectional performance of the fund managers using conventional performance measures and by performing a simple two-beta regression model to obtain an indication of the fund managers' timing skills. This will help us understand better the results presented in section five, where the LPW measure is applied to the same data.

## 4. Preliminary analysis of the data

### *4.1 The data*

The data was obtained from Mercer and consists of quarterly net returns for 44 British pension fund managers for a 10-year period, starting in March 1990 and ending in September 1999. For the risk-free asset, the returns on the three-month UK Treasury bill were used. As for the benchmark, the Caps pooled median was considered as an adequate candidate.

*4.2 Preliminary measures*

To analyse and examine the data thoroughly, this section utilises five traditional measures, widely used in the empirical literature, to assess the performance of the fund managers, as well as the PW measure as developed and applied by Grinblatt and Titman (1989, 1994). The latter measure is the basis of the modified LPW measure that has been derived in section three and will help us understand even better the performance of our sample funds and later assess whether the modification did improve the performance evaluation process. We note here that since all the above measures are applied over the 40 quarters under consideration (March 1990 to March 1999), we set, in the next calculations, $T = 40$, and that the abnormal performance of a fund is calculated relative to the benchmark considered, i.e. the Caps pooled median.

The Jensen Measure, is calculated as the intercept $\alpha$ in the regression of the excess returns of the fund being evaluated against the benchmark excess returns, over the 40 quarters being considered in this study:

$$\tilde{R}_{pt} - R_{Ft} = \alpha_p + \beta_p[\tilde{R}_{Bt} - R_{Ft}] + \tilde{u}_{jt} \qquad t = 1,...,T \tag{12}$$

where $\tilde{R}_{pt}$ is the return on the fund being analysed and $\tilde{R}_{Bt}$ is the return on the bench-mark. The *t*-statistic reported for the Jensen alphas are the standard intercept *t*-statistic that result from the above regression.

The Treynor-Mazuy (1966) measure involves the following quadratic regression:

$$\tilde{R}_{pt} - R_{Ft} = \alpha_p + \beta_{1p}[\tilde{R}_{Bt} - R_{Ft}] + \beta_{2p}[\tilde{R}_{Bt} - R_{Ft}]^2 + \tilde{u}_{jt} \qquad t = 1,...,T \tag{13}$$

where, following Grinblatt and Titman (1994) presentation, $\alpha_p$ represents an estimate of the fund manager's selectivity abilities, $\beta_{2p} * \mathrm{var}(\tilde{R}_B)$ represents an estimate of the fund manager's timing abilities, and finally, the Treynor-Mazuy total performance measure is defined to be:

$$TM = \alpha_p + \beta_{2p} * \mathrm{var}(\tilde{R}_B) \tag{14}$$

The *t*-statistic for the Treynor-Mazuy total performance measure is slightly more complex than the rest of the measures. Grinblatt and Titman (1994) define it as being a test statistic with a *t*-distribution with *T-K-1* degrees of freedom, where *T* is the number of returns and *K* the number of benchmarks used. It is computed as being the ratio of the Treynor-Mazuy total performance measure over its standard error, $TM/s(TM)$, where $s(TM) = \sqrt{q'Vq}$, $V = s^2(e)\,(X'X)^{-1}$, $s(e)$ is the standard error of the Jensen regression for the fund being evaluated and *X* is the $T \times 3$ matrix of regressors in the quadratic regression defined above. Hence, *V* is the variance-covariance matrix of the coefficients in this quadratic regression, conditional on the benchmark excess returns and $q'$ is the following $3 \times 1$ vector: $\begin{pmatrix}1 & 0 & \mathrm{var}(\tilde{R}_B)\end{pmatrix}$.

The Sharpe ratio or the reward-to-risk ratio is the ratio of a fund's excess return, here relative to the benchmark being used, to the standard deviation of this fund's return. It is hence a measure of "risk bearing" where the risk is measured by the standard deviation of the returns on the particular fund being analysed. It is thus computed as follows:

$$SR_p = \mu_p / \sigma_p \tag{15}$$

where:

$\mu_p$ is the expected excess arithmetic return on fund $p$ over the 40 quarters in the sample i.e. $\mu_p = \sum_{t=1}^{t=40} (\tilde{R}_{pt} - \tilde{R}_{Caps\,t}) \big/ T$

$\sigma_p$ is the standard deviation of the returns of fund $p$ i.e. $\sigma_p = \sqrt{\sum_{t=1}^{t=40} (\tilde{R}_{pt} - \overline{R}_p)^2 \big/ (T-1)}$.

The Sortino ratio relies on the same concept as the Sharpe ratio, the difference being that it uses as a measure of risk of the fund's volatility the square root of the semi-variance of the fund returns. It is formulated as follows:

$$T_i = \mu_i \big/ \sqrt{SV_i} \tag{16}$$

where:

$$SV_i = \frac{1}{T} \sum_{t=1}^{t=40} [\min(R_{it} - R_{f\,t}, 0)]^2 \tag{17}$$

$$\mu_i = \sum_{t=1}^{t=40} (\tilde{R}_{it} - \tilde{R}_{Caps\,t}) \big/ T \tag{18}$$

Finally, the information ration (IR) for each fund is calculated as follows:

$$\text{Information ratio} = \frac{Annualised\ Excess\ Returns}{Annualised\ Tracking\ Error} \tag{19}$$

where:

Annualised Tracking error

$$= 100 * \sqrt{4} * \sqrt{\frac{1}{T-1}\left( \sum_{t=1}^{T} (R_{it} - R_{Caps\,t})^2 - \left( \frac{1}{T} \left( \sum_{t=1}^{T} (R_{it} - R_{Caps\,t}) \right)^2 \right) \right)} \tag{20}$$

And

$$\text{Annualised excess return} = \left( \sum_{t=1}^{T} (R_{it} - R_{Caps\,t}) \Big/ T \right) * 100 * 4 \qquad (21)$$

$T$ is the number of quarters and $er_{it} = R_{it} - R_{Caps\,t}$ stands for excess returns of fund $i$ in quarter *t*.

The last measure to be used in this section to evaluate the performance of our sample of funds is the PW, following Grinblatt and Titman (1994)'s methodology as outlined in their paper's appendix. Indeed, in their article, GT assume that the investor possesses a power utility function, $u(X) = -(X)^{-v}$, and hence they set the weights in the PW calculations[8] to be equal to the marginal utilities of an investor possessing such a utility representation.

The only difference in our application of their methodology is that this paper first sets the optimal combination between the risk free asset and the benchmark to be equal to 0.75, assuming that the choice of a 75% investment level in the risky asset is a plausible estimation of the actual level in the UK market, and then solve the following minimisation problem: Finding the value of $v$ that minimise the weighted sum of the excess returns of the benchmark portfolio $\sum_{t=1}^{T} \tilde{w}_t \tilde{r}_{B\,t}$ [9] subject to the condition that $\theta = 0.75$. The solution of the above minimisation problem yield the following value for the risk-aversion parameter for the power utility function, $v$ = 5.6247, while the resulting figure for the weighted sum of the excess benchmark returns over the period under consideration $\sum_{t=1}^{T} \tilde{w}_t \tilde{r}_{B\,t}$ is extremely negligible, being equal to $8.0551 \times 10^{-9}$.

[8] Refer to section *3.1* for the discussion of the PW measure as developed by GT(1989).

Having introduced the six performances measures to be used in this section as well as the intuition behind them, the results obtained from applying them to assess the performance of the 44 active UK fund managers over the 10-year sample period and their descriptive statistics are exposed in table 1 and 2 respectively.

TABLE 1
Preliminary performance measures applied to the 44 UK active fund managers over the 10-year sample period

| | PW (power utility) | Jensen Measure | T-M Measure | Sharpe Ratio | Sortino Ratio | Inform. Ratio |
|---|---|---|---|---|---|---|
| Abn Amro | **1.6287** | **1.5876** | **1.5732** | **0.1753** | **0.8375** | **0.5513** |
| | (1.4155) | (1.3898) | (1.3769) | | | |
| Aegon | **0.0996** | **0.0534** | **0.0467** | **-0.0136** | **-0.0952** | **-0.1374** |
| | (0.4128) | (0.2229) | (0.1947) | | | |
| Axa Sun Life | **-0.0343** | **-0.0705** | **-0.0745** | **-0.0041** | **-0.0398** | **-0.0564** |
| | (-0.8026) | (-1.1777) | (-0.3679) | | | |
| Britannic Inv. Managers | **0.2627** | **0.3125** | **0.3199** | **0.0618** | **0.8083** | **0.7118** |
| | (1.1387) | (1.3649) | (1.3966) | | | |
| Cazenove Concentrated | **0.7589** | **0.7498** | **0.7463** | **0.0491** | **0.2465** | **0.2520** |
| | (1.7262) | (1.7173) | (1.7094) | | | |
| Clerical Medical | **0.2221** | **0.1947** | **0.1894** | **0.0285** | **0.4210** | **0.3766** |
| | (1.1018) | (0.9725) | (0.9462) | | | |
| Colonial | **-0.4401** | **-0.3621** | **-0.3512** | **-0.0430** | **-0.2598** | **-0.4377** |
| | (-1.6657) | (-1.3805) | (-1.3387) | | | |
| Deutsche | **0.6896** | **0.6432** | **0.6368** | **0.0822** | **0.8273** | **0.7427** |
| | (2.3432) | (2.2012) | (2.1787) | | | |
| Dresdner RCM | **0.1127** | **0.0594** | **0.0530** | **0.0338** | **0.2503** | **0.2188** |
| | (0.2543) | (0.1351) | (0.1203) | | | |
| Equitable High Income | **-0.5785** | **-0.5461** | **-0.5387** | **-0.0794** | **-0.2513** | **-0.4451** |
| | (-1.1918) | (-1.1332) | (-1.1176) | | | |
| Equitable Pelican | **-0.5667** | **-0.5963** | **-0.5982** | **-0.0645** | **-0.3237** | **-0.6323** |
| | (-2.0449) | (-2.1668) | (-2.1737) | | | |
| Equitable Spec. Sits. | **-2.0626** | **-2.0935** | **-2.0968** | **-0.2461** | **-0.4287** | **-0.8417** |
| | (-2.2767) | (-2.3274) | (-2.3306) | | | |
| Friends I&S Stewardship | **0.5765** | **0.6024** | **0.6077** | **-0.0054** | **-0.0125** | **-0.0192** |
| | (0.9346) | (0.9836) | (0.9921) | | | |
| Friends Ivory & Sime | **0.3201** | **0.2550** | **0.2440** | **0.0505** | **0.7202** | **0.5181** |
| | (1.2099) | (0.9708) | (0.9287) | | | |
| Friendsivory&Sime (FP) | **0.1713** | **0.1888** | **0.1884** | **0.0220** | **0.1399** | **0.1541** |
| | (0.4437) | (0.4924) | (0.4914) | | | |
| Friendsivory&Sime (I&S) | **0.1293** | **0.1808** | **0.1888** | **0.0301** | **0.2013** | **0.2293** |
| | (0.3567) | (0.5023) | (0.5245) | | | |

[9] Where $w_t = U'_{LA}(X_t) \Big/ \Sigma_t U'_{LA}(X_t) = vX_t^{-v-1} \Big/ \Sigma_t \left( vX_t^{-v-1} \right)$

| | | | | | | |
|---|---|---|---|---|---|---|
| Gartmore | **0.5143** | **0.4446** | **0.4329** | **0.0380** | **0.2301** | **0.2593** |
| | (1.3824) | (1.2034) | (1.1716) | | | |
| Gartmore/Natwest Index | **0.1096** | **0.1077** | **0.1080** | **0.0166** | **0.4385** | **0.4984** |
| | (1.2570) | (1.2432) | (1.2470) | | | |
| Govett | **0.0750** | **0.1261** | **0.1316** | **0.0010** | **0.0040** | **0.0062** |
| | (0.1766) | (0.2993) | (0.3122) | | | |
| Guardian | **-1.1028** | **-1.0129** | **-0.9983** | **-0.0273** | **-0.1071** | **-0.1747** |
| | (-2.6704) | (-2.4704) | (-2.4342) | | | |
| Henderson | **0.2152** | **0.2171** | **0.2189** | **0.0133** | **0.1199** | **0.1595** |
| | (1.0451) | (1.0624) | (1.0708) | | | |
| Hill Samuel | **0.0929** | **0.0470** | **0.0385** | **-0.0137** | **-0.1362** | **-0.1980** |
| | (0.5745) | (0.2925) | (0.2397) | | | |
| INVESCO | **0.1001** | **0.0947** | **0.0945** | **0.0144** | **0.3406** | **0.4120** |
| | (1.0934) | (1.0430) | (1.0404) | | | |
| Invesco UK Core | **-0.4477** | **-0.4577** | **-0.4579** | **-0.0382** | **-0.1388** | **-0.2203** |
| | (-0.8926) | (-0.9193) | (-0.9193) | | | |

TABLE 1 (continued)

| | PW (power utility) | Jensen Measure | T-M Measure | Sharpe Ratio | Sortino Ratio | Inform. Ratio |
|---|---|---|---|---|---|---|
| KQEP Enhanced | **0.3406** | **0.3355** | **0.3345** | **0.0495** | **1.6502** | **0.9127** |
| | (2.3714) | (2.3523) | (2.3452) | | | |
| Legal & General i | **0.0994** | **0.0977** | **0.0979** | **0.0176** | **0.4776** | **0.5366** |
| | (1.1628) | (1.1508) | (1.1536) | | | |
| Legal & General p | **0.0868** | **0.0999** | **0.1018** | **0.0207** | **0.4488** | **0.4896** |
| | (0.7881) | (0.9136) | (0.9310) | | | |
| London Life | **-0.1134** | **-0.1759** | **-0.1865** | **-0.0296** | **-0.2073** | **-0.3351** |
| | (-0.4922) | (-0.7693) | (-0.8153) | | | |
| Martin Currie UK Growth | **-0.1807** | **-0.0446** | **-0.0280** | **0.0015** | **0.0059** | **0.0084** |
| | (-0.3478) | (-0.0865) | (-0.0543) | | | |
| Merrill Lynch Balanced | **0.1905** | **0.1944** | **0.1949** | **0.0103** | **0.0794** | **0.1070** |
| | (0.7872) | (0.8090) | (0.8110) | | | |
| Morley (was CU) | **-0.2019** | **-0.1409** | **-0.1305** | **-0.0265** | **-0.1940** | **-0.3299** |
| | (-0.9748) | (-0.6853) | (-0.6347) | | | |
| Morley (was GA) | **0.0636** | **0.0280** | **0.0234** | **-0.0287** | **-0.2100** | **-0.3406** |
| | (0.3530) | (0.1568) | (0.1308) | | | |
| Morley PP (Was NU) | **0.0724** | **0.0096** | **0.0002** | **0.0188** | **0.2936** | **0.2171** |
| | (0.3106) | (0.0413) | (0.0007) | | | |
| National Mutual Life | **-0.1778** | **-0.1494** | **-0.1453** | **-0.0127** | **-0.0886** | **-0.1233** |
| | (-0.6380) | (-0.5400) | (-0.5252) | | | |
| Northern Trust | **-0.0181** | **0.0118** | **0.0172** | **0.0083** | **0.0412** | **0.0565** |
| | (-0.0444) | (0.0292) | (0.0427) | | | |
| Prudential M&G | **0.0808** | **0.1338** | **0.1419** | **0.0018** | **0.0170** | **0.0252** |
| | (0.4671) | (0.7790) | (0.8260) | | | |
| Royal Sunalliance | **0.0902** | **0.0635** | **0.0588** | **0.0143** | **0.1445** | **0.1444** |
| | (0.3387) | (0.0635) | (0.0588) | | | |
| Scottish Life | **-0.0991** | **-0.1042** | **-0.1052** | **-0.0108** | **-0.1524** | **-0.2108** |
| | (-0.7358) | (-0.7791) | (-0.7864) | | | |
| SLC Asset Management | **-0.1312** | **-0.1664** | **-0.1718** | **-0.0285** | **-0.2255** | **-0.3834** |
| | (-0.6823) | (-0.8714) | (-0.8995) | | | |
| Standard Life | **0.2037** | **0.2079** | **0.2087** | **0.0072** | **0.0788** | **0.1091** |
| | (1.3501) | (1.3882) | (1.3932) | | | |
| Swiss Life | **0.7583** | **0.6742** | **0.6606** | **0.1042** | **0.7231** | **0.5197** |
| | (1.2485) | (1.1180) | (1.0953) | | | |
| Swiss Life Index | **0.1749** | **0.1363** | **0.1317** | **-0.0128** | **-0.0913** | **-0.1301** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (1.0505) | (0.6234) | (0.7964) | | | |
| Winterthur Life | **-0.8206** | **-0.8287** | **-0.8276** | **-0.0716** | **-0.3181** | **-0.5890** |
| | (-2.4354) | (-2.4764) | (-2.4733) | | | |
| Zurich Scudder | **0.1634** | **0.1581** | **0.1570** | **0.0195** | **0.1977** | **0.2530** |
| | (0.8030) | (0.7826) | (0.7767) | | | |

Examining the results and their statistics, we can see that there is no strong evidence of abnormal performance exhibited by our sample of funds in the 10-year period considered. In fact, for the six measures considered, out of the 44 funds, only one-quarter (i.e. 11 funds) exhibit statistically significant results at the 10% significance level, with five funds significantly underperforming the benchmark and just six significantly outperforming it. For a more thorough analysis of the obtained performance scores, we will consider next the individual results as exhibited by each of the measure considered with one exception only: the results in tables 1 and 2 show that the Jensen and the Treynor-Mazuy measure give out the same inferences on the abnormal performance of the various funds and have extremely similar statistics. Consequently, we will just present an analysis of the former measure.

TABLE 2
The descriptive statistics of the performance results presented in table 1

| | PW | Jensen Measure | T-M Measure | Sharpe Ratio | Sortino Ratio | Inform. Ratio |
|---|---|---|---|---|---|---|
| Mean | 0.0324 | 0.0288 | 0.0281 | 0.0030 | 0.1469 | 0.0651 |
| Standard Error | 0.0824 | 0.0807 | 0.0804 | 0.0089 | 0.0607 | 0.0592 |
| Standard Deviation | 0.5463 | 0.5354 | 0.5330 | 0.0592 | 0.4028 | 0.3924 |
| Sample Variance | 0.2985 | 0.2866 | 0.2841 | 0.0035 | 0.1622 | 0.1540 |
| Excess Kurtosis | 4.8094 | 5.4021 | 5.4916 | 6.7103 | 2.7447 | -0.4307 |
| Skewness | -0.9367 | -1.0632 | -1.0923 | -1.1106 | 1.4312 | -0.0575 |
| Range | 3.6912 | 3.6811 | 3.6699 | 0.4214 | 2.0789 | 1.7543 |
| Count | 44 | 44 | 44 | 44 | 44 | 44 |
| | | | | | | |
| Minimum value | -2.0626 | -2.0935 | -2.0968 | -0.2461 | -0.4287 | -0.8417 |
| 1st quartile | -0.1178 | -0.1134 | -0.1115 | -0.0169 | -0.1368 | -0.2012 |
| Median | 0.0961 | 0.0962 | 0.0962 | 0.0078 | 0.0600 | 0.08175 |
| 3rd quartile | 0.2065 | 0.1980 | 0.1984 | 0.0236 | 0.3053 | 0.2886 |
| Maximum | 1.6287 | 1.5876 | 1.5732 | 0.1753 | 1.6502 | 0.9127 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Jarque-Bera Statistic | 48.8400 | 61.7921 | 64.0388 | 91.5975 | 28.8328 | 0.3644 |
| Probability | 0.0000 | 0.0000 | 0.0000 | 0.000000 | 0.000000 | 0.8334 |

According to the Jensen measure, the average abnormal performance of the 44 funds under consideration over the 10-year period is quite negligible. Indeed, the mean performance value is equal to 0.0288% and lies in the second quartile, denoting a low level of abnormal performance. This is accentuated by the fact that the results are shown to be negatively skewed as reported in table 2; the bottom 50% of the funds exhibit performance scores covering a range of 1.9801%, while the top 50%'s range is 1.3896%. Moreover, the interquartile range is equal to 0.3114%, ranging from -0.1134 to 0.1980%, a very low level of performance for 50% of the funds. As mentioned earlier, the Treynor-Mazuy performance measure does report extremely similar results.

As conveyed by the first two measures, the Sharpe ratio also does not find strong evidence of positive abnormal performance by our sample of funds. Indeed, the mean value is merely equal to 0.0030% and lies in the second quartile. The median is also very low, at 0.0778%. It is also very worth noting the narrowness of the second and third quartile. Indeed, the interquartile range is merely equal to 0.0405% and thus, 50% of the funds are being very negligibly rewarded for the risk they are incurring. Even when examining the top quartile, one can see that the results are not very high, varying from 0.0236 to 0.1175% with the range being 0.0939; while if one studies the bottom quartile, the results turn out to be quite low, varying from –0.0169 to –0.2461%, with a range equal to 0.2292. These findings confirm the results reported by the first two performance measures, by indicating that there is no evidence of strong positive abnormal performance and that the underperformance of the funds relative to the benchmark is on a higher level than the outperformance. Indeed, here also, the results are reported to be negatively skewed.

Moving to the Sortino ratio, the results seem to be indicating a better performance than the one reported by the previous three measures: the mean performance is at a higher level, at 0.1469%, and lies in the third quartile. In addition, the results are positively skewed as one can see in table 2; in fact, the top quartile varies from 0.3053 to 1.6502% (with a range equal 1.3449) while the bottom quartile varies from –0.1368 to –0.4287% (the range being 0.2919). Hence, when we considered only downside risk in performance evaluation, the funds' performance improved.

As for the information ratio, it presents nearly symmetrical results. Indeed, according to the Jarque-Bera statistic, the information ratio performance results have a normal distribution with mean equal to 0.0651 and a variance equal to 0.1539 and hence, they are nearly half-split between positive and negative abnormal performance, ranging for -0.8417% to 0.9127. As a result, for half of the funds, the tilts away from the benchmark were successful and positively rewarded; while for the other half, they generated negative abnormal performance. Hence, according to the information ratio, the top quartile of fund managers does seem to possess some skills in managing money.

Finally, the results obtained form applying the PW measure to our sample of fund managers seem to agree with the findings of the conventional measures: There is no strong evidence of abnormal performance. Indeed, the results range from –2.0626 to 1.6287% and the median fund exhibit a very small abnormal performance equal to 0.0961%. The mean of the performance measures lie in the second quartile, at the very low level of

0.0324%, which indicates that on average the funds did not outperform the benchmark by any significant level. To understand better the distribution of these results, we examine first the second and third quartile range: they are respectively 0.2139% and 0.1104%. Thus, the magnitude of underperformance around the centre of the results is higher than the magnitude of outperformance. This is also evident when looking at the results of the two extreme quartiles, where the top 25% of funds beat the benchmark by a margin ranging from 0.2065% to 1.6287% - the array hence being 1.4222% - while the bottom 25% of funds underperformed the benchmark from –0.1178% to –2.0626% - the range being equal to 1.9448%. This is confirmed in table 2 where the performance results given by the PW measure are reported to be negatively skewed. It is worth noting here however that the significant results reported by the PW measure occurred at the two extremes tails of the distribution. On the one hand, the five funds that significantly underperformed lie at the end of the first quartile, ranging from Colonial at –0.4401% to Equitable Spec. Sits at –2.0626%; on the other hand, from the six funds that showed significant signs of abnormal performance, five lie at the end of the top quartile, ranging from KQEP Enhanced at 0.3406% to Abn Amro at 1.6287%. Comparing these results with the mean, 0.0324%, and the median, 0.0961%, these values are quite extreme. This finding combined with the high level of excess kurtosis reported in table 2 indicates that the probability of obtaining an extreme fund, either a winner or a looser, could be fairly high.

Hence overall, according to the preliminary measures studied in this section, the funds do not exhibit convincing signs of abnormal performance. The average abnormal performance of all funds is reported to be extremely low, nearly equal to 0, the only exception being the average performance reported by the Sortino ratio. Moreover, with all the measures considered, only six out of the 44 funds actually exhibit significantly positive abnormal performance. However, to understand better the relation between the performance results reported by the six different performance measures, this study analyses and compares them in the aim of finding whether they are really picking up the same information and hence actually giving out identical inferences.

Comparing the top and bottom quartiles of funds, we find that the measures are split in two groups. On one hand, the Sortino ratio and the Information ratio seem to agree highly by having 11 out of 11 funds in common in both quartiles, with only slightly different rankings. The PW measure, the Jensen measure and the Sharpe ratio on the other hand present similar result by having at least 9 funds in common between them. However, it is worth noting that in the case of the bottom 25% of funds, all the performance measures seem to agree more and the above two groups have eight to ten fund in common. Consequently, one can already say that the Jensen measure, the Sharpe ratio and the PW measure seem to present the same performance evaluation of the funds, which is somewhat slightly different than the inferences given by the Sortino and the Information ratios that tend to converge more. To see this more clearly, this study analyses next the correlations between the various measures, which are presented in the following table:

TABLE 3

The correlations between abnormal performance as measured by the six different performance measures

| | PW measure | Jensen measure | TM measure | Sharpe ratio | Sortino ratio | Information ratio |
|---|---|---|---|---|---|---|
| PW measure | 1 | | | | | |
| Jensen measure | 0.9965 | 1 | | | | |
| T-Mazuy measure | 0.9953 | 0.9999 | 1 | | | |
| Sharpe ratio | 0.9204 | 0.9257 | 0.9258 | 1 | | |
| Sortino ratio | 0.6216 | 0.6178 | 0.6168 | 0.7342 | 1 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Information ratio | 0.7196 | 0.7235 | 0.7238 | 0.8263 | 0.9290 | 1 |

Examining closely the results in table 3, we notice that the correlations between the first four measures are extremely high, all exceeding 0.9. Indeed, the Jensen and the Treynor-Mazuy measure are characterised by the highest correlation level which is nearly perfect, at 0.9999, making it evident that they capture the same information and hence give out the same inferences on the abnormal performance of the various funds. In addition, the PW measure's correlation with these two measures is also extremely high, of the order of 0.99, while the Sharpe ratio's correlation with each of the three mentioned measures is around 0.92. Consequently, these four measures yield very similar conclusions and do not seem to offer the investor an edge, as they seem to be picking up similar information. However, the last two measures, the Sortino and the Information ratio, which are highly correlated (0.9290), seem to present different results than the former four measures. Indeed, both of them exhibit relatively low correlations with each of the first four measures. This might be due to the fact that both of them do portray the risk of the portfolio in a very precise and different manner. For the Sortino ratio, the fund's downside risk is the most important and is the only one considered in evaluating the fund's performance while for the Information ratio, it is the tracking error, which represents the risk of deviating from the benchmark, that is the most relevant: is the manager's tilts away from the benchmark successful in generating excess returns?

The next section adds to this a thorough analysis of the data at hand by applying to it a fairly simple but quite indicative two-beta regression model, in the aim of better understanding the behaviour exhibited by of our sample of active fund managers.

## *4.3 The two-beta regression model*

To analyse and understand better the performance of the fund managers, this section applies a fairly simple model to the data in the aim of detecting whether the funds under study were actually timing the market during the sample period. The method employed here consists of constructing a two-beta model, one for when the market is up and one for when it is down, that captures the relationship between each fund's excess returns and the market portfolio return in these both setting. This model attempts to detect any market timing behaviour exhibited by the funds, since if the respective managers were actually timing the market during that particular period, one would expect the two betas to be highly significant. A high beta when the market is up and a low beta when the market is down would reflect a fund manager who had superior information and was able to capitalise on it to successfully time the market.

The regression model is as follows:

$$(R_{it} - R_{ft}) = \alpha + \beta_u R^{+}_{Mt} + \beta_d R^{-}_{Mt} + error\,, \quad i = 1,2 \text{ and } t = 1,\ldots,T \tag{22}$$

where

$$R^{+}_{Mt} = \max(0, R_{Mt} - R_{ft})$$

$$R^{-}_{Mt} = \min(0, R_{Mt} - R_{ft})$$

and

$R_{Mt}$ is the return on the market portfolio, here being the FT all share.

The results of the above model are presented in table 4, and examining them, we do not pick up strong indication of any timing skills exhibited by the fund managers in our sample. In fact, it seems that the majority of the funds have been mainly following the market very closely over our sample period, in its both up and down states, and thus have not been exhibiting any timing behaviour. To see this more clearly, the descriptive statistics of the regression coefficients are presented later in table 5.

TABLE 4
The two-beta model regression for the 44 funds under study

| | $\alpha$ | $\beta u$ | $\beta d$ | | $\alpha$ | $\beta u$ | $\beta d$ | | $\alpha$ | $\beta u$ | $\beta d$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Abn Amro** | | | | **Friendsivory&Sime (I&S)** | | | | **Morley (was CU)** | | | |
| Estimate | 1.0427 | 1.1102 | 0.9399 | Estimate | 0.6820 | 0.9222 | 1.1163 | Estimate | 0.4973 | 0.8684 | 1.1088 |
| Standard Error | 1.8847 | 0.2459 | 0.3156 | Standard Error | 0.5849 | 0.0763 | 0.0980 | Standard Error | 0.2964 | 0.0387 | 0.0496 |
| t-value | 0.5532 | 4.5158 | 2.9777 | t-value | 1.1660 | 12.0868 | 11.3955 | t-value | 1.6780 | 22.4610 | 22.3403 |
| **Aegon** | | | | **Gartmore** | | | | **Morley (was GA)** | | | |
| Estimate | -0.3194 | 0.9754 | 0.8831 | Estimate | -0.3238 | 1.0210 | 0.7897 | Estimate | -0.4066 | 0.9593 | 0.8458 |
| Standard Error | 0.3809 | 0.0497 | 0.0638 | Standard Error | 0.6312 | 0.0823 | 0.1057 | Standard Error | 0.2798 | 0.0365 | 0.0469 |
| t-value | -0.8386 | 19.6340 | 13.8458 | t-value | -0.5129 | 12.3988 | 7.4703 | t-value | -1.4532 | 26.2824 | 18.0506 |
| **AXA Sun Life** | | | | **Gartmore/Natwest Index** | | | | **Morley PP (Was NU)** | | | |
| Estimate | -0.4588 | 1.0381 | 0.9417 | Estimate | 0.0215 | 0.9919 | 0.9976 | Estimate | -0.6594 | 1.1081 | 0.9196 |
| Standard Error | 0.3167 | 0.0413 | 0.0530 | Standard Error | 0.0539 | 0.0070 | 0.0090 | Standard Error | 0.3762 | 0.0491 | 0.0630 |
| t-value | -1.4487 | 25.1308 | 17.7578 | t-value | 0.3983 | 141.0599 | 110.5092 | t-value | -1.7527 | 22.5793 | 14.5954 |
| **Britannic** | | | | **Govett** | | | | **National Mutual Life** | | | |
| Estimate | 0.7723 | 0.9688 | 1.1504 | Estimate | 0.3537 | 0.9050 | 1.0110 | Estimate | -0.0251 | 0.9730 | 1.0469 |
| Standard Error | 0.3866 | 0.0504 | 0.0647 | Standard Error | 0.6661 | 0.0869 | 0.1116 | Standard Error | 0.4340 | 0.0566 | 0.7268 |
| t-value | 1.9978 | 19.2115 | 17.7701 | t-value | 0.5310 | 10.4152 | 9.0635 | t-value | -0.0578 | 17.1871 | 14.4041 |
| **Cazenove Con.** | | | | **Guardian** | | | | **Norhtern Trust** | | | |
| Estimate | 0.3734 | 0.8878 | 0.7796 | Estimate | -0.2543 | 1.1087 | 1.3953 | Estimate | 0.2985 | 0.9459 | 1.0615 |
| Standard Error | 0.7555 | 0.0985 | 0.1265 | Standard Error | 0.6482 | 0.0846 | 0.1086 | Standard Error | 0.7110 | 0.0928 | 0.1191 |
| t-value | 0.4943 | 9.0091 | 6.1624 | t-value | -0.3923 | 13.1117 | 12.8526 | t-value | 0.4198 | 10.1979 | 8.9146 |
| **Clerical Medical** | | | | **Henderson** | | | | **Prudential M&G** | | | |
| Estimate | -0.2017 | 1.0317 | 0.9278 | Estimate | 0.3609 | 0.9159 | 0.9945 | Estimate | 0.5074 | 0.8842 | 1.0377 |
| Standard Error | 0.3843 | 0.0501 | 0.0644 | Standard Error | 0.3139 | 0.0410 | 0.0526 | Standard Error | 0.2534 | 0.0331 | 0.0424 |
| t-value | -0.5247 | 20.5788 | 14.4156 | t-value | 1.1495 | 22.3655 | 18.9161 | t-value | 2.0022 | 26.7448 | 24.4502 |
| **Colonial** | | | | **Hill Samuel** | | | | **Royal Sunalliance** | | | |
| Estimate | 0.2623 | 0.8969 | 1.1320 | Estimate | -0.5795 | 1.0107 | 0.8328 | Estimate | -0.1648 | 1.0183 | 0.9735 |
| Standard Error | 0.4144 | 0.0541 | 0.0694 | Standard Error | 0.2704 | 0.0353 | 0.0453 | Standard Error | 0.4444 | 0.0580 | 0.0744 |
| t-value | 0.6330 | 16.5935 | 16.3131 | t-value | -2.1429 | 28.6533 | 18.3905 | t-value | -0.3708 | 17.5676 | 13.0812 |
| **Deutsche** | | | | **INVESCO I** | | | | **Scottish Life** | | | |
| Estimate | 0.1670 | 1.0293 | 0.8976 | Estimate | -0.0136 | 0.9938 | 0.9927 | Estimate | -0.2597 | 1.0003 | 0.9785 |
| Standard Error | 0.5194 | 0.0678 | 0.0870 | Standard Error | 0.0337 | 0.0044 | 0.0056 | Standard Error | 0.2642 | 0.0345 | 0.0442 |
| t-value | 0.3215 | 15.1908 | 10.3187 | t-value | -0.4028 | 226.3713 | 176.1277 | t-value | -0.9830 | 29.0211 | 22.1139 |
| **Dresdner RCM** | | | | **Invesco UK Core** | | | | **SLC Asset Management** | | | |
| Estimate | -0.3088 | 1.0915 | 0.9974 | Estimate | -0.5661 | 1.0304 | 1.0242 | Estimate | -0.6167 | 1.0185 | 0.8994 |
| Standard Error | 0.7476 | 0.0975 | 0.1252 | Standard Error | 0.8171 | 0.1066 | 0.1368 | Standard Error | 0.3302 | 0.0431 | 0.0553 |
| t-value | -0.4130 | 11.1931 | 7.9666 | t-value | 0.1066 | 9.6673 | 7.4854 | t-value | -1.8675 | 23.6439 | 16.2636 |
| **Equitable High Income** | | | | **KQEP Enhanced** | | | | **Standard Life** | | | |
| Estimate | -0.1988 | 0.8999 | 1.0409 | Estimate | 0.1673 | 1.0113 | 0.9901 | Estimate | 0.1937 | 0.9264 | 0.9536 |
| Standard Error | 0.7871 | 0.1027 | 0.1318 | Standard Error | 0.1937 | 0.0253 | 0.0324 | Standard Error | 0.2098 | 0.0274 | 0.0351 |
| t-value | -0.2525 | 8.7653 | 7.8972 | t-value | 0.8635 | 40.0215 | 30.5213 | t-value | 0.9233 | 33.8556 | 27.1475 |
| **Equitable Pelican** | | | | **Legal & Generali** | | | | **Swiss Life** | | | |
| Estimate | -0.9269 | 1.0448 | 0.9655 | Estimate | 0.0199 | 0.9967 | 1.0054 | Estimate | 0.0077 | 1.1365 | 0.9412 |

| | | | |
|---|---|---|---|
| Standard Error | 0.4713 | 0.0615 | 0.0789 |
| t-value | -1.9666 | 16.9942 | 12.2327 |
| **Equitable Spec. Sits.** | | | |
| Estimate | -2.6004 | 1.0036 | 0.8534 |
| Standard Error | 1.4747 | 0.1924 | 0.2470 |
| t-value | -1.7634 | 5.2170 | 3.4556 |
| **Friends I&S Stewardship** | | | |
| Estimate | 0.9379 | 0.7176 | 0.8424 |
| Standard Error | 1.0108 | 0.1319 | 0.1693 |
| t-value | 0.9279 | 5.4426 | 4.9766 |
| **Friends Ivory & Sime** | | | |
| Estimate | -0.5178 | 1.1249 | 0.9015 |
| Standard Error | 0.4264 | 0.0556 | 0.0714 |
| t-value | -1.2144 | 20.2248 | 12.6263 |
| **Friendsivory&Sime (FP)** | | | |
| Estimate | 0.3064 | 0.9484 | 1.0126 |
| Standard Error | 0.6522 | 0.0851 | 0.1092 |
| t-value | 0.4697 | 11.1464 | 9.2700 |

| | | | |
|---|---|---|---|
| Standard Error | 0.0402 | 0.0052 | 0.0067 |
| t-value | 0.4959 | 190.1246 | 149.3954 |
| **Legal & Generalp** | | | |
| Estimate | 0.1083 | 0.9917 | 1.0281 |
| Standard Error | 0.1456 | 0.0190 | 0.2438 |
| t-value | 0.7437 | 52.2275 | 42.1723 |
| **London Life** | | | |
| Estimate | -0.9645 | 1.0659 | 0.8383 |
| Standard Error | 0.3342 | 0.0436 | 0.0560 |
| t-value | -2.8862 | 24.4517 | 14.9802 |
| **Martin Currie UK Growth** | | | |
| Estimate | 1.0846 | 0.8294 | 1.2165 |
| Standard Error | 0.8691 | 0.1134 | 0.1455 |
| t-value | 1.2480 | 7.3153 | 8.3581 |
| **Merrill Lynch Balanced** | | | |
| Estimate | 0.1192 | 0.9448 | 0.9490 |
| Standard Error | 0.4030 | 0.0526 | 0.0675 |
| t-value | 0.2958 | 17.9711 | 14.0602 |

| | | | |
|---|---|---|---|
| Standard Error | 1.0058 | 0.1312 | 0.1684 |
| t-value | 0.0077 | 8.6626 | 5.5880 |
| **Swiss Life Index** | | | |
| Estimate | -0.1803 | 0.9460 | 0.8751 |
| Standard Error | 0.3049 | 0.0398 | 0.0511 |
| t-value | -0.5913 | 23.7873 | 17.1388 |
| **Winterthur Life** | | | |
| Estimate | -0.9028 | 1.0567 | 1.0636 |
| Standard Error | 0.5607 | 0.0731 | 0.0939 |
| t-value | -1.6102 | 14.4464 | 11.3263 |
| **Zurich Scudder** | | | |
| Estimate | -0.0542 | 0.9989 | 0.9608 |
| Standard Error | 0.3245 | 0.0423 | 0.0544 |
| t-value | -0.1669 | 23.5953 | 17.6784 |

The statistics show how, on average, the funds have been keeping very close tracks to the market. Indeed, both regression coefficients have a mean around 0.98, which indicates that on average, a one unit increase or fall in the market's excess returns would result in a 0.98 increase or fall in the funds' excess returns. Hence, any positive or negative shock over our sample period seem to be transmitted almost entirely to the funds, which do not appear to have possessed over that period any information that would have allowed them to time the market. This is also evident when one notices how small the interquartile range, where 50% of the funds lie, is in both cases: 0.0905 when the market is up and 0.1295 when it is down. Next, we consider each market state separately in order to perform a more thorough analysis of the timing behaviour exhibited by the funds.

TABLE 5
The descriptive statistics of the regression coefficients of the two beta model

| | $\beta_u$ | $\beta_d$ |
|---|---|---|
| Mean | 0.9852 | 0.9799 |
| Standard error | 0.0126 | 0.0174 |
| Standard deviation | 0.0835 | 0.1154 |
| Sample variance | 0.0070 | 0.0133 |
| Excess Kurtosis | 0.9911 | 2.3808 |
| Skewness | -0.5889 | 1.0416 |
| Range | 0.4189 | 0.6156 |

| | | |
|---|---|---|
| Count | 44 | 44 |
| Minimum value | 0.7176 | 0.7796 |
| 1st quartile (25th percentile) | 0.9402 | 0.9010 |
| Median | 0.9953 | 0.9760 |
| 3rd quartile (75th percentile) | 1.0307 | 1.0305 |
| Maximum value | 1.1365 | 1.3953 |
| Jarque-Bera Statistic | 4.3445 | 18.3471 |
| Probability | 0.1139 | 0.0001 |
| Correlation ( $\beta_u$ , $\beta_d$ ) | -0.0779 | |

When the market is up, 75% of the funds had a regression coefficient that lay below 1.0307, which indicates that 75% of the sample funds did not exhibit signs of timing behaviour when the market was doing well. The difference between the top and the bottom quartile is also worth noting; the top quartile of the regression coefficient $\beta_u$ starts from 1.0307 to 1.1365, the range being equal to 0.1058, while the bottom quartile's range is 0.2226, starting from $\beta_u$ = 0.7176 to 0.9402. Hence, the results of the bottom quartile of funds were even more dramatic, not only evidence of no special timing skills possessed by the fund managers but also of underperformance relative to the market. This also confirmed by noting that the $\beta_u$ are actually negatively skewed.

On the other hand, when the market was down, 75% of the funds' $\beta_d$ lay above 0.9010. Indeed, the funds seem to have performed as worse as the market when it was passing through a downturn, with 25% of the funds performing even worse with their $\beta_d$ ranging from 1.0305 to 1.3953. This is even more evident when one compares the ranges of the top vs. bottom quartile: 0.3648 vs. 0.1214 and when one notes that the $\beta_d$s are positively skewed. Hence, the fund managers were not able to game on any extra information to time the market and on average, they performed worse than the market when the latter was falling.

Consequently, in both states, the funds managers on average do not appear to have possessed any special information that could allow them to time the market and produce any excess returns. The very negligible correlation (-0.0779) between the two coefficients confirms this: If fund managers did possess special timing skills, one would expect it to be a significantly high negative number. However, it is worth noting that by examining the results for each individual funds, some of them did exhibit some timing skills such as, when the market was up, Friends Ivory&Sime and Swiss life with their $\beta_u$ respectively equal to 1.1249 and 1.1365, and in the case where the market was down, Gartmore and Cazanove concentrated with their $\beta_d$ equal to 0.7897 and 0.7796 respectively.

Finally, to see more clearly that for our sample of funds in the 10-year period under study, the timing abilities of the managers are not very impressive, we present the next figure where the coefficients are plotted for illustration purposes:

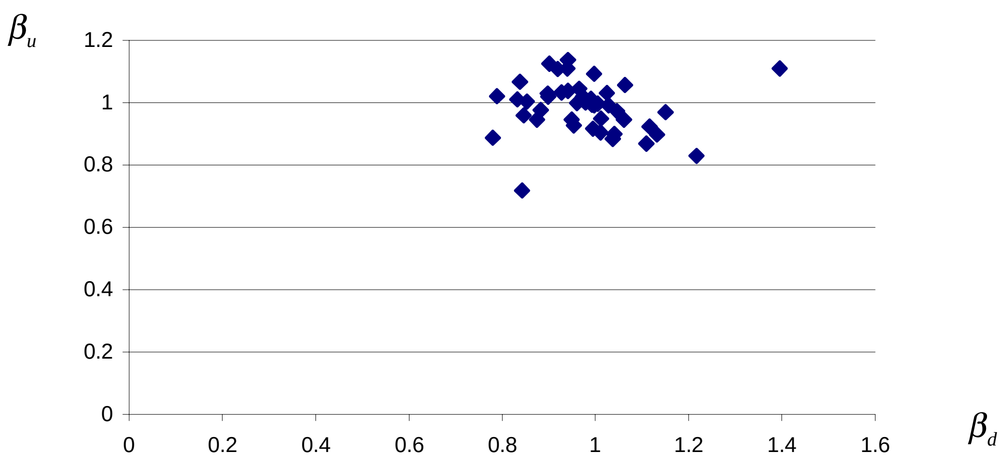


Figure 1

A plot of the two-beta model regression's coefficients

In case of special timing skills from the fund mangers in both states, one would expect the coefficients to be clustered in the top left corner of the graph, with a high $\beta_u$ and low $\beta_d$. But, as one can see in the graph, for our sample period, the evidence is not for strong timing skills exhibited by the fund managers.

Now that the data has been analysed using various methods, this article can now move to applying the newly derived LPW measure to the empirical data and analysing the performance of the 44 British pension fund managers for two different cases: first, the investor is considered to be risk-averse upward and risk-loving downward (0<$v_1$<1 and 0<$v_2$<1) while in the second case he is taken to be risk-loving upward and risk-averse downward ($v_1$>1 and $v_2$>1). The results will be compared to the evaluation performed in the above section using the six different measures, in the aim of discovering whether the LPW does capture new information. As a first step toward achieving this, the next section discusses these two approaches and derives all the necessary parameters needed to apply them to our data.

### *4.4 Derivation of essential parameters for the empirical application of the LPW performance measure*

To apply the LPW performance measure to our sample of active fund managers, for the two cases discussed earlier, we first need to determine the relevant parameters of the loss aversion utility function $v_1, v_2$ and $\lambda$, while satisfying one of the main conditions of the theory, namely $p\lim\left[\sum_{t=1}^{T}\tilde{w}_t\tilde{r}_{Bt}\right]=0$ [10], and while keeping a value for the proportion invested in equity, $\theta$ [11], that corresponded to the one prevalent in the UK market.

To achieve that, this study devised and solved the following minimisation problem: Finding the values of $v_1, v_2$ and $\lambda$ that minimise the weighted sum of the excess returns of the benchmark portfolio $\sum_{t=1}^{T}\tilde{w}_t\tilde{r}_{Bt}$ subject to the condition that $\theta = 0.75$ [12], $v_1, v_2$ and $\lambda$ being positive and finally that $v_2 - v_1 > 0$. The last condition is imposed in order to ensure that the investor displays a rational behaviour; indeed, Hwang and Satchell (2003) proved in their article that if the investor possesses a loss aversion utility function and one wants to assume that $\theta$ is an increasing function of $p$, i.e. that as the probability of equity outperforming the risk-free asset increases, the investor would increase his holdings in equity which is considered to be a rational decision, then $v_2 - v_1$ must be >0.

Additional conditions are imposed depending on the various scenarios considered. In the first case, where the investor is assumed to be risk-averse for gains and risk-loving for losses, $v_1$ and $v_2$ are both required to be less than 1. The second case, on the other hand, studies an investor who is risk-

---

[10] Where $w_t = \frac{U'_{LA}(X_t)}{\Sigma_t U'_{LA}(X_t)} = \frac{X_t^{v_1-1} I_t + \lambda(-X_t)^{v_2-1}(1-I_t)}{\Sigma_t\left(X_t^{v_1-1} I_t + \lambda(-X_t)^{v_2-1}(1-I_t)\right)}$, $I_t = \begin{cases} 1 & if\ X_t > 0 \\ 0 & if\ X_t \le 0 \end{cases}$

[11] $\theta = \left(\frac{u^+ p}{\lambda u^-(1-p)}\right)^{\frac{1}{v_2 - v_1}}$ where $u^+ = \Gamma(v_1+\alpha_1)\big/\lambda_1^{v_1}\Gamma(\alpha_1)$ , $u^- = \Gamma(v_2+\alpha_2)\big/\lambda_2^{v_2}\Gamma(\alpha_2)$ and $\alpha_1, \alpha_2, \lambda_1, \lambda_2$ are the KST parameters of the benchmark portfolio.

[12] As mentioned earlier, the choice of a 75% investment level in the risky asset seemed a plausible estimation of the actual level in the UK market.

averse to losses and risk-loving for gains and thus the condition imposed in this situation would be that $v_1 > 1$ and $v_2 > 1$.

Next, given that they are identical for the two cases considered, the KST parameters for the benchmark portfolio were determined using maximum likelihood estimation and the results obtained were as follows:

TABLE 6
The estimates of the KST parameters for the Caps pooled median

| | $\alpha_1$ | $\lambda_1$ | $\alpha_2$ | $\lambda_2$ | $p$ |
|---|---|---|---|---|---|
| Estimates | 1.7089 | 0.2555 | 1.4086 | 0.2349 | 0.7 |
| Standard Error | 0.4125 | 0.0715 | 0.5442 | 0.1086 | |
| *t*-statistic | 4.1428 | 3.5734 | 2.5884 | 2.1629 | |

Using these results, we can now move to determining the relevant parameters necessary to the application of each individual scenario of the LPW performance measure.

For the first case considered, where the investor is assumed to be risk-averse for gains and risk-loving for losses, solving the minimisation problem to calculate the correspondent parameters for the loss aversion utility function with $v_1$ and $v_2$ both required to be less than 1, gives the following values: $v_1 = 0.1$, $v_2 = 0.2$ and $\lambda = 2.0950$. The resulting figure for the weighted sum of the benchmark's excess returns, $\sum_{t=1}^{T} \tilde{w}_t \tilde{r}_{Bt}$, is equal to $4.9154 \times 10^{-4}$, which is an acceptable low level that is very close to 0.

The second scenario analysed in this article is one that considers an investor who is who is risk-averse to losses and risk-loving for gains. Given all the tools necessary to solve the minimisation problem for $v_1 > 1$ and $v_2 > 1$ are available, the solution is readily obtained: $v_1 = 1.6585$, $v_2 = 1.7214$ and

$\lambda = 2.3392$, with the weighted sum of the benchmark's excess returns $\sum_{t=1}^{T} \tilde{w}_t \tilde{r}_{B\,t}$ being equal to the extremely negligible figure of $-1.0944\times10^{-8}$.

Now, that the two LPW performance measure's settings have clearly defined and that all the necessary parameters have been calculated, the next section applies these two methods to assess the performance of the funds in our sample data and proposes a thorough analysis of the results obtained.

## 5. Empirical application of the LPW performance measure

### *5.1 For an investor who is risk-averse to gains and risk-loving to losses*

In this section, we apply the newly modified LPW measure to evaluate the performance of 44 UK funds over a 10-year sample period (March 1990 to December 1999), under the assumption that the investor is risk-averse to gains and risk-loving to losses, i.e. that $0 < v_1 < 1$ and $0 < v_2 < 1$.

This choice is motivated by the many empirical results that were reported across the literature. Indeed, as early as Fishburn and Kochenberger (1979), evidence were presented to indicate that $0 < v_1 < 1$ and $0 < v_2 < 1$. Indeed, when empirically evaluating the two-piece utility function of individuals when faced with changes over wealth, Fishburn and Kochenberger (1979) found evidence that investors are risk-averse for gains and risk-loving for losses, i.e. that $0 < v_1 < 1$ and $0 < v_2 < 1$, and also cited many other references that confirm their reports. In addition, Kahneman and Tversky (1992) used a nonlinear regression procedure to estimate the values for these parameters for various subjects and discovered that the median value is equal to 0.88, for both gains and losses. It is worth noting that having the investor to be risk-loving for losses is a behaviour that has been discussed in the literature and has been called by Kahneman and Tversky (1992) as "risk-seeking".

Indeed, when it applies to losses, it refers to an intuitive behaviour that was pointed out by Kahneman and Tversky (1979) in a series of experiments they conducted: it implies than individuals prefer a loss that is merely probable to a smaller loss that is certain.

Using the values obtained in section 4.4 to calculate the positive weight vector and the methodology outlined in the previous sections, this article presents in table 7 the performance scores for the 44 funds over the 10-year sample period as well as their relevant statistics.

At first, the results reported in table 7 seem to indicate that the LPW performance evaluation of our sample of funds is distinct from the measures discussed in section 4.2: the LPW measure results seem to detect signs of abnormal performance and indicate slightly better skills from the fund managers.

TABLE 7
The LPW performance measure results and their descriptive statistics
calculated for 44 UK funds over the 10-year period (March1990-December1999)

| | | | | | |
|---|---|---|---|---|---|
| Equitable Spec. Sits. | **-2.8031** | Legal & Generali | **-0.1222** | Friends Ivory &Sime | **0.3459** |
| | **(-1.3948)** | | (-0.6446) | | (0.5894) |
| London Life | **-1.1817** | Swiss Life Index | **-0.1039** | Equitable High Income | **0.3878** |
| | **(-2.3129)** | | (-0.2814) | | (0.3601) |
| Winterthur Life | **-1.1545** | Royal Sunalliance | **-0.1006** | Friends I&S Stewardship | **0.4854** |
| | **(-1.5445)** | | (-0.1703) | | (0.3548) |
| Equitable Pelican | **-0.9095** | Legal & Generalp | **-0.0054** | Cazenove Concentrated | **0.4917** |
| | **(-1.4796)** | | (-0.0220) | | (0.5041) |
| Dresdner RCM | **-0.6978** | Guardian | **0.0028** | Govett | **0.5583** |
| | (-0.7097) | | (0.0031) | | (0.5928) |
| Morley (was GA) | **-0.4979** | Standard Life | **0.0105** | Gartmore | **0.6181** |
| | (-1.2463) | | (0.0313) | | (0.7489) |
| Invesco UK Core | **-0.4181** | Morley (was CU) | **0.0118** | Clerical Medical | **0.6334** |
| | (-0.3758) | | (0.0256) | | (1.4164) |
| Colonial | **-0.4032** | SLC Asset Management | **0.0144** | Deutsche | **0.8105** |
| | (-0.6880) | | (0.0336) | | (1.2414) |
| Axa Sun Life | **-0.3995** | Hill Samuel | **0.0883** | Swiss Life | **0.8298** |
| | (-0.9332) | | (0.2463) | | (0.6159) |
| Friendsivory&Sime | **-0.2753** | Henderson | **0.1108** | National Mutual Life | **0.9270** |
| | (-0.3424) | | (0.2425) | | **(1.4997)** |
| Prudential M&G | **-0.2625** | Aegon | **0.1244** | Friendsivory&Sime (FP) | **1.1211** |
| | (-0.6838) | | (0.2323) | | **(1.3088)** |
| Scottish Life | **-0.2429** | Northern Trust | **0.1860** | Britannic Inv. Managers | **1.4776** |

| | | | | | |
|---|---|---|---|---|---|
| | (-0.8129) | | (0.2060) | | **(2.8878)** |
| Merrill Lynch Balanced | **-0.2035** | KQEP Enhanced | **0.2124** | Martin Currie UK Growth | **1.9332** |
| | (-0.3790) | | (0.6667) | | **(1.6777)** |
| Gartmore/Natwest Index | **-0.1555** | Morley PP(Was NU) | **0.2347** | ABN AMRO | **4.1086** |
| | (-0.8036) | | (0.4540) | | **(1.6098)** |
| Invesco | **-0.1449** | Zurich Scudder | **0.2800** | | |
| | (-0.7138) | | (0.6204) | | |

**Descriptive Statistics:**

| | | | |
|---|---|---|---|
| Mean | 0.1346 | Minimum value | -2.8031 |
| Standard Error | 0.1464 | 1st quartile (25th percentile) | -0.2478 |
| Standard deviation | 0.9708 | Median (50th percentile) | 0.0131 |
| Sample variance | 0.9425 | 3rd quartile (75th percentile) | 0.4870 |
| Excess kurtosis | 6.3093 | Maximum value | 4.1086 |
| Skewness | 1.1105 | | |
| Range | 6.9117 | Jarque-Bera Statistic | 81.1227 |
| Count | 44 | Probability | 0.0000 |

Indeed, they show that the magnitude of the abnormal performance for the 44 funds over the 10-year period under study varies from about –2.8031% to 4.1086%. The median fund is characterised by an abnormal performance close to 0.0131%, and hence the funds are nearly split in half between under- and out-performers. The mean of the performance measures, which is equal to 0.1346%, lies in the third quartile.

Examining the centre of the distribution of these results, we see that the third quartile range is equal to 0.4739% while the second quartile range is equal 0.2608, and consequently the level of outperformance is higher than the magnitude of the underperformance, a result confirmed in table 7 where the performance scores are reported to be positively skewed. Indeed, the interquartile range is equal to 0.7347%, a significant number. We finally note that the top 25% of funds beat the benchmark by a margin ranging from half a percent to 4.1086%, which is quite a good result given that we are considering net returns.

Looking at the *t*-statistics[13] presented below each LPW result, it is however evident that most of the results presented in table 7 are not statistically significant. Indeed, from the 25 funds that outperformed the benchmark, only 6 exhibit statistically significant results at the 10% significance level. On the other hand, from the 19 funds that underperformed, only 4 funds possess statistically significant LPWs.

However, it is very worth noting that those significant performances occurred at the two extremes of the distribution. Indeed, the 6 significant outperformers all lie in the fourth quartile, at the far end of the distribution's positive tail, with values between 0.6334% and 4.1086%, while the 4 significant underperformers lie at the opposite side, at the far end of the distribution's negative tail, with values ranging from –0.9095% and –2.8031%. Compared to the mean, 0.1346%, or the median, 0.0131%, those values are quite extreme. Hence, the funds that did actually perform significantly differently from the benchmark went all the way. In addition, given the high level of excess kurtosis shown in table 7, the distribution of the LPW does seem to possess thick tails, and thus the probability of actually obtaining extreme values could be fairly high.

In conclusion, a significant portion of the funds considered exhibit performance that is very close in magnitude to the benchmark. However, the few that actually have shown evidence of significantly distinct performance,

[13] The *t*-statistic for the LPW measure is calculated using the definition by Grinblatt and Titman (1995). It is considered as having a *t*-distribution with *T-K-1* degrees of freedom, where *T* is the number of returns and *K* the number of benchmarks used. The *t*-statistic is equal to $PPW \Big/ \sqrt{s^2 \Sigma w_t^2}$ , where *s* is the standard error of the Jensen regression for the fund being evaluated.

exhibited strong results, whether positive or negative. Indeed, they are extreme values that lie at both far ends of the distribution.

However, care should be taken in considering the above results: one should not forget how noisy the returns generally are, a fact that could lead to biases in the statistical power of the tests.

Having examined in details the results exhibited by the LPW measure in the case of an investor who is risk-averse for gains and risk-loving for gains, this section can now move to their analysis relative to the results reported by conventional measures. Indeed, as mentioned earlier, the results reported in table 7 seem to indicate that the LPW does pick up new information, as its evaluation of our sample of funds' performance appeared to be distinct from the results of the various measures considered earlier. To see this more clearly, table 8 compares the LPW performance measure with the six preliminary measures considered in section 4.2 by presenting their correlation matrix:

TABLE 8

The correlations between the performance results as measured by the seven different performance measures

| | LPW Measure $0 < v_1 < 1, 0 < v_2 < 1$ | PW Measure | Jensen Measure | T-M measure | Sharpe ratio | Sortino ratio | Inf. ratio |
|---|---|---|---|---|---|---|---|
| LPW $(0 < v_1 < 1, 0 < v_2 < 1)$ | 1 | | | | | | |
| PW (Power utility | 0.7221 | 1 | | | | | |
| Jensen measure | 0.7499 | 0.9965 | 1 | | | | |
| Treynor-Mazuy measure | 0.7527 | 0.9953 | 0.9999 | 1 | | | |
| Sharpe ratio | 0.7722 | 0.9204 | 0.9257 | 0.9258 | 1 | | |
| Sortino ratio | 0.4913 | 0.6216 | 0.6178 | 0.6168 | 0.7342 | 1 | |
| Information ratio | 0.5455 | 0.7196 | 0.7235 | 0.7238 | 0.8263 | 0.9290 | 1 |

According to the correlations presented in the above table, the LPW does seem able to detect different aspects of the management efforts as it gives different results from all the six traditional measures considered. Indeed, while the correlations between the Jensen, the Treynor-Mazuy and the

Sharpe ratio are very high (all above 90%), the LPW measure exhibits the lowest correlation with each of the other measures, ranging from 0.4913 with the Sortino ratio to 0.7722 with the Sharpe ratio. Consequently, the LPW could be actually picking up evidence of managers' abilities, where the other measures are failing to do.

In fact, in this study, the correlation between the Jensen measure and our modified LPW measure is quite low, a result that contrasts with the very high correlation between the Jensen measure and the PW measure. As a result, it is possible that the use of the loss aversion utility function instead of the power utility function, enabled the LPW to better detect the funds that possess timing abilities, and hence to produce different results than the Jensen measure and the other traditional measures considered. To test that claim, we choose to study four funds, for which the evaluation given by the LPW measure was significantly distinct from the Jensen measure's inferences: Britannic Inv. Managers, Guardian, Martin Currie UK Growth and National Mutual Life. The results for these four funds are reproduced in table 9.

Indeed, while the LPW measure attributed for Britannic a positive and highly significant performance above the benchmark, the PW measure, the Jensen measure and the Treynor-Mazuy measure did not detect such strong behaviour: although they are positive, the results are all relatively small and only significant for the Jensen and Treynor-Mazuy at the 10% level of significance. The Sharpe ratio as well is negligible. The Sortino and information ratios on the other hand seem to agree with the LPW measure since they are fairly high, placing the fund in the top quartile of the funds.

TABLE 9

The abnormal performance results of the four funds to be studied

| | LPW LA utility $0 < v_1 < 1, 0 < v_2 < 1$ | PW Power utility | Jensen Measure | T-M Measure | Sharpe Ratio | Sortino Ratio | Inform. Ratio |
|---|---|---|---|---|---|---|---|
| Britannic Inv. Managers | **1.4776** | **0.2627** | **0.312517** | **0.319900** | **0.0618** | **0.8083** | **0.7118** |
| | (2.8878) | (1.1387) | (1.364875) | (1.396583) | | | |
| Guardian | **0.0028** | **-1.1028** | **-1.01286** | **-0.998300** | **-0.0273** | **-0.1071** | **-0.1747** |
| | (0.0031) | (-2.6704) | (-2.470352) | (-2.434163) | | | |
| Martin Currie UK Growth | **1.9332** | **-0.1807** | **-0.044624** | **-0.028001** | **0.0015** | **0.0059** | **0.0084** |
| | (1.6777) | (-0.3478) | (-0.086515) | (-0.054280) | | | |
| National Mutual Life | **0.9270** | **-0.1778** | **-0.149426** | **-0.145325** | **-0.0127** | **-0.0886** | **-0.1233** |
| | (1.4997) | (-0.6380) | (-0.540040) | (-0.525176) | | | |

As for Guardian, The PW measure, the Jensen measure and the Treynor-Mazuy measure clearly concluded that it underperformed the benchmark in a very significant way. The results are indeed large, negative and highly significant at the 5% level of significance. Similarly, the Sharpe ratio is extremely small and places the fund in the bottom quartile while the Sortino and the information ratios are both negative (in the second quartile). On the other hand, the LPW assigned a very negligible and insignificant value to the performance of the Guardian; indeed, according to the LPW measure, this particular fund did not underperform the benchmark, it merely performed the same way.

For the last two funds, the results are very controversial as well. Indeed, looking at the LPW scores, one can conclude that the funds did fairly well compared to the benchmark: they both outperformed the Caps pooled median by 1.9332% and 0.9270% respectively, with the results being significant at the 10% significance level. However, examining the Jensen measure's results, one obtains a different analysis: it attributes to both these funds negative results that are not significant at any relevant levels. The same results apply for both the Treynor-Mazuy and the PW measures. Furthermore, the Martin Currie UK growth fund exhibits very negligible Sharpe, Sortino and Information ratios while the National Mutual Life is characterised by a highly small Sharpe and Sortino ratios and a negative Information ratio. Both funds are placed in the second quartile by these three measures of performance. Hence whereas the LPW measure identified both these funds as significant outperformers, the other measures evidently did not detect any abnormal performance from their part.

In summary, for each of the above funds, the LPW attributed to it a better performance relative to the other measures. Britannic, which was classified as an average performer by the other measures, was assigned an above-the-benchmark performance by the LPW measure. Guardian, which was clearly identified as an underperformer by the traditional measures, was found to be an average performing fund by the LPW measure. Finally, the last two funds were attributed no significant performance by the six different measures (if any performance was picked up, it was a negative one) but were however classified as significant outperformers by the LPW. Could these discrepancies be due to the fact that the PW measure combined with a loss aversion utility function to make the LPW measure was in fact able to pick up some timing behaviour exhibited by the fund managers over the sample period, a behaviour that made their performance stand out?

A plot of the returns of the funds under consideration against the market[14] should give us an indication of the relative performance of the four funds over the sample period. As an example, we present the result obtained for Guardian:

[14] The market proxy used in this study is the FT all share. We note here that over our sample period, the FT all share and the Caps pooled median returns were nearly perfectly correlated, 0.998055.

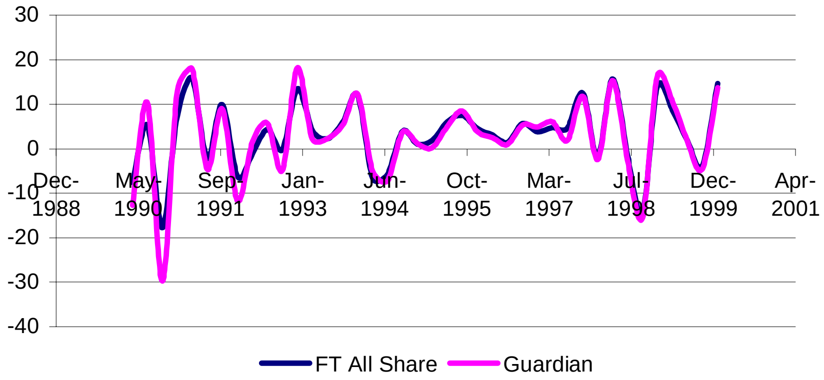


Figure 2
A plot of the returns of Guardian against the market, the FT all share, over our sample period.

The results show that all funds seem to have followed the market quite closely. Indeed, the above graph, as well as the graphs of the other three funds, do not show very strong signs of active management or timing skills: The funds' returns mimic the market returns most of the time over this 10-year period. However, if any behaviour can be detected from the graphs, it is actually reflecting bad managerial skills, as one can very distinctly see various points at which the particular funds underperformed the market when the market was down. This coincides with the traditional measures performance evaluation and not the LPW's. Next, in table 10, we calculate the correlations between the excess returns of the four funds under study and the FT all share or the Caps pooled median.

The magnitudes of the results are again extremely striking (all above 90%). The funds returns' series are very highly correlated with the market always moving in the same direction, which coincides with the earlier graphs.

TABLE 10
The correlations between the excess returns of the four funds under study and the market over the sample period

| | Martin Currie | National |
|---|---|---|

| | Caps | FT | Britannic | Guardian | UK Growth | Mutual Life |
|---|---|---|---|---|---|---|
| Caps pooled median | 1 | 0.9981 | 0.9866 | 0.9697 | 0.9325 | 0.9790 |
| FT all share | | 1 | **0.9837** | **0.9679** | **0.9180** | **0.9795** |
| Britannic | | | 1 | 0.9609 | 0.9194 | 0.9695 |
| Guardian | | | | 1 | 0.9078 | 0.9559 |
| Martin Currie UK Growth | | | | | 1 | 0.9154 |
| National Mutual Life | | | | | | 1 |

Hence, the four funds don't seem to have under- or out-perform the market significantly over the period under study. To understand these results even better, we re-examine the two-beta model results presented in section 4.3, which are very simple but fair indicators of the timing behaviour of the various managers under consideration. Indeed, if the LPW is picking timing behaviour, this should be reflected in the two-beta model regression results. Looking back at table 4, the results do not show any strong evidence of timing skills from the fund managers of the four funds under study. Indeed, in the case where the market up, the only fund that exhibit signs of market timing behaviour is Guardian, whose regression coefficients lie in the top 25% of funds at 1.1087. On the other hand**,** Martin Currie UK Growth exhibit a very low coefficient $\beta_u$, at 0.8294, which lies in the bottom quartile of funds, whereas the Britannnic and National Mutual Life funds exhibit a $\beta_u$ that is very close to 1, at around 0.97, that lie in the second quartile. The results are even more extreme in the case where the market was down. Indeed, they seem to indicate that the fund managers of these particular funds seem to have actually exhibited weak timing skills: the four funds exhibit quite high $\beta_d$, which lie all in the top quartile of funds, with Guardian possessing the highest $\beta_d$ out of the 44 funds at 1.3953.

In conclusion, the inferences given by the two-beta model regression are in accordance with the traditional measures' conclusions and seem to disagree with the LPW scores. But, if the funds are not exhibiting any special skills, then what is causing the discrepancy in the results, which are making the LPW associate better performance with the funds under study? Why does the LPW measure contrary to all the rest of the measures attribute this significantly better performance to our sample of funds? In an attempt to answer these puzzling questions and explain this inconsistency, this article reviewed carefully the details of the theory and calculations behind the LPW measure.

Indeed, a detailed analysis of the LPW measure's theory and derivation methodology shed the light on a possible shortcoming that, in this particular case, is behind the difference in the results. It is mainly due to the combination of the properties of the loss aversion utility function, the construction of the PW measure and the particular assumptions about the investor preferences that were made in this section.

More precisely, in conducting the performance evaluation of the sample of funds under study, this section assumed that the investor is risk-averse to gains and risk-loving to losses, an assumption that meant for the loss aversion utility function that $0 < v_1 < 1$ and $0 < v_2 < 1$. Now, recalling the particular structure of the loss aversion utility function,

$$\begin{aligned} U(X) &= X^{v_1}/v_1 && \text{if } X > 0 \\ &= \lambda(-X)^{v_2}/v_2 && \text{if } X \leq 0 \end{aligned}$$

where $X$ represents the gains, we can see that the above assumption translates into a potential problem when considering the marginal utilities of the loss aversion utility function,

$$\begin{aligned} U'_{LA}(X_t) &= X_t^{v_1-1} && \text{if } X_t > 0 \\ &= \lambda(-X_t)^{v_2-1} && \text{if } X_t \leq 0 \end{aligned} \tag{23}$$

since, when $0 < v_1 < 1$ and $0 < v_2 < 1$, we have that $v_1 - 1 < 0$ and $v_2 - 1 < 0$ and hence,

$$\begin{aligned} U'_{LA}(X_t) &= 1 \big/ X_t^{\,1-v_1} && \text{if } X_t > 0 \\ &= \lambda \big/ (-X_t)^{1-v_2} && \text{if } X_t \leq 0 \end{aligned} \tag{24}$$

As the gains represented by $X$ become smaller and closer to 0, the marginal utilities increase toward infinity: $\lim\limits_{X_t \to 0} U'_{LA}(X_t) \to \infty$

The following graph illustrates the behaviour of the loss aversion utility function and its marginal utility around 0, in the case of an investor who is assumed to be risk-averse to gains ($0 < v_1 < 1$) and risk-loving to losses ($0 < v_2 < 1$):

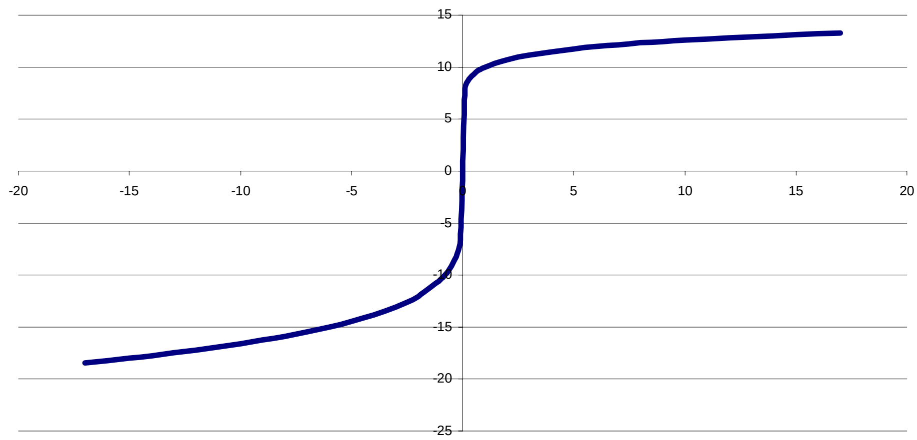


Figure 3
The LA utility function for an investor who is risk-averse for gains and risk -loving for losses
$u(X) = X^{v_1} / v_1, \ if \quad X > 0$ and $u(X) = -\lambda(-X)^{v_2} / v_2, \ if \quad X \leq 0,$
for $v_1 = 0.1$, $v_2 = 0.2$ and $\lambda = 2.0965$

Given that when applying the LPW measure, the marginal utilities of the loss aversion function are used as period weights, this discovery made this study re-analyse the calculation behind the vector of weights obtained under these specific conditions and re-examine it in details to determine whether this particular behaviour is responsible for the discrepancies in the performance results reported by the LPW. We remind the reader quickly of the expression derived for the weight vector in section 3.3:

$$w_t = \frac{U'_{LA}(X_t)}{\sum_t U'_{LA}(X_t)} = \frac{X_t^{v_1-1} I_t + \lambda(-X_t)^{v_2-1}(1-I_t)}{\sum_t \left(X_t^{v_1-1} I_t + \lambda(-X_t)^{v_2-1}(1-I_t)\right)}$$

where

$$X_t = \theta(r_{Caps\,t} - r_{ft}) \qquad \text{and} \qquad I_t = \begin{cases} 1 & \text{if } X_t > 0 \\ 0 & \text{if } X_t \le 0 \end{cases}$$

As one can notice from the above expression, if, in quarter *t*, the gains $X_t$ are around 0, and the investor is assumed to be risk-averse to gains ($0 < v_1 < 1$) and risk-loving to losses ($0 < v_2 < 1$), the marginal utility of $X_t$ in that quarter will be large and thus the weight for that quarter will automatically be large as well. Consequently, when using this weight vector to assess the performance of fund $i$, following the relevant formula, $LPW = \sum_t w_{LA\,t} R_{it}$, its performance in this quarter *t* will be heavily weighted and hence responsible for a big part of its overall performance evaluation.

Next, this study attempts to discover whether such anomaly has occurred while calculating the weighting vector for our benchmark by presenting in table 11 the details of the procedure behind the derivation of the weighting vector, quarter by quarter.

Examining carefully the numbers in the latter table, we notice that in the quarter March 92, the gains *X* of the benchmark portfolio - the Caps pooled median - are nearest to 0, at –0.1156. This level was low enough to drive the marginal utility to its highest point at 11.7688, which constitutes almost one-third of the sum of the marginal utility vector over the 40 quarters. However, what is most worth noting is how large is the weight associated with that quarter, 0.3529, relative to the other 39 quarters weights which are extremely small. Consequently, any fund that performed well (bad) in that quarter, will be attributed a high performance measure, even if it did not perform well (bad) overall. And so, what the LPW is mainly picking up in this case is the performance of each particular fund in the quarter where the benchmark's performance was very close to the risk-free asset. If the fund performed well in that quarter relative to the risk-free asset, then it will be associated with a high overall score; if it did not, then its score will be significantly lower.

TABLE 11
Calculation of the weight vector for an investor with a LA utility function,
$v_1 = 0.1$, $v_2 = 0.2$, $\lambda = 2.0965$ and $\theta = 0.75$

| Quarter | $r_{ft}$ | $R_{caps\,t}$ | $R_{caps\,t} - r_{ft}$ | $X_t$ | $u'_t$ | $w_t$ |
|---|---|---|---|---|---|---|
| Mar-1990 | 1.2148% | -5.5000% | -6.7149% | -5.0361% | 0.5748 | 0.0172 |
| Jun-1990 | 1.2005 | 6.0000 | 4.7995 | 3.5996 | 0.3158 | 0.0095 |
| Sep-1990 | 1.1914 | -16.5000 | -17.6914 | -13.2686 | 0.2648 | 0.0079 |
| Dec-1990 | 1.1172 | 8.0000 | 6.8828 | 5.1621 | 0.2283 | 0.0068 |
| Mar-1991 | 0.9635 | 16.7000 | 15.7365 | 11.8023 | 0.1085 | 0.0033 |
| Jun-1991 | 0.8932 | -1.7000 | -2.5933 | -1.9449 | 1.2305 | 0.0369 |
| Sep-1991 | 0.8073 | 10.0000 | 9.1927 | 6.8945 | 0.1759 | 0.0053 |
| Dec-1991 | 0.8438 | -5.7000 | -6.5438 | -4.9078 | 0.5868 | 0.0176 |
| **Mar-1992** | **0.8542** | **0.7000** | **-0.1542** | **-0.1156** | **11.7688** | **0.3529** |
| Jun-1992 | 0.7865 | 5.8000 | 5.0135 | 3.7602 | 0.3036 | 0.0091 |
| Sep-1992 | 0.6927 | -0.5000 | -1.1927 | -0.8945 | 2.2904 | 0.0687 |
| Dec-1992 | 0.5443 | 14.3000 | 13.7557 | 10.3168 | 0.1224 | 0.0037 |
| Mar-1993 | 0.4609 | 4.3000 | 3.8391 | 2.8793 | 0.3861 | 0.0116 |
| Jun-1993 | 0.4453 | 2.7000 | 2.2547 | 1.6910 | 0.6233 | 0.0187 |
| Sep-1993 | 0.4349 | 6.3000 | 5.8651 | 4.3988 | 0.2636 | 0.0079 |
| Dec-1993 | 0.4167 | 11.7000 | 11.2833 | 8.4625 | 0.1463 | 0.0044 |
| Mar-1994 | 0.4089 | -5.6000 | -6.0089 | -4.5066 | 0.6282 | 0.0188 |
| Jun-1994 | 0.4115 | -5.5000 | -5.9115 | -4.4336 | 0.6365 | 0.0191 |
| Sep-1994 | 0.4714 | 3.6000 | 3.1286 | 2.3465 | 0.4641 | 0.0139 |
| Dec-1994 | 0.5156 | 1.5000 | 0.9844 | 0.7383 | 1.3140 | 0.0394 |
| Mar-1995 | 0.5156 | 2.5000 | 1.9844 | 1.4883 | 0.6992 | 0.0210 |
| Jun-1995 | 0.5260 | 6.2000 | 5.6740 | 4.2555 | 0.2716 | 0.0081 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sep-1995 | 0.5469 | 7.9000 | 7.3531 | 5.5148 | 0.2151 | 0.0065 |
| Dec-1995 | 0.5182 | 5.1000 | 4.5818 | 3.4363 | 0.3292 | 0.0099 |
| Mar-1996 | 0.4818 | 3.8000 | 3.3182 | 2.4887 | 0.4402 | 0.0132 |
| Jun-1996 | 0.4648 | 2.3000 | 1.8352 | 1.3764 | 0.7501 | 0.0225 |
| Sep-1996 | 0.4688 | 5.7000 | 5.2313 | 3.9234 | 0.2922 | 0.0088 |
| Dec-1996 | 0.5130 | 4.3000 | 3.7870 | 2.8402 | 0.3908 | 0.0117 |
| Mar-1997 | 0.5156 | 5.1000 | 4.5844 | 3.4383 | 0.3291 | 0.0099 |
| Jun-1997 | 0.5365 | 4.4000 | 3.8635 | 2.8977 | 0.3838 | 0.0115 |
| Sep-1997 | 0.5807 | 12.8000 | 12.2193 | 9.1645 | 0.1362 | 0.0041 |
| Dec-1997 | 0.6120 | -0.9000 | -1.5120 | -1.1340 | 1.8945 | 0.0568 |
| Mar-1998 | 0.6040 | 15.2000 | 14.5960 | 10.9470 | 0.1160 | 0.0035 |
| Jun-1998 | 0.6224 | -0.6000 | -1.2224 | -0.9168 | 2.2458 | 0.0673 |
| Sep-1998 | 0.6081 | -14.2000 | -14.8081 | -11.1061 | 0.3053 | 0.0092 |
| Dec-1998 | 0.4948 | 14.6000 | 14.1052 | 10.5789 | 0.1197 | 0.0036 |
| Mar-1999 | 0.4167 | 8.6000 | 8.1833 | 6.1375 | 0.1953 | 0.0059 |
| Jun-1999 | 0.4010 | 1.9000 | 1.4990 | 1.1242 | 0.9000 | 0.0270 |
| Sep-1999 | 0.4271 | -4.1000 | -4.5271 | -3.3953 | 0.7879 | 0.0236 |
| Dec-1999 | 0.4688 | 15.6000 | 15.1313 | 11.3484 | 0.1123 | 0.0034 |
| | | | | | 33.3471 | 1 |

To confirm this, we analysed the performance of the four funds under study in the quarter under question: the LPW associated with these four funds better performance than all the other conventional measures because in this particular quarter, March 92, these four funds performed well, a performance that was very heavily weighted driving the overall performance score to be very high. If one considers in details each fund’s performance, one notices how much the performance of each fund in that quarter is influencing the LPW overall performance result. For instance, for Britannic Inv. Managers, the overall LPW score is equal to $LPW = \sum_{t=1}^{40} w_t (R_{B\,t} - r_{f\,t}) = 1.4776\%$, of which 70% (1.0439%) is due to quarter March 1992; For Martin Currie UK growth, the ratio is as high as 0.93%.

From the above numbers, we can deduce how important is the impact of the behaviour of the loss aversion utility function, under these particular assumptions, on the overall results. Any fund that performed well relative to the risk-free rate in a quarter where the benchmark performance was very close to the risk-free asset (as in quarter March 1992), will be attributed a better performance by the LPW given the large weight associated with that quarter. However, it is worth noting that this shortcoming will happen only under these particular settings: the investor is assumed to be risk-averse to gains ($0 < v_1 < 1$) and risk-loving to losses ($0 < v_2 < 1$), and in a particular quarter, the benchmark's excess returns must be close to 0.

In the next section, this problem is overcome, since the performance of the 44 UK funds are evaluated for a different investor, in attempt to capture all sides of this newly modified performance measure.

### 5.2 *For an investor who is risk-averse to losses and risk-loving to gains*

Given the calculations and the methodology outlined in the previous sections, we can evaluate the performance of our sample of 44 UK pension funds, for the 10-year period under study, using the LPW measure for an investor who is risk-averse to losses ($v_1 = 1.6585$) and risk-loving to gains ($v_2 = 1.7214$). The results and their descriptive statistics are presented in table 12.

The results show that on average, the performance evaluation results presented by the LPW in this section, under the particular conditions imposed, is quite similar to the results proposed by the conventional measures. It seems that for the conditions imposed in this section, the LPW measure does not share the problem that it encountered in section 5.1, for an investor who is risk-averse to gains and risk-loving to losses ($0 < v_1 < 1$ and $0 < v_2 < 1$).

Indeed, the average abnormal performance is quite negligible at 0.0483% and lies in the second quartile of funds. The second and the third quartile are very narrow, with the interquartile range only equal to 0.3827%. Particularly, the second quartile span a range equal to 0.2349% below the median while for the third quartile, this value is only equal to 0.1478%. These figures first indicate that 50% of the funds' performances lie in a very small range around a median of 0.1115% and thus at least half the funds show signs of negligible abnormal performance. Second, they show that the results are slightly negatively skewed, as confirmed by the skewness level reported in table 12.

TABLE 12
The LPW performance measure results calculated for
44 UK funds over the 10-year period, with $v_1 > 1$ and $v_2 > 1$

| | | | | | |
|---|---|---|---|---|---|
| Equitable Spec. Sits. | **-1.8861** **(-1.7783)** | Govett | **0.0161** (0.0324) | Morley (was GA) | **0.2239** (1.0622) |
| Guardian | **-1.4380** **(-2.9743)** | Britannic Inv. Managers | **0.0325** (0.1205) | Zurich Scudder | **0.2310** (0.9699) |
| Winterthur Life | **-0.8910** **(-2.2587)** | AXA Sun Life | **0.0491** (0.2173) | Swiss Life Index | **0.2403** (1.2329) |
| Equitable High Income | **-0.8802** **(-1.5490)** | Legal & Generalp | **0.0674** (0.5228) | Morley PP (Was NU) | **0.3164** (1.1596) |
| Colonial | **-0.6960** **(-2.2502)** | Henderson | **0.0806** (0.3342) | Hill Samuel | **0.3483** **(1.8400)** |
| Martin Currie UK Growth | **-0.6119** (-1.0062) | Legal & Generali | **0.0977** (0.9764) | Clerical Medical | **0.3533** **(1.4969)** |
| Equitable Pelican | **-0.5261** **(-1.6219)** | INVESCO | **0.1084** (1.0120) | KQEP Enhanced | **0.3789** **(2.2533)** |
| Invesco UK Core | **-0.5027** (-0.8561) | Gartmore/Natwest Index | **0.1146** (1.1227) | Friends I&S Stewardship | **0.4071** (0.5638) |
| Morley (was CU) | **-0.4817** **(-1.9867)** | AEGON | **0.1596** (0.5649) | Friends Ivory & Sime | **0.6460** **(2.0859)** |
| National Mutual Life | **-0.2874** (-0.8810) | Friendsivory&Sime (FP) | **0.1709** (0.3781) | Gartmore | **0.8357** **(1.9187)** |
| Northern Trust | **-0.1981** (-0.4158) | Royal Sunalliance | **0.1791** (0.5747) | Deutsche | **0.8669** **(2.5161)** |
| Friendsivory&Sime(I&S) | **-0.0980** (-0.2310) | Standard Life | **0.1872** (1.0600) | Cazenove Concentrated | **0.9139** **(1.7757)** |
| Prudential M&G | **-0.0794** (-0.3918) | Dresdner RCM | **0.2171** (0.4184) | Swiss Life | **1.0516** **(1.4790)** |
| Scottish Life | **-0.0628** (-0.3981) | Merrill Lynch Balanced | **0.2199** (0.7762) | ABN AMRO | **2.0320** **(1.5086)** |
| SLC Asset Management | **-0.0010** (-0.0046) | London Life | **0.2203** (0.8171) | | |

**Descriptive Statistics:**

| | | | |
|---|---|---|---|
| Mean | 0.0483 | Minimum value | -1.8861 |
| Standard Error | 0.0973 | 1st quartile (25th percentile) | -0.1230 |
| Standard deviation | 0.6456 | Median (50th percentile) | 0.1115 |
| Sample variance | 0.4168 | 3rd quartile (75th percentile) | 0.2593 |
| Excess kurtosis | 2.3756 | Maximum value | 2.0320 |
| Skewness | -0.2188 | | |
| Range | 3.9180 | Jarque-Bera Statistic | 10.5374 |
| Count | 44 | Probability | 0.0047 |

On the other hand, the results reported in the two extreme quartiles are definitely more interesting. Indeed, the top 25% covers a range of 1.7726%, starting with Morley PP (was NU) at 0.3164% till Abn Amro whose excess returns over the period under study were equal to 2.0319%. Similarly, the bottom quartile of funds performance covered a quite similar range, equal to 1.7627%. This finding, combined with the low level of skewness reported in table 12, seems to indicate a symmetrical distribution to the performance results. In addition, compared to the low average abnormal performance at 0.0484% and the median at 0.1115%, these values are reasonably high. Hence, as in the previous sections, the funds that did outperform or underperform the benchmark did it in a significant and quite extreme way. This is confirmed if one examines carefully the performance scores of the funds in the top and bottom quartiles since one discovers that these results are quite robust: all the statistically significant performance results reported in table 12 lie in either of these two quartiles. As a matter of fact, out of the 16 funds that possess an abnormal performance score that is significant at the 10% significance level, seven lie in the bottom quartile with a negative abnormal performance and nine lie in the top quartile with positive excess returns. In addition, the *t*-statistics reported for these 16 funds are the largest, when compared with the other measures.

In summary, reviewing the performance evaluation reported by the LPW measure for $v_1 > 1$ and $v_2 > 1$, one reaches the following conclusions: on average, the abnormal performance of the funds over the period under study is negligible. Indeed, more than 60% of the funds present negligible and non-statistically significant excess returns but, the results reported in the top quartile do give evidence of some funds performing significantly well relative to the benchmark. Finally, here as well, we need to note that the given the nature of the returns data, one has to be very careful in considering the statistical power of the tests performed.

Next, to evaluate even better the performance evaluation reported by the LPW measure under this section's special setting, we compare it to the performance assessment as made by the traditional and conventional measures discussed earlier, in section 4.2. Examining the results more carefully, the LPW measure in this section exhibits much closer performance assessment to the traditional measures than in the case of an investor who is risk-loving for losses and risk-averse for gains ($0 < v_1 < 1, 0 < v_2 < 1$). Furthermore, for many funds, the performance scores reported by the LPW measure in this section are much more statistically robust and slightly higher in absolute value: more funds exhibit statistically significant abnormal performance, with higher magnitudes as well. The similarity in the performance evaluation of our sample of funds by the LPW considered in this section and the six more traditional measures' results is even more obvious as one studies their correlation matrix in the next table:

TABLE 13

The correlations between abnormal performance as measured by the LPW with $v_1 > 1$ and $v_2 > 1$, and the six different conventional performance measures

| | LPW Measure | LPW Measure | PW Measure | Jensen Measure | T-M measure | Sharpe ratio | Sortino ratio | Infor. ratio |
|---|---|---|---|---|---|---|---|---|

| | $v_1 > 1, v_2 > 1$ | $0 < v_1 < 1, 0 < v_2 < 1$ | | | | | | |
|---|---|---|---|---|---|---|---|---|
| LPW ($v_1 > 1, v_2 > 1$) | 1 | 0.6164 | 0.9599 | 0.9350 | 0.9305 | 0.8590 | 0.6080 | 0.6715 |

The first four measures reported in the above table possess very high correlation, all above 0.93%. Indeed, the LPW measure for an investor who is risk-averse to losses and risk-loving for gains, with $v_1 > 1$ and $v_2 > 1$, seem to share the highest correlation with the PW measure and then with the Jensen and the Treynor-Mazuy measures, which indicates how close their respective performance evaluation of the various funds in our sample is. The LPW measure in this section is also fairly closely related with the Sharpe ratio, their correlation being around 0.86%. However, it does exhibit low correlation with the last two measures, the Sortino and the Information ratio, the lowest being with the Sortino ratio; as analysed previously, this is due to the difference in each of these measures representation of the risk entailed by the fund manager.

Finally, the ranking of the funds in the two extreme quartiles gives an additional indication on how much these measures agree on the performance evaluation of the funds with the most significant abnormal performance. In fact, the importance of the performance of the funds in the top and bottom quartiles was noted earlier as most interesting; as a result, we compare next these two quartiles for the various measures considered. In the bottom quartile, the LPW measure, with $v_1 > 1$ and $v_2 > 1$, has the most funds in common with the PW measure: the same ten funds are placed in the bottom 25% of funds. This number drops to nine and eight funds, respectively, when the Jensen measure and the Sharpe ratio are considered. As expected, the Sortino and the Information ratio have only 7 funds in common with the LPW measure as measured in this section, placed in the bottom quartile. The results for the top quartile of funds are quite similar. The LPW measure has nine funds in common with the PW measure while with the Jensen measure, this number drops to eight, similarly to the Sharpe ratio. Finally, for the last two measures, this number is even lower than in the case of the bottom quartile, at six funds only.

Hence, in conclusion, as opposed to the section 5.1, the LPW measure for an investor who is risk-averse for losses and risk-loving for gains, with $v_1 > 1$ and $v_2 > 1$, present very similar performance evaluation to the one reported by the conventional measures. Indeed, it does not pick up on average any strong proof for the presence of abnormal excess returns in our sample of funds. It does however indicate the presence some significant outperformers in the top quartile; both extreme quartiles seem to include funds that exhibit robust performance scores, either positive or negative.

### *5.3 Analysis and Comparison of the two different risk-preference scenarios*

In this section, we compare the performance assessments of our sample of funds that were reported by the LPW for the two different investors discussed in the previous sections. In fact, recalling the analysis of each case alone and their correlations with the conventional measures evaluations, we would expect, that results for the second case, where the investor is assumed to be risk-averse for losses and risk-loving for gains, to be clearly distinct from the first case where the investor considered is risk-averse for gains and risk-loving for losses, especially given that the second case is supposed to have overcome the shortcoming that faced the loss aversion utility function when $v_1$ and $v_2$ were taken to be less than one.

Comparing the results reported in tables 7 and 12 gives a first indication that our expectations were true: while the LPW measure's performance evaluation for $0 < v_1 < 1$ and $0 < v_2 < 1$ is evidently different from the assessment given by the LPW measure which consider an investor who is risk-averse for losses and risk-loving for gains. To view these differences in a more thorough and detailed manner, we present next a comparison of the descriptive statistics of each measure, as well as the correlation between them:

TABLE 14
The descriptive statistics and correlation of the LPW performance results for the two different preference schemes

| | LPW $0 < v_1 < 1, 0 < v_2 < 1$ | LPW $v_1 > 1, v_2 > 1$ |
|---|---|---|
| **<u>Descriptive statistics:</u>** | | |
| Mean | 0.1346 | 0.0483 |
| Standard Error | 0.1464 | 0.0973 |
| Standard Deviation | 0.9708 | 0.6456 |
| Sample Variance | 0.9425 | 0.4168 |
| Excess Kurtosis | 6.3093 | 2.3800 |
| Skewness | 1.0538 | -0.2188 |
| Range | 6.9117 | 3.9180 |
| Count | 44 | 44 |
| Minimum value | -2.8031 | -1.8861 |
| 1st quartile | -0.2478 | -0.1230 |
| Median | 0.0131 | 0.1115 |
| 3rd quartile | 0.4870 | 0.2593 |
| Maximum | 4.1086 | 2.0320 |
| Jarque-Bera Statistic | 81.1227 | 10.7354 |
| Probability | 0.0000 | 0.0047 |
| **Correlation** | 0.6164 | |

On average, It is very obvious that the LPW measure in the case of an investor who is risk-averse for gains and risk-loving for losses ($0 < v_1 < 1$ and $0 < v_2 < 1$) attributes higher and better performance to the 44 funds in our sample, while for the LPW for an investor who is risk-loving for gains and risk-averse for losses ($v_1 > 1$ and $v_2 > 1$), the results appear to be more moderate. Indeed, the first indication of such a behaviour is the mean performance score for these two cases, 0.1346% vs. 0.0483. The second signal of this distinct difference is the range that the performance results cover in these two cases: Indeed, the LPW abnormal performance results of the top quartile of funds for $0 < v_1 < 1$ and $0 < v_2 < 1$ vary from 0.4870% to 4.1086%, while for $v_1 > 1$ and $v_2 > 1$, the top 25% of funds beat the benchmark from a level of 0.2593% to 2.0320%, the difference being fairly evident. Furthermore, the correlation between these two measures presented at the end of table 14 confirms our analysis: the dissimilarity in the performance results reported by the two versions of the LPW measure is quite evident due to the low correlation level between them, 0.6164.

However, one has to remember here that in the case of the LPW for $0 < v_1 < 1$ and $0 < v_2 < 1$, the better performance is not rewarding any special skills or risk-taking behaviour, but due to the special conditions under which it was constructed[15], it is more of a reward for generating positive excess returns over the risk-free asset in a quarter where the benchmark performed very closely to the risk-free asset. Hence, the weak correlation between these two measures seems to suggest that the LPW measure for $v_1 > 1$ and $v_2 > 1$ may be better at picking up the actual abnormal performance of the funds under study. In fact, examining more thoroughly the results presented in

[15] Refer to the discussion presented at the end of section 5.1.

tables 7 and 12, one can notice that the performance scores reported in by the LPW measure for $v_1 > 1$ and $v_2 > 1$, are more robust: overall, 16 funds respectively exhibit performance that is significant at the 10% level while it is only 10 for the LPW measure for $0 < v_1 < 1$ and $0 < v_2 < 1$. In addition, the LPW measure for $v_1 > 1$ and $v_2 > 1$, possess 9 funds with significant positive abnormal performance in the top quartile. This number falls to 6 funds in the case of the LPW for $0 < v_1 < 1$ and $0 < v_2 < 1$. As a result, the LPW measure for an investor who is risk-loving for gains and risk-averse for losses ($v_1 > 1$ and $v_2 > 1$) does have stronger and more robust performance evaluation.

Furthermore, the differences between these two measures are also picked up when examining the two most important quartiles of funds where all the significant performances lie: the bottom and top quartile of funds. Indeed, comparing the rankings and performance scores of the eleven funds that lie in these two extreme quartiles for the two different settings of the LPW measure, we find that they only have 5 funds in common in the bottom quartile and 6 in the top quartile, reconfirming the difference in the information picked up by these two measures. More drastically, the National Mutual Life fund who is ranked by the LPW measure for $0 < v_1 < 1$ and $0 < v_2 < 1$ to be in its top quartile with a positive, statistically significant at the 10% level, abnormal performance of 0.9269%, is actually placed by the LPW measure for $v_1 > 1$ and $v_2 > 1$ in its bottom quartile with an un-significant negative abnormal performance of -0.2874%. The last ranking is definitely more in accordance with the evidence of no timing behaviour that was reported for that fund, since it was characterised with a $\beta_u < 1$ and a

$\beta_d > 1$[16]. Similarly, Martin Currie UK Growth fund is attributed by the LPW measure, for $0 < v_1 < 1$ and $0 < v_2 < 1$, a significantly positive abnormal performance that ranks it among the top 25% of the funds considered; however, the LPW measure for $v_1 > 1$and $v_2 > 1$, assign to this fund an un-significant negative abnormal performance that places it in the bottom quartile of funds.

In fact, looking very closely at the results in tables 7 and 12 and linking them to the funds' timing behaviour presented in table 4 in section 4.3, we notice that the funds for which the LPW measures for $v_1 > 1$ and $v_2 > 1$ attributed a better (worse) performance than the LPW for $0 < v_1 < 1$ and $0 < v_2 < 1$, have actually exhibited some (lack of) signs of timing skills either when the market were up or when they were down. Indeed, table 15 next shows evidence of this claim.

TABLE 15
An analysis of the timing skills of the various funds for which the performance results reported by the two settings of the LPW measure were significantly **distinct**

| | LPW $0 < v_1 < 1, 0 < v_2 < 1$ | LPW $v_1 > 1, v_2 > 1$ | $\beta_u$ | $\beta_d$ |
|---|---|---|---|---|
| **Superior:** | | | | |
| Cazenove Concentrated | **0.4917** | **0.9139** | **0.8878** | **0.7796** |
| | (0.5041) | (1.7757) | (9.0091) | (6.1624) |
| | | | | (*Bottom quartile*) |
| Friends Ivory & Sime | **0.3459** | **0.6460** | **1.1249** | **0.9015** |
| | (0.5894) | (2.0859) | (20.2248) | (12.6263) |
| | | | (*Upper quartile)* | |
| Gartmore | **0.6181** | **0.8357** | **1.0210** | **0.7897** |
| | (0.7489) | (1.9187) | (12.3988) | (7.4703) |
| | | | | *(Bottom quartile*) |
| Hill Samuel | **0.0883** | **0.3483** | **1.0107** | **0.8328** |
| | (0.2463) | (1.8400) | (28.6533) | (18.3905) |
| | | | | *(Bottom quartile*) |
| KQEP Enhanced | **0.2124** | **0.3789** | **1.0113** | **0.9901** |
| | (0.66667) | (2.2533) | (40.0215) | (31.5213) |
| | | | (*3rd quartile*) | |
| London Life | **-1.1817** | **0.2203** | **1.0659** | **0.8383** |
| | (-2.3113) | (0.8171) | (24.4517) | (14.9802) |
| | | | (*Upper quartile*) | (*Bottom quartile*) |

[16] Refer to table 5 in section 4.3.

| | | | | |
|---|---|---|---|---|
| Morley (was GA) | **-0.4979** | **0.2239** | **0.9593** | **0.8458** |
| | (-1.2463) | (1.0622) | (26.2824) | (18.0506) |
| | | | (2nd quartile) | (*Bottom quartile*) |
| Swiss Life | **0.8298** | **1.0516** | **1.1365** | **0.9412** |
| | (0.6159) | (1.4790) | (8.6626) | (5.5880) |
| | | | (*Upper quartile*) | |
| **Inferior:** | | | | |
| Britannic Inv. Managers | **1.4776** | **0.0325** | **0.9688** | **1.1504** |
| | (2.8878) | (0.1205) | (19.2115) | (17.7701) |
| | | | (*2nd quartile*) | (*Top quartile*) |
| Colonial | **-0.4032** | **-0.6960** | **0.8969** | **1.1320** |
| | (-0.6880) | (-2.2502) | (16.5935) | (16.3131) |
| | | | (*Bottom quartile*) | (*Top quartile*) |
| Equitable High Income | **0.3878** | **-0.8802** | **0.8999** | **1.0409** |
| | (0.3601) | (-1.5490) | (8.7653) | (7.8972) |
| | | | (*Bottom quartile*) | (*Top quartile*) |
| Friendsivory&Sime (FP) | **1.1211** | **0.1709** | **0.9484** | **1.0126** |
| | (1.3088) | (0.3781) | (11.1464) | (9.2700) |
| | | | (*2nd quartile*) | (*3rd quartile*) |
| Guardian | **0.0028** | **-1.4380** | **1.1087** | **1.3953** |
| | (0.0031) | (-2.9743) | (13.1117) | (12.8526) |
| | | | (*Top quartile*) | (*Top quartile*) |
| Martin Currie UK Growth | **1.9332** | **-0.6119** | **0.8294** | **1.2165** |
| | (1.6777) | (-1.0062) | (7.3153) | (8.3581) |
| | | | (*Bottom quartile*) | (*Top quartile*) |
| Morley (was CU) | **0.0118** | **-0.4817** | **0.8684** | **1.1088** |
| | (0.0256) | (-1.9867) | (22.4610) | (22.3403) |
| | | | (*Bottom quartile*) | (*Top quartile*) |
| National Mutual Life | **0.9270** | **-0.2874** | **0.9730** | **1.0469** |
| | (1.4997) | (-0.8810) | (17.1871) | (14.4041) |
| | | | (*2nd quartile*) | (*Top quartile*) |

For the first set of funds in the latter table, the LPW measure for $v_1 > 1$ and $v_2 > 1$ attribute a better and, most of the times statistically significant, abnormal performance compared with the one reported by the LPW measure with $0 < v_1 < 1$ and $0 < v_2 < 1$, indicating the presence of skills that lead to the funds outperforming the benchmark. This is confirmed when examining the results of the two-beta model discussed in section 4.3, since each of the funds presented in the table above does exhibit, during the time period under study, signs of timing abilities relative to the rest of the sample of funds, for one of the two market states. Indeed, the funds either possess a relatively high $\beta_u$ (low $\beta_d$) which for most of the funds in the first set of table 15 lies in the top (bottom) 25% of the entire sample. Moreover, all the funds exhibit a $\beta_d$<1, with Cazanove Concentrated possessing the lowest $\beta_d$ of all our sample of funds, and 6 out of the 8 funds possess a $\beta_u$ >1. Hence, the LPW measure for $v_1 > 1$and $v_2 > 1$, in contrast to the LPW measure with $0 < v_1 < 1$ and $0 < v_2 < 1$, does seem to have picked up some extra information about the timing skills exhibited by some of the funds in the sample and have associated with these funds a positive and significant abnormal performance over the benchmark.

A similar analysis, but with stronger results, can be applied to the funds to which the LPW measures for $v_1 > 1$and $v_2 > 1$ attribute, in table 15, a worse performance than the LPW with $0 < v_1 < 1$ and $0 < v_2 < 1$; the results show that they exhibit signs of bad timing behaviour in both states of the market, which could explain the low performance results associated with them. We note that the four funds for which the LPW performance measure with $0 < v_1 < 1$ and $0 < v_2 < 1$ had attributed controversial results[17] are among the funds reported in table 15, with the LPW measure with $v_1 > 1$and $v_2 > 1$ attributing to them, as expected, a low or negligible performance.

It is evident from the results presented in the second set of funds in table 15 that all these funds show very strong evidence of weak timing skills: they all possess the wrong combination of a low $\beta_u$ (3 in the bottom quartile, 3 in the second quartile) and a high $\beta_d$ (6 in the top quartile and 1 in the third quartile)[18]. Indeed, a low $\beta_u$ (a high $\beta_d$) indicates that the fund manager did not possess any prior information that allowed him to forecast the direction of the market and then increase (decrease) his portfolio's beta accordingly to

[17] Refer to the discussion in section 5.1.

[18] The only exception is Guardian who possesses a high $\beta_u$ that lies in the top quartile. However, this is accompanied by the highest $\beta_d$ in the entire sample.

capitalise on such information and gain abnormal performance. Hence, for these particular funds, it seems that the fund managers did not have any special skills and were not able to change their portfolio's beta in a way to take advantage of the market.

Consequently, the LPW measure for $v_1 > 1$ and $v_2 > 1$ was successful at detecting this bad or lack of timing skills and associating significant negative performance evaluation with such a behaviour, a result that contrasted with the LPW measure for $0 < v_1 < 1$ and $0 < v_2 < 1$ 's assessment. For instance, Morley (was CU), as shown in table 15, possess a low $\beta_u$ that lie in the top quartile and a high $\beta_d$ that lie in the bottom quartile, proving that the fund manager was not able to use any prior information or any other special skill to predict the movement of the market and capitalise on his expectations. The LPW measures with $v_1 > 1$ and $v_2 > 1$ was able to pick up on this behaviour and as a result associated with this fund a very significant negative abnormal performance; the LPW measure with $0 < v_1 < 1$ and $0 < v_2 < 1$, on the other hand, reported a negligible performance that ranked the fund's performance as very close to the benchmark's.

At the end of this section, we can conclude that the LPW measures for $v_1 > 1$ and $v_2 > 1$ do seem to be able to detect timing skills and reward them accordingly far better than the LPW measure with $0 < v_1 < 1$ and $0 < v_2 < 1$. Hence, it does seem that the former measure has overcome the shortcoming that the LPW measure with $0 < v_1 < 1$ and $0 < v_2 < 1$ has been shown to face in section 5.1. To analyse this more carefully, we compare next, in table 16, the set of weights used in the calculations of the performance scores in the two cases, in the attempt to show how the second case does possess a bias-free vector of weights.

TABLE 16
Comparison of the two weight vectors used in the calculation of the LPW performance scores in the two different cases considered

| Quarter | $w_t$ $(0 < v_1 < 1, 0 < v_2 < 1)$ | $w_t$ $(v_1 > 1, v_2 > 1)$ | Quarter | $w_t$ $(0 < v_1 < 1, 0 < v_2 < 1)$ | $w_t$ $(v_1 > 1, v_2 > 1)$ |
|---|---|---|---|---|---|
| Mar-1990 | 0.0172 | 0.0495 | Mar-1995 | 0.0210 | 0.0086 |
| Jun-1990 | 0.0095 | 0.0153 | Jun-1995 | 0.0081 | 0.0171 |
| Sep-1990 | 0.0079 | 0.0995 | Sep-1995 | 0.0065 | 0.0203 |
| Dec-1990 | 0.0068 | 0.0194 | Dec-1995 | 0.0099 | 0.0149 |
| Mar-1991 | 0.0033 | 0.0335 | Mar-1996 | 0.0132 | 0.0120 |
| Jun-1991 | 0.0369 | 0.0249 | Jun-1996 | 0.0225 | 0.0081 |
| Sep-1991 | 0.0053 | 0.0235 | Sep-1996 | 0.0088 | 0.0162 |
| Dec-1991 | 0.0176 | 0.0486 | Dec-1996 | 0.0117 | 0.0131 |
| **Mar-1992** | **0.3529** | **0.0033** | Mar-1997 | 0.0099 | 0.0149 |
| Jun-1992 | 0.0091 | 0.0158 | Jun-1997 | 0.0115 | 0.0133 |
| Sep-1992 | 0.0687 | 0.0142 | Sep-1997 | 0.0041 | 0.0283 |
| Dec-1992 | 0.0037 | 0.0306 | Dec-1997 | 0.0568 | 0.0169 |
| Mar-1993 | 0.0116 | 0.0132 | Mar-1998 | 0.0035 | 0.0319 |
| Jun-1993 | 0.0187 | 0.0093 | Jun-1998 | 0.0673 | 0.0145 |
| Sep-1993 | 0.0079 | 0.0175 | Sep-1998 | 0.0092 | 0.0875 |
| Dec-1993 | 0.0044 | 0.0269 | Dec-1998 | 0.0036 | 0.0311 |
| Mar-1994 | 0.0188 | 0.0457 | Mar-1999 | 0.0059 | 0.0218 |
| Jun-1994 | 0.0191 | 0.0451 | Jun-1999 | 0.0270 | 0.0071 |
| Sep-1994 | 0.0139 | 0.0116 | Sep-1999 | 0.0236 | 0.0372 |
| Dec-1994 | 0.0394 | 0.0054 | Dec-1999 | 0.0034 | 0.0326 |

As one can obviously deduce from the results presented in table 16, the LPW measure's vector of weights in the case where $v_1 > 1$ and $v_2 > 1$ is not subject to the same problem that faced the LPW measure when both $v_1$ and $v_2$ were required to be less than one. Indeed, the weight in quarter March 1992, for the LPW measure with $v_1 > 1$ and $v_2 > 1$, is not high enough to influence the overall performance score and hence this measure has overcome the shortcoming that might face the LPW measure if $v_1$ and $v_2$ are required to be less than one. Consequently, the LPW measure with $v_1 > 1$ and $v_2 > 1$ does possess an edge, which enables it to report more accurate results.

Finally, at the end of this section, we propose an alternative way to overcome the problem faced by the LPW with $0 < v_1 < 1$ and $0 < v_2 < 1$, which allows us to still consider an investor who is risk-loving for losses and risk-averse for gains. Indeed, in risk terms, the problem amounts to huge rewards/losses for over/under-performing the benchmark when the latter's return is close to that of cash and hence it is hard to attach a great deal of meaning to this and to what it could possibly reflect on individual concerns. To illustrate this in a simpler setting, let's consider a world of Two Fund Money Separation, involving a benchmark and cash. In such a world, different managers will hold different proportions of these two assets. However, when the benchmark and cash possess the same return, all 2-funds managers will have the same return and hence, cross-sectional volatility will be very low. It follows that, at that point in time, a small amount of over/under-performance will be identified with a high/low ranking across managers.

Another way to overcome this possible shortcoming while keeping the same risk preferences is to drop the offending points, the quarter in which the benchmark performs to closely to cash. Applying this to our sample, we re-evaluate the performance of the fund managers using only 39 quarters, omitting to use the quarter in which the above problem occurs: March 1992. To achieve that, we solve the minimisation problem for this new data and obtain the following values for the necessary parameters: $v_1$=0.15, $v_2$=0.25 and $\lambda = 2.3262$, with the weighted sum of the benchmark's excess returns $\sum_{t=1}^{T} \tilde{w}_t \tilde{r}_{Bt}$ being equal to the negligible figure of $-3.1867 \times 10^{-4}$. The descriptive statistics of the performance evaluation results obtained in such a setting are presented next:

TABLE 17

The descriptive statistics of the LPW performance results for $0 < v_1 < 1$ and $0 < v_2 < 1$, calculated over **39 quarters**

| | | | |
|---|---|---|---|
| Mean | -0.0331 | Minimum value | -2.9413 |
| Standard Error | 0.1085 | 1st quartile (25th percentile) | -0.1439 |
| Standard deviation | 0.7196 | Median (50th percentile) | 0.1227 |

| | | | |
|---|---|---|---|
| Sample variance | 0.5178 | 3rd quartile (75th percentile) | 0.2216 |
| Excess kurtosis | 5.8857 | Maximum value | 2.1216 |
| Skewness | -1.1860 | | |
| Range | 5.0629 | Jarque-Bera Statistic | 73.8252 |
| Count | 44 | Probability | 0.0047 |

Examining the results presented in the above table show that they are distinct form the results reported by the LPW for $0 < v_1 < 1$ and $0 < v_2 < 1$ that was calculated over the 40 quarters and more in accordance with the evaluation reported by the conventional measures as well as with the LPW for $v_1 > 1$ and $v_2 > 1$. Indeed, the average abnormal performance is at the very low level of –0.0331%, and lies in the second quartile, indicating that on average our sample of fund does not seem to exhibit significant abnormal performance. Moreover, the results are clearly negatively skewed; the bottom quartile range is equal to 2.7974% while the interquartile range is only equal to 0.3665%. Indeed, the results seem to indicate in this setting more negative than positive abnormal behaviour. Indeed, of the 13 significant performance scores, 8 lie in the bottom quartile and 5 in the top quartile. In addition, the top quartile's range is much smaller than the bottom quartile, being equal to 1.8999%.

Hence, dropping the controversial points in the sample seem to provide a solution to the shortcoming that the LPW for $0 < v_1 < 1$ and $0 < v_2 < 1$ might encounter. To see this more clearly, table 18 compares next this new measure with all the other measures that were considered in this study.

The low correlation between the LPW with $0 < v_1 < 1$ and $0 < v_2 < 1$ calculated over 39 quarters and the LPW with $0 < v_1 < 1$ and $0 < v_2 < 1$ calculated over 40 quarters (0.7347) indicate that the former measure seem to have overcome the problem discussed earlier. Indeed, the performance results reported by the LPW with $0 < v_1 < 1$ and $0 < v_2 < 1$ that was calculated by dropping the controversial quarter is more correlated with the results of LPW with $v_1 > 1$ and $v_2 > 1$, and very highly correlated with the evaluation of the conventional methods.

Indeed, the performance results reported by the LPW with $0 < v_1 < 1$ and $0 < v_2 < 1$ that was calculated by dropping the controversial quarter is more correlated with the results of LPW with $v_1 > 1$ and $v_2 > 1$, and very highly correlated with the evaluation of the conventional methods. Moreover, if one examines in table 18 the performance scores of the four controversial funds discussed in section 5.1 table 10, one can clearly see that by dropping the controversial quarter lead to the LPW with $0 < v_1 < 1$ and $0 < v_2 < 1$ attributing to them a performance that is closer to their true performance.

TABLE 18
Comparison of the LPW's performance results for three different schemes,
followed by the correlation matrix of the new measure with the rest of the measures considered in this study

| | $0 < v_1 < 1$, $0 < v_2 < 1$ LPW (40) | $0 < v_1 < 1$, $0 < v_2 < 1$ LPW (39) | $v_1 > 1$, $v_2 > 1$ LPW (40) |
|---|---|---|---|
| **Abn Amro** | | | |
| Perf. score | 4.1086 | 2.1216 | 2.0320 |
| t-value | (1.6098) | (1.4129) | (1.5086) |
| **Aegon** | | | |
| Perf. score | 0.1244 | 0.2106 | 0.1596 |
| t-value | (0.2323) | (0.6686) | (0.5649) |
| **AXA Sun Life** | | | |
| Perf. score | -0.3995 | -0.5463 | 0.0491 |
| t-value | (-0.9332) | (-2.1688) | (0.2173) |
| **Britannic** | | | |
| Perf. score | 1.4776 | 0.4621 | 0.0325 |
| t-value | (2.8878) | (1.5349) | (0.1205) |
| **Cazenove Con.** | | | |
| Perf. score | 0.4917 | 0.3587 | 0.9140 |
| t-value | (0.5041) | (0.6251) | (1.7757) |
| **Clerical Medical** | | | |
| Perf. score | 0.6334 | -0.0533 | 0.3533 |
| t-value | (1.4164) | (-0.2025) | (1.4969) |
| **Colonial** | | | |
| Perf. score | -0.4032 | -0.0554 | -0.6960 |
| t-value | (-0.6880) | (-0.1608) | (-2.2502) |
| **Deutsche** | | | |
| Perf. score | 0.8105 | 0.3717 | 0.8669 |
| t-value | (1.2414) | (0.9677) | (2.5161) |
| **Dresdner RCM** | | | |

| | $0 < v_1 < 1$, $0 < v_2 < 1$ LPW (40) | $0 < v_1 < 1$, $0 < v_2 < 1$ LPW (39) | $v_1 > 1$, $v_2 > 1$ LPW (40) |
|---|---|---|---|
| **Friendsivory&Sime (I&S)** | | | |
| Perf. score | -0.2753 | 0.2109 | -0.0980 |
| t-value | (-0.3424) | (0.4459) | (-0.2310) |
| **Gartmore** | | | |
| Perf. score | 0.6181 | 0.2006 | 0.8357 |
| t-value | (0.7489) | (0.4131) | (1.9187) |
| **Gartmore/Natwest Index** | | | |
| Perf. score | -0.1555 | 0.1246 | 0.1146 |
| t-value | (-0.8036) | (1.0950) | (1.1227) |
| **Govett** | | | |
| Perf. score | 0.5583 | 0.4570 | 0.0161 |
| t-value | (0.5928) | (0.8248) | (0.0324) |
| **Guardian** | | | |
| Perf. score | 0.0028 | -1.1371 | -1.4380 |
| t-value | (0.0031) | (-2.1096) | (-2.9743) |
| **Henderson** | | | |
| Perf. score | 0.1108 | 0.4691 | 0.0806 |
| t-value | (0.2425) | (1.7457) | (0.3343) |
| **Hill Samuel** | | | |
| Perf. score | 0.0884 | -0.0058 | 0.3483 |
| t-value | (0.2463) | (-0.0273) | (1.8400) |
| **INVESCO I** | | | |
| Perf. score | -0.1449 | 0.0960 | 0.1084 |
| t-value | (-0.7138) | (0.8036) | (1.0121) |
| **Invesco UK Core** | | | |

| | $0 < v_1 < 1$, $0 < v_2 < 1$ LPW (40) | $0 < v_1 < 1$, $0 < v_2 < 1$ LPW (39) | $v_1 > 1$, $v_2 > 1$ LPW (40) |
|---|---|---|---|
| **Morley (was CU)** | | | |
| Perf. score | 0.0118 | 0.1171 | -0.4817 |
| t-value | (0.0256) | (0.4333) | (-1.9867) |
| **Morley (was GA)** | | | |
| Perf. score | -0.4979 | -0.0973 | 0.2240 |
| t-value | (-1.2463) | (-0.4139) | (1.0622) |
| **Morley PP (Was NU)** | | | |
| Perf. score | 0.2347 | -0.1655 | 0.3164 |
| t-value | (0.4540) | (-0.5440) | (1.1596) |
| **National Mutual Life** | | | |
| Perf. score | 0.9270 | -0.6355 | -0.2874 |
| t-value | (1.4997) | (-1.7473) | (-0.8810) |
| **Norhtern Trust** | | | |
| Perf. score | 0.1860 | -0.3883 | -0.1981 |
| t-value | (0.2060) | (-0.7311) | (-0.4158) |
| **Prudential M&G** | | | |
| Perf. score | -0.2625 | 0.1664 | -0.0794 |
| t-value | (-0.6838) | (0.7370) | (-0.3918) |
| **Royal Sunalliance** | | | |
| Perf. score | -0.1006 | 0.3861 | 0.1791 |
| t-value | (-0.1703) | (1.1110) | (0.5747) |
| **Scottish Life** | | | |
| Perf. score | -0.2429 | -0.1367 | -0.0628 |
| t-value | (-0.8129) | (-0.7778) | (-0.3982) |
| **SLC Asset Management** | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Perf. score | -0.6978 | 0.1968 | 0.2171 | Perf. score | -0.4181 | -0.7198 | -0.5027 | Perf. score | 0.0144 | -0.3986 | -0.0010 |
| t-value | (-0.7097) | (0.3401) | (0.4184) | t-value | (-0.3758) | (-1.0996) | (-0.8561) | t-value | (0.0336) | (-1.5880) | (-0.0046) |
| **Equitable High Income** | | | | **KQEP Enhanced** | | | | **Standard Life** | | | |
| Perf. score | 0.3878 | -0.8471 | -0.8802 | Perf. score | 0.2124 | 0.2538 | 0.3789 | Perf. score | 0.0105 | 0.3660 | 0.1872 |
| t-value | (0.3601) | (-1.3371) | (-1.5490) | t-value | (0.6667) | (1.3539) | (2.2533) | t-value | (0.0313) | (1.8590) | (1.0600) |
| **Equitable Pelican** | | | | **Legal & Generali** | | | | **Swiss Life** | | | |
| Perf. score | -0.9095 | -1.2453 | -0.5261 | Perf. score | -0.1223 | 0.1165 | 0.0977 | Perf. score | 0.8298 | 0.7782 | 1.0516 |
| t-value | (-1.4796) | (-3.4432) | (-1.6219) | t-value | (-0.6446) | (1.0441) | (0.9764) | t-value | (0.6159) | (0.9818) | (1.4790) |
| **Equitable Spec. Sits.** | | | | **Legal & Generalp** | | | | **Swiss Life Index** | | | |
| Perf. score | -2.8031 | -2.9413 | -1.8861 | Perf. score | -0.0054 | 0.1209 | 0.0674 | Perf. score | -0.1039 | 0.2092 | 0.2403 |
| t-value | (-1.3948) | (-2.4876) | (-1.7783) | t-value | (-0.0220) | (0.8412) | (0.5228) | t-value | (-0.2814) | (0.9627) | (1.2329) |
| **Friends I&S Stewardship** | | | | **London Life** | | | | **Winterthur Life** | | | |
| Perf. score | 0.4854 | 0.2098 | 0.4071 | Perf. score | -1.1817 | -0.0438 | 0.2203 | Perf. score | -1.1545 | -1.1447 | -0.8910 |
| t-value | (0.3548) | (0.2606) | (0.5638) | t-value | (-2.3129) | (-0.1456) | (0.8171) | t-value | (-1.5445) | (-2.6029) | (-2.2587) |
| **Friends Ivory & Sime** | | | | **Martin Currie UK Growth** | | | | **Zurich Scudder** | | | |
| Perf. score | 0.3459 | 0.1354 | 0.6460 | Perf. score | 1.9332 | -0.0053 | -0.6119 | Perf. score | 0.2800 | 0.1899 | 0.2310 |
| t-value | (0.5894) | (0.3922) | (2.0859) | t-value | (1.6777) | (-0.0078) | (-1.0062) | t-value | (0.6204) | (0.7152) | (0.9699) |
| **Friendsivory&Sime (FP)** | | | | **Merrill Lynch Balanced** | | | | | | | |
| Perf. score | 1.1211 | 0.6406 | 0.1709 | Perf. score | -0.2035 | 0.1396 | 0.2199 | | | | |
| t-value | (1.3088) | (1.2711) | (0.3781) | t-value | (-0.3790) | (0.4418) | (0.7762) | | | | |

**Correlation matrix:**

| | LPW Measure 39 quarters $0 < v_1 < 1$ $0 < v_2 < 1$ | LPW Measure 40 quarters $0 < v_1 < 1$ $0 < v_2 < 1$ | LPW Measure 40 quarters $v_1 > 1$ $v_2 > 1$ | PW Measure | Jensen Measure | T-M measure | Sharpe ratio | Sortino ratio | Inform. ratio |
|---|---|---|---|---|---|---|---|---|---|
| LPW (over 39 quarters) $0 < v_1 < 1$, $0 < v_2 < 1$ | 1 | 0.7347 | 0.8457 | 0.9248 | 0.9367 | 0.9377 | 0.8952 | 0.5619 | 0.6779 |

Hence, following this alternative method could lead to obtaining less controversial and more sensible results and hence to solving the problem faced in section 5.1.

## 6. Conclusion

This study has proposed a new measure of performance measurement (LPW) that introduces the loss aversion theory to the field of performance evaluation. To achieve that, we combine the already established positive period weighting measure (PW) developed by Grinblatt and Titman (1989) with the loss aversion utility function for two different types of investors, the first being risk-averse for gains and risk-loving for losses while the second being risk-loving for gains and risk-averse for losses.

Although the empirical evidence in the literature points out to an individual investor who is risk-averse for gains and risk-loving for losses, the results in this study shows that in this particular case, the LPW performance measure faces a possible shortcoming that is due to the structure of the marginal utility of the loss aversion function and the dynamics behind the construction of the PW performance measure's vector of weights. Hence, when it comes to the evaluation of the utility of an institution, it seems that new sets of rules hold than when considering an individual; to look at what constitutes representative behvaviour in a universe of institutional investors may exhibit different risk characteristics from private investors. An alternative pragmatic approach was to delete those contributions to performance where the excess returns of the benchmark are zero.

The results reported by the LPW performance measure for the case of an investor who is risk-averse for losses and risk-loving for gains are more compatible with the traditional measures' evaluation and do seem to pick up on the timing skills exhibited by the active fund managers and then reward them accordingly.

In conclusion, using parameter-dependent evaluation methods will always lead to the adoption of results that are controversial and that would differ drastically depending on which values of the parameters are adopted. Adopting a non-parametric approach might be able to go pass this problem and hence present the researcher with better and more reliable results.

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