Are individual investors such poor portfolio managers?

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Abstract

In that paper we evaluate individual investors' performance with measures which fit their preferences and risk perception. Based on 24,766 individual investors from a French brokerage between 2003 and 2006, we evidence that choosing alternative performance measures to the Sharpe ratio result in different rankings of investors. When they are evaluated with a measure consistent with their attitude towards risk rather than with the Sharpe ratio, a larger proportion of investors beat the market index. Yet, individual investors underperform a random investing strategy even with alternative measures. We conclude that the improvement of investor's performance with alternative measures is driven by mechanical effects du to the skewness of their portfolio rather than good stock picking skills.

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"Individual traders are often regarded as at best uninformed, at worst fools." Coval, Hirshleifer, and Shumway (2005).

Financial performance is one main concern of investors, whether they are professionals or individual investors. The success of an investment strategy and the skills of a trader are evaluated ex-post by assigning a score to the portfolio, which usually corresponds to risk-adjusted returns. Concerning individual investors, the global evidence reports that they do not outperform relevant benchmarks. Barber and Odean (2000) show on 66,465 U.S households that neither the Jensen's alpha (Jensen (1968)) nor the intercept test from the Fama–French model (Fama and French (1993)) are reliably different from zero from 1991 to 1996. Barber and Odean (2000) also find that the Sharpe ratio (Sharpe (1966)) of the average household in their sample is 0.179, compared to 0.366 for the market during the period. Based on the Jensen's alpha and the intercept test from the Fama–French model, Odean (1999) provides evidence that the stocks that investors buy subsequently underperform the stocks they sell. On the Taiwanese market, long-short portfolios that mimic the buy–sell trades of individual investors earn reliably negative monthly alphas of 11.0%, 3.3%, and 1.9% over horizons of 1, 10, and 25 days respectively (Barber, Lee, Liu, and Odean (2009)).

Researchers demonstrate that these poor results can be explained by psychological considerations such as (among others) overconfidence, familiarity bias, or loss aversion. Even if these considerations are unrelated to the information about underlying security values, they impact the trading choices of individual investors. As a result, individual investors trade excessively, under-diversify their portfolio and have a tendancy to sell winners too early and to ride losers too long (the so-called disposition effect).

In this paper, we argue that the poor performance of individual investors may be simply due to a wrong performance measure. Indeed, risk-adjusted return indicators such as the Jensen's alpha, the Fama-French intercept and the four-factor intercept stem from the Mean-Variance model (Markowitz (1952)). In this paradigm, we evaluate the risk of a choice by the variance of the outcomes. However, surveys reveal that the variance does not fit with the risk perception of individual investors (Unser (2000); Veld and Veld-Merkoulova (2008)). Therefore, though these performance indexes are widely spread in the literature, we should interpret them cautiously when they are related to individual investors. The same argument applies to the Sharpe ratio which is the most popular performance measure in the finance industry. In «The (more than) 100 ways to measure portfolio performance» Cogneau and Hubner (2009a) and Cogneau and Hubner (2009b) suggest that a number of alternative performance measures overcome the main drawbacks of the Sharpe ratio. Besides the abovementioned problem on risk perception, the fact that the Sharpe ratio is founded on the Expected Utility Theory (EUT) questions its use as a relevant performance measure for individuals investors. According to the EUT, investors exhibit a uniform attitude towards risk, i.e., they are risk averse throughout (Von Neumann and Morgenstern (1947)). Yet, experimental evidences find that investors do not behave as it is assumed in this model of decision-making. Research show that individual investors exhibit loss aversion, have risk averse preferences for gains combined with risk seeking preferences for losses[1] (Kahneman and Tversky (1979); Tversky and Kahneman (1992)) and target lottery-like outcomes (Friedman and Savage (1948); Mitton and Vorkink (2007)). To adress for these actual behaviors, the Prospect Theory (Kahneman and Tversky (1979); Tversky and Kahneman (1992)) and the Behavioral Portfolio Theory (BPT) (Shefrin and Statman (2000)) have been proposed in the litterature as alternative models of preferences.

In this work, we demonstrate that individual investors are not such poor managers when we evaluate their performance with measures correctly weighting their preferences and risk perception. More precisely we choose performance measure which adjust gains by the risk associated with losses (downside risk) instead of the total risk. Furthermore we allow for different models of choices with the performance measure proposed by Farinelli

[1]This is the certainty effect (risk averse preference for a sure gain over a larger gain that is merely probable) combined with the reflection effect (risk seeking preference for a loss that is merely probable over a smaller losses that is certain

and Tibiletti (2008). This ratio exhibit a great flexibility in such a way that attitudes toward risk can be weighted for gains and losses.

Our empirical study shows that the proportion of individual investors beating the market is much larger when performance is evaluated with a measure consistent with the Behavioral Portfolio Theory, compared to the score they obtain with the Sharpe ratio. As a consequence, we actively support a replacement of the Sharpe ratio by more fitted performance measures when it comes to evaluate the performance of individual investors.

The equivalence of performance measure is a topic of debate in the literature. On one side, Eling and Schuhmacher (2007) compare 13 performance measures[2] and find that the ranking of 2763 hedge funds (over the period 1985-2004) is not significantly affected by the choice of the performance measure. In fact, the average rank correlation of performance mesure with the Sharpe ratio is 97%. Eling (2008) conforms these results on a set of 38,954 mutual funds invested in stocks, bonds, commodities and real estate. In contrast with these findings, Zakamouline (2011) finds that the evaluation of performance depends on the selected performance measure.

We contribute to the litterature on alternative performance measures by focusing on individual investors instead of hedge funds. Our contribution is threefold. First we support the results of Zakamouline (2011) and find that the choice of alternative performance measures has an impact on the ranking of investors. For instance in 2003, the proportion of investors who are upgraded (downgraded) with another measure than the Sharpe ratio ranges from 35.94% to 46.45% (5.85% to 36.19%). We show that these proportions significantly differ from what is expected with random permutations. Second we show that, compared to the market index, individual investors are not such poor managers as reported by the Sharpe ratio ranking. For example in 2006, though only 10% of investors outperform the market index according to the Sharpe ratio, 60% of the population beat

[2] Sharpe ratio, Treynor ratio, Jensen's alpha, Omega ratio, Sortino ratio, Kappa3 ratio, Upside Potential ratio, Calmar ratio, Sterling ratio, Burke ratio, Excess return on value at risk, Conditional Sharpe ratio and Modified Sharpe ratio.

the market with the measure fitting the Behavioral Portfolio Theory. With this measure, 30% of investors outperform the market during 4 consecutive years, whereas no investor beat the market persistently with the Sharpe ratio. Finally we show that randomly created portfolio outperform investors in our sample, even with the alternative measures. We conclude that the improvement of investors'performance is not driven by their stock picking skills but rather by mechanical effects linked to the skewness of their portfolio as a whole. As a result, though our main finding is the importance of the choice of the measure, we do not conclude that individual investors exhibit particular skills to select outperforming stocks.

This paper is organized as follows. In Section 1, we challenge the Sharpe ratio and present the alternative measures analyzed in our study. We present the empirical study in Section 2 and we conclude in Section 3.

1 The Sharpe ratio and the alternative measures

The Sharpe ratio is usually computed as follows:

$$Sharpe\,ratio = \frac{(r_i - r_f)}{\sigma_i} \tag{1}$$

in which r_i is the mean return of the investor i, r_f is the risk free rate and σ_i is the standard deviation of the portfolio returns. This measure has a simple design and includes two main information (risk and return). Yet, the Sharpe ratio is not relevant in case of individual investors.

Firstly, it is impossible to establish a global ranking of investors with the Sharpe ratio. Indeed, when the numerator is positive, the larger the excess return and the lower the standard deviation, the larger the Sharpe ratio. However in case of a negative numerator, investors cannot be ranked in order of their performance. To illustrate this limit, consider this small example, with 3 assets, A ($r_A - r_f = -0.10; \sigma_A = 0.40$), B

$(r_B - r_f = -0.10; \sigma_B = 0.50)$, and C $(r_C - r_f = -0.05; \sigma_C = 0.40)$.

$$Sharpe\,ratio_A = \frac{(r_A - r_f)}{\sigma_A} = -0.25$$

$$Sharpe\,ratio_B = \frac{(r_B - r_f)}{\sigma_B} = -0.20$$

$$Sharpe\,ratio_C = \frac{(r_C - r_f)}{\sigma_C} = -0.125$$

A and B exhibit the same excess return, but B is more volatile. Therefore, B is prefered to A. In term of Sharpe ratio, that means that $Sharpe\,ratio_B = -0.20$ is worse than $Sharpe\,ratio_A = -0.25$. In that case, the smaller the Sharpe ratio, the better the performance of the asset. Yet, let's compare A and C which exhibit the same volatility, but $r_C = -0.05$ is larger than $r_A = -0.10$. Therefore C is prefered to A, which means that $Sharpe\,ratio_C = -0.125$ is better than $Sharpe\,ratio_A = -0.25$. In that case, the rule is reversed: the larger the Sharpe ratio, the better the performance of the asset.

Secondly, the variance used as a risk measure in the Sharpe ratio constitutes a major drawback because it allocates the same weight to positive and negative deviations. Actually, surveys on risk perceptions reveal that symmetric risk measures are neglected by investors in favor of asymmetric ones (Unser (2000); Veld and Veld-Merkoulova (2008)).

At the same time, Ang and Chen (2006) show that returns integrate a premium for the risk of losses. The aggravation that one experience losing a sum of money appears to be greater than the pleasure associated with gaining the same amount; this effect is so-called loss aversion (Kahneman and Tversky (1979), Kahneman, Knetsch, and Thaler (1990), Tversky and Kahneman (1992)).

Numerous alternative measures to the Sharpe ratio have been suggested in the litterature. In that paper, we study alternative measures that have a *return/risk* design. This simplicity is one main strenght of the Sharpe ratio. To adress the abovementioned weaknesses, we select alternative measures that are based on upper and lower partial moments.

Lower partial moments (LPM) measure the risk as negative deviations from a reference point. Therefore, they evaluate the undesirable volatility (i.e., left-side volatility), or the so-called "downside risk". The lower partial moment of order k ($k > 0$) for investor i during the period T is defined as:

$$LPM_k(r_i) = \frac{1}{T}\sum_{t=1}^{T}[Max(0, \tau - r_{it})]^k \tag{2}$$

in which τ is the target return and r_{it} is the stock return on date t. The coefficient k weights the deviation from the target return. For example, LPM of order one measures the expected value of loss and LPM of order two measures the semi-variance. Note that the semi variance is a measure of the asymmetry of the distribution. In case of symmetric returns, the semi-variance is equal to half of the variance.

In LPM of order k, if $k > 1$, the greater the k, the higher the emphasis on the extreme deviations from the benchmark. By contrast, a $k < 1$ means that the agent's main concern is to fail the target without regard to the amount lost. If moderate deviations from the target are relatively harmless when compared to large deviation, then a high order for the lower moment is adapted ($k > 1$). Figure 1 illustrates this mechanism. For each graph, returns r_{it} presented on the x-axis lie between -2% and 2%. Outcomes $[Max(0, \tau - r_{it})]^k$, based on a target return τ equal to 0.5%, are on the y-axis. We present 2 cases for k: $k = 0.5$ and $k = 1.5$. For $k < 1$ additional percent of return *lost* provide diminishing marginal contribution to the shrinkage of the outcome. By contrast, when $k > 1$, additional percent of return *lost* provide increasing marginal contribution to the shrinkage of the outcome.

Symmetrically to Lower Partial Moments, Upper Partial Moments (UPM) measure the positive deviation of returns from the target return:

$$UPM_k(r_i) = \frac{1}{T}\sum_{t=1}^{T}[Max(0, r_{it} - \tau)]^k \tag{3}$$

As for lower partial moments, the coefficient k ($k > 0$) enables the user to allocate a weight to deviations (see figure 2). The higher the order, the higher the agents inclination towards the extreme outcomes (with outcomes equal to $[Max(0, r_{it} - \tau)]^k$). If small gains are satisfactory, then an order lower to 1 fits the purpose ($k < 1$).

To synthesize, partial moments are always positive, allowing a global ranking of investors. Risk is defined by downside risk and loss aversion can be taken into account with a higher coefficient for lower than upper moments.

The Farinelli-Tibiletti ratio is a performance measure based on Upper Partial Moments at the numerator and Lower Partial Moments at the denominator.

$$Farinelli - Tibiletti_{(p-q)} \quad ratio(r_i) = \frac{(UPM_p(r_i))^{1/p}}{(LPM_q(r_i))^{1/q}} \tag{4}$$

The flexibility in the coefficients p and q allows designing a performance measure adapted to investor's preferences.

In a first case, we choose p and q equal to 1 to convey neutral attitude towards risk for gains and losses. Indeed, $p = q = 1$ implies that positive and negative deviations from the target are equally weighted. The Farinelli-Tibiletti$_{(1,1)}$ corresponds to the Omega ratio, previously proposed by Keating and Shadwick (2002).

$$Omega\, ratio(r_i) = \frac{(UPM_1(r_i))}{(LPM_1(r_i))} \tag{5}$$

In a second case, we integrate loss aversion in the Farinelli-Tibiletti ratio with a higher order for the LPM: $q = 2$. The Farinelli-Tibiletti$_{(1,2)}$ corresponds to the Upside Potential ratio, previously proposed by Sortino, Van Ver Meer, and Plantinga (1999).

$$Upside\, potential\, ratio(r_i) = \frac{(UPM_1(r_i))}{(LPM_2(r_i))^{1/2}} \tag{6}$$

The Omega ratio and the Upside Potential ratio are the first measures selected in our study to be compared to the Sharpe ratio (Selected performance measures are summarized in table 1).

The Sharpe ratio microeconomic foundations are based on the Expected Utility Theory (EUT) (Von Neumann and Morgenstern (1947)). A performance measure that is suited to such behaviors reflects risk aversion in the domain of gains and in the domain of losses. To take into account this model, we choose $p < 1$ and $q > 1$. Indeed, in the domain of gains (UPM at the numerator), $p < 1$ indicates that investors are not necessarily seeking large gains with low probability of occurrence. Instead, they are satisfied as soon as outcomes pass the target and additional gains provide a decreasing marginal contribution to utility. In the domain of losses (LPM at the denominator), $q > 1$ signifies that large deviations from the target return are not desired. The marginal contribution of additional losses to (des)utility is increasing.

Yet, Kahneman and Tversky (1979) evidence the inability of the EUT to explain portfolio choices of investors. More precisely, in EUT investors exhibit uniform attitude towards risk. Contrary to this assumption, experimental evidence has established a "fourfold pattern of risk attitudes": risk aversion for most gains and low probability losses, and risk seeking for most losses and low probability gains (Kahneman and Tversky (1979)).

To consider the attitude towards risk for most commons events, Kahneman and Tversky (1979) introduced a S-shaped utility function (the so-called Value function) in Prospect Theory. With this Value function, the marginal value of both gains and losses decreases with their magnitude. The concept of Loss aversion is integrated by a steeper Value function for losses than for gains. We take into account this model of preferences in the Farinelli-Tibiletti ratio with $p < 1$ at the numerator, meaning that the investor is risk averse in the domain of gains, and $q < 1$ at the denominator, meaning that the investor is risk seeking in the domain of losses.

Concerning unlikeky outcomes, Kahneman and Tversky (1979) report that individuals are risk averse for losses and risk seeking for gains. This behavior is in line with Friedman and Savage (1948) puzzle, the fact that investors who buy insurance policies often buy lottery tickets at the same time. Friedman and Savage (1948) explain that (p.279) *"An individual who buys fire insurance on a house he owns is accepting the certain loss of a small sum (the insurance premium) in preference to the combination of a small chance of a much larger loss (the value of the house) and a large chance of no loss.That is, he is choosing certainty in preference to uncertainty. An individual who buys a lottery ticket is subjecting himself to a large chance of losing a small amount (the price of the lottery ticket) plus a small chance of winning a large amount (a prize) in preference to avoiding both risks. He is choosing uncertainty in preference to certainty"*.

More recently, researchers observe that individual investors design their portfolio with the intention of increasing the likelihood of extreme positive returns. In other words, investors make the distributions of their wealth more lottery-like (Statman (2002); Kumar (2009); Barberis and Huang (2008)). Kumar (2009) define lottery-type stocks following the salient features of state lotteries. Lottery tickets have very low prices relative to the highest potential payoff (i.e., the size of the jackpot); they have low negative expected returns; their payoffs are very risky (i.e., the prize distribution has extremely high variance); and, most importantly, they have an extremely small probability of a huge reward (i.e., they have positively skewed payoffs). As with lotteries, if investors are searching for lottery-like assets, they are likely to seek low-priced, high stock-specific skewness stocks.

Along the same lines, Mitton and Vorkink (2007) find that investors consciously hold few stocks to capture positive skewness. Indeed, though increasing the number of assets in a portfolio enables to decrease the total variance by cancelling specific risk of each security, it also reduces portfolio skewness. Therefore, a strategic underdiversification is necessary to capture asymmetric returns. Moreover, underdiversified investors are more prone to select positively skewed stocks (Mitton and Vorkink (2007)). Goetzmann and Kumar (2008) prove that investors who tilt their portfolio towards stocks with an asymmetric distribution and a high variance (small capitalizations, growth stocks, technological sector) hold concentrated portfolios.

In Prospect Theory, these preferences can be adressed by the combination of the Value function and an overweighting of the probabilities of extreme events. The probability transformation offset the initial shape of the Value function. As a result, additional percent of return lost provide decreasing marginal (des)utility, whereas additional percent of return gained provide increasing marginal utility. Shefrin and Statman (2000) have emphasized the role of gambling in investment decisions in their Behavioral Portfolio Theory (BPT). According to BPT, investors proceed in two steps to set their portfolio. First they satisfy a security criteria, ensuring a minimum return with riskless assets. Second they invest their remaining wealth in a cheap asset with huge probability of gains[3].

We can translate such preferences in the Farinelli-Tibiletti ratio with $p > 1$ at the numerator and $q > 1$ at the denominator. With $p > 1$, investors target exceptional performances and gives importance to large but unlikely excess returns above the benchmark. $q > 1$ means that large losses are undesired.

In that paper, we follow Zakamouline (2011) and estimate the Farinelli-Tibiletti ratio according to 3 $(p - q)$ couples: $(0.5 - 2)$ to be in accordance with the EUT; $(0.8 - 0.85)$ to model the Value function, and $(1.5 - 2)$ to depict BPT investors.

To sum up, alternative performance measures are always positive and consider downside risk thanks to lower partial moments at the denominator. The Omega ratio represents investors with neutral attitude towards risk. The Upside Potential ratio integrates loss aversion with a stronger coefficient for LPM. The Farinelli-Tibiletti ratio$_{(0.5\text{-}2)}$ represents investors who behave as it is assumed in the EUT, the Farinelli-Tibiletti ratio$_{(0.8\text{-}0.85)}$ represents investors whose preferences are conveyed by the Value function and the Farinelli-Tibiletti ratio$_{(1.5\text{-}2)}$ represents investors who behave accordingly with the BPT.

In this first section, we explained why the Sharpe ratio is not a suitable measure to estimate the performance of individual investors. Based on five alternative performance

[3]Two versions of BPT co-exist: One mental account and multiple mental accounts. We set in the one mental account case.

measures that overcome the Sharpe ratio main drawbacks, we now evidence that the evaluation of individual performance is influenced by the choice of the measure. In a second step, we show that investors are not such poor managers when their performances are estimated with alternative measures.

2 Empirical study

2.1 Data

The primary data set is provided by a large European brokerage house. We obtained daily transactions records of 24,766 French investors over the period 2003-2006. Descriptive statistics related to these investors are presented in table 2. Data in the panel A indicate that among the 24,766 investors, 80.4% are men. The panel B and C are dedicated to transactions and portfolios respectively, and present yearly results. The 24,766 investors realized 1,882,044 trades over the 4 years. On average, each investor realized 19.2 transactions in 2003, 16.7 transactions in 2004, 18.7 transactions in 2005 and 21.4 in 2006. The investors average purchase (sale) turnover lies between 5.9% (6.2%) in 2004 and 7.8% (8.7%) in 2006. Note that the purchase turnover and the sales turnover are the values of the amounts bought or sold, respectively, in proportion of the monthly portfolio value.

From the trade records, we computed the daily stock portfolio of each investor. On average, the portfolio value of investors worthes 24,241€ in 2003, 27,901€ in 2004, 31,259€ in 2005 and 36,629€ in 2006. Investors hold an average of 8 stocks in their portfolios. Yearly returns of portfolios are computed based on weekly returns. The lowest annual return is observed in 2004 (8.16%) whereas the largest is observed in 2003 (31.40%). Over the same period, the market index[4] exhibit annual returns of 22.99% (2003), 14.95% (2004), 28.99% (2005) and 25.23% (2006). The difference between the average return of

[4]Data on the market index is given by the Eurofidai general index (computed using the methodology of the Center for Research in Security Prices, CRSP, and based on approximately 700 stocks over the period under consideration). European financial data institute: https://www.eurofidai.org

investors and the market return in 2003 is explained by an important skewness of investor (0.76). Computed Jensen' s α are consistent with these differences. Indeed, in 2003, α is positive, equal to 6.99% whereas in 2004 it is negative, equal to -3.83%.

It is worth mentionning that in 2003 (resp. 2004, 2005, 2006), 82.8% (resp.18%, 37.7%, 44.5%) of investors hold portfolio with non Gaussian distribution of returns. We test normality with the Jarque-Bera test at 95% confidence level.

Stock price data come from two sources, Eurofidai for stocks traded on Euronext and Bloomberg for the other stocks. Investors trade 2,491 stocks, of which 1,191 are French, and the main part of the others comes essentially from the U.S. (1020 stocks). Despite this large part of U.S stocks, more than 90% of trades are realized on French stocks.

In the following section, we demonstrate that the alternative measures chosen in this study are not equivalent to the Sharpe ratio. This observation is the starting point required to justify that alternative measures should be favored over the Sharpe ratio when evaluating individual investors.

2.2 Equivalence between measures

Two measures are said equivalent if they generate the same ranking of the set of investors. Performance measures are calculated each year using weekly returns. The target return on performance measures requiring such target return is the risk-free rate. Each year, we sort investors in decile with each measure, including the Sharpe ratio. The ranking computed for the Sharpe ratio is sightly different from a classic ranking. Though we cannot rank together several investors who exhibit a negative Sharpe ratio, we can rank a positive and a negative Sharpe ratio. Indeed, the positive Sharpe ratio is better than the negative one. We thus rank investors who exhibit a negative Sharpe ratio in the bottom decile. It follows that the bottom decile may contain more than 10% of investors. More precisely, in 2003 (resp. 2004 2005 and 2006), the bottom decile contains 4.22% (resp. 25.85%, 7.52% and 8.57%) of investors. We then rank investors who exhibit a positive

Sharpe ratio in nine quantiles. These nine quantiles each contains 11.11% of remaining investors.

We present the rank correlations in table 3. We compute two statistics (Spearman ρ and Kendall τ) and both result in similar conclusions, although the Kendall τ provides lower statistics. Since both statistics are supported by researchers in the litterature (Noether (1981), Griffiths (1980)), there is no reason to prefer one to the other.

The Omega ratio is the measure that exhibit the higher correlation with the Sharpe ratio. With the Spearman ρ, the correlation is close to 98% each year. Therefore the only consideration of the downside risk does not modify the evaluation of investors. The Upside Potential ratio is the second most correlated measure with the Sharpe ratio. The inclusion of the consideration of loss aversion does not much more influence the evaluation of investors. We observe that the correlation is stronger in 2004, rising to 94.88% with the Spearman statistic, when the proportion of investors who exhibit normal returns is the highest (82%). Since the alternative measures are based on deviations from the benchmark, the ranking by these measures should be closer to the ranking produced by the Sharpe ratio when returns are normal. Yet, we do not observe a similar increase of correlation with the other measures, indicating that others effect are interacting.

In order of decreasing correlation, we next find the Farinelli-Tibiletti$_{(0.5\text{-}2)}$ ratio, the Farinelli-Tibiletti$_{(0.8\text{-}0.85)}$ ratio and the Farinelli-Tibiletti$_{(1.5\text{-}2)}$ ratio. For the latter, Spearman ρ ranges between 30.59% and 41.58%, and Kendall τ ranges between 23.17% and 32.60% across years. This model seems to be the farthest to the Sharpe ratio.

These strengths of relationship between alternative measures and the Sharpe ratio are corroborated by the transition matrices presented in tables 4, 5, 6, 7 and 8. In rows we present the ranking resulting from the evaluation of investors' performance with the Sharpe ratio. In columns, we present the ranking resulting from the evaluation with the considered alternative measure. For each pair of deciles (i, j), we report the conditional probability to be ranked in the decile j with the alternative measure when the rank with the Sharpe ratio is the decile i. [5]

If the rankings are similar, i.e the decile of investor with the Sharpe ratio (i) and the decile of investor with the alternative measure (j) are equal, we should observe positive probabilities only on the diagonal of the matrix.

We see clearly that the rankings resulting from the evaluation of performance with the Omega ratio and the Sharpe ratio are close. Indeed, most probabilities in the matrices are null except the values on the main diagonal where $i = j$ and on the second diagonals where $j = i + 1$ and $j = i - 1$. For instance in 2003, if an investor is ranked in the first decile with the Sharpe ratio, then the probability to be ranked in the first decile with the Omega ratio is 100%. Therefore the probability to be in $j = 2, ..., 10$ is null when $i = 1$. If the investor is ranked in decile i with the Sharpe ratio, then there are large probabilities for him to be ranked in decile $j = i$ or in decile $j = i - 1$ with the Omega ratio. Similar patterns are observed in 2005 and 2006. Yet in 2004, the diagonal is shift to the right of the matrix. Hence, an investor ranked in decile i ($i = 3\, to\, 8$) with the Sharpe ratio has more probability to be ranked in decile $j = i + 1$ than in decile $j = i$ with the Omega ratio.

With the Upside potential ratio, the conditional probabilities are more spread out over the matrices, but they are null for the extreme pairs of deciles. For instance in 2004 with $i = 10$, we observe null probabilities for $j = 1$ to $j = 4$, i.e., an investor ranked in the top decile with the Sharpe ratio cannot be ranked in the first worst deciles with the Upside potential ratio.

We obtain even more positive conditional probabilities with the Farinelli-Tibiletti$_{(0.5\text{-}2)}$ and the Farinelli-Tibiletti$_{(0.8\text{-}0.85)}$.

With the Farinelli-Tibiletti$_{(1.5\text{-}2)}$ ratio, the conditional probabilites are spread out over the whole matrix. In other words, it is possible to be ranked in each decile $j = 1, ..., 10$ resulting from the alternative measure evaluation whatever the decile i resulting from the Sharpe ratio evaluation . We observe similar patterns across years.

[5]Based on contingency tables (i.e., the observed frequencies for each pair of deciles (i, j)), Khi2 test confirms that the ranking of investors according to the Sharpe ratio is not independant from the ranking of investors according to alternative measures: $P(i, j) \neq P(Decile_{Sharpe} = i) * P(Decile_{MesureAlternative} = j)$.

These transition matrices indicate that the performance measure does influence the evaluation of investors, which corroborates Zakamouline (2011) works. We summarize the rank permutations in table 9. With the Farinelli-Tibiletti(1.5-2) ratio, the maximum downgrade (presented in column 1) is -9. In other words, some investors ranked in the best decile with the Sharpe measure move to the bottom decile with this alternative measure. We observe the same phenomenon in the opposite direction. For instance in 2003, with the 3 versions of the Farinelli-Tibiletti ratio, the maximum upgrade (presented in column 2) is 9. With the Omega ratio the maximum upgrade is 2 in 2003 and 2005, and only 1 in 2004 and 2006. Note that the maximum upgrade is always observed with the Farinelli-Tibiletti(1.5-2) ratio, which is consistent with the fullness of the transitions matrices. We observe that the results are similar for the Upside Potential ratio that integrates the value of loss aversion and the Farinelli-Tibiletti(0.5-2) ratio that accounts for the Expected Utility Theory.

We present the proportion of investors who remains in the same decile in the third column. In 2006 for instance, this proportion ranges from 17.90% with the Farinelli-Tibiletti(1.5-2) ratio to 82.64% with the Omega ratio. Over the years, the highest proportion of investors who remain in the same decile is always observed with the Omega ratio, followed by the Upside potential ratio. By contrast, the largest proportions of investors who move to a higher/lower decile (see the fourth and fifth column of the table) are observed with the Farinelli-Tibiletti(1.5-2) ratio. With this measure in 2004, 47.33% of investors are downgraded whereas 36.27% of investors are upgraded.

Hence, a considerable proportion of investors moves to a different decile with certain alternative measures. Computed proportions are similar across years, which supports the robustness of this observation.

To test whether these rank permutations are significant, we run Monte-Carlo simulations. More precisely, we create a vector of 24,766 fictitious investors, ranked in deciles.

We rank investors #1 to #2477 in the first decile, investors #2478 to #4955 in the second decile, and so on until investors $\#22,290$ to $\#24,766$ who are ranked in the 10^{th} decile. Based on this initial vector, we compute 1,000 random rank permutations to obtain 1,000 new vectors with permuted deciles. Across the 1,000 permutations, the proportion of fictious investors who remain in the same decile ranges between 9.63% and 10.38% at the 95% confidence level. Therefore, if our results were driven by chance, we should observe that the proportion of investors who remain in the same decile when we evaluate them with an alternative measure rather than with the Sharpe ratio is comprised in this confidence interval. Yet in 2003 for instance, the actual proportions ranges from 17.35% to 58.20%. Therefore the permutations that we observe are not the result of a random process.

2.3 Comparison with the market index

Permutations resulting from evaluation with alternative measures apply to the market index too. In table 10 we present for each year and each measure the decile of the market index. These grades are based on the initial ranking of investors computed for each measure. To understand how the choice of the performance measure does influence the evaluation of investors, it is interesting to analyze this table in term of percentages. For example, in 2005, only 10% of investors outperform the market index according to the Sharpe ratio. Yet, if we refer to the Farinelli-Tibiletti$_{(0.8\text{-}0.85)}$ ratio, for the same year, 30% of investors beat the market, while this proportion rises to 60% with the Farinelli-Tibiletti$_{(1.5\text{-}2)}$ ratio. Therefore, evaluating investors with a measure that fits to the S-shaped Value function leads to worse results (for investors) than with a mesure that fits the Behavioral Portfolio Theory.

More substantial, in 2004, though only 10% of investors outperform the market index according to the Sharpe ratio, with the Farinelli-Tibiletti$_{(1.5\text{-}2)}$ ratio 90% of the population is ranked in a better decile. This large difference is consistent with the results reported in table 9 and lead us to wonder whether individual investors are such poor managers as studies usually report. Note that the measure that fits the Value function in Prospect Theory is the second most favorable measure for individual investors.

In 2003, we observe a smaller difference between the ranks defined according to each measure. This effect is consistent with the strong outperformance of annual returns of investors on the market this particular year (see table 2).

To test whether our results are driven by the value of p and q chosen in that paper, we compute the proportion of investors who beat the maket each year, according to the value of $(p - q)$ couple. Results are presented in figure 3, 4, 5 and 6. p and q coefficients lie between 0 and 4, with a 0.1 incremental unit. It appears that the proportion of investor who beat the market increases with the coefficient p and q.

Depending on the value of $(p - q)$, the proportion of investors who beat the market ranges between 10 % and 90% in 2003, and between 0% and 90% in 2004. In 2005 and 2006, the maximum proportion of investors who beat the market is 70%.

To end with the largest proportion of investors beating the market (darkest area) when $q = 2$, p must be at least equal to 1.5 in 2003, 1.3 in 2004, and 2 in 2005. These results explain why the Farinelli-Tibiletti(1.5-2) ratio gives rise to a larger part of investors beating the market than the Farinelli-Tibiletti(0.5-2). In 2006, if $q = 2$, p must be at least 3.9 to be located in the darkest area. This value is more than twice the value of the highest p in our computations ($p = 1.5$). This observation is consistent with the previous result that only 50% of investors beat the market with the Farinelli-Tibiletti(1.5-2) in 2006. In fact, with $q = 2$, the proportion of investors who beat the market increases with the value of p. The surface is darker and darker as we move to the right side of the figure.

If we compare $p = 0.5$ and $p = 0.8$, the proportion of investors who beat the market is most of time larger with $p = 0.8$, whatever the value of q. Therefore, the value of p (for the UPM at the numerator) is more determinant than the value of q (for the LPM at the denominator) to evaluate the outperformance of investors.

We next examine whether outperformance is persistant over time. In table 11, we present the proportion of investors who are ranked in a higher decile than the market index with each measure during 1, 2, 3 and 4 years starting from 2003. In other words, we analyze the proportion of investors who beat the market in 2003, in 2003 and 2004, in 2003, 2004 and 2005 and in 2003, 2004, 2005 and 2006. With the Farinelli-Tibiletti$_{(1.5\text{-}2)}$ ratio, 90% (resp. 81.37%, 48.16%, 30.48%) of investors beat the market during 1 year (resp. 2 years, 3 years, 4 years). These proportions are the largest ones in the table, followed by the values obtained with the Farinelli-Tibiletti$_{(0.8\text{-}0.85)}$ ratio and the Farinelli-Tibiletti$_{(0.5\text{-}2)}$ ratio. As a comparison, with the Sharpe ratio 42.66% of investors beat the market in 2003, 4.67% in 2003 and 2004, 1.12% from 2003 to 2005 and less than 0.3% over the complete period.

Therefore, with the Sharpe ratio we conclude that a handful of them beat persistently the market. By contrast with the measure that fits BPT, more than a quarter of investors beat the market during 4 consecutive years.

2.4 Skills or luck?

In the previous section, we provided evidence that the Farinelli-Tibiletti$_{(p\text{-}q)}$ ratio that is consistent with the Behavioral Portfolio Theory promotes the portfolio hold by individual investors. In other words, with this measure, individual investors perform much better than with the others. BPT investors tend to increase the likelihood of extreme positive returns by making the distributions of their wealth more lotery-like,. Mitton and Vorkink (2007) show that this skewness seeking drives investors to hold underdiversified portfolios. Consistently with this finding, the median number of stocks hold in portfolio is 6 in our sample (see descriptive statistics in table 2). According to the works of Statman (1987), a well diversified portfolio must include at least 30 stocks. Hence, investors hold underdiversified portfolios, which confirm that individual investors in our sample try to capture extreme asymmetric returns. Both results (outperformance of investors with BPT and underdiversification) jointly indicate that the behavior of investors in our sample is best modelized with the Behavioral Portfolio Theory.

In that section we analyze whether the observed outperformance of investors is solely mechanical. Actually, it is not surprising to find that investors who are underdiversified outperform the market with a measure that promote asymetric returns. Though our results might be purely driven by mechanical effects, our goal in this paper is to emphasize that there exists measures more suited to individual investor than the Sharpe ratio. We indeed show that these measures lead to refined conclusions relatively to their poor trading ability. Yet, can we really conclude that individual investors select stocks correclty? Do they really have particular stock picking skills? Are they doing better than they could do by luck?

To answer these questions, we start with the creation of 24,766 portfolios composed of stocks picked at random. The weights that we allocate to each stock in the portfolios are drawn randomly as well. We then compute Sharpe ratios and alternative measures each year, for each portfolio, based on weekly returns. Lastly, we rank each year and with each measure the random portfolios.

The number of stocks in each portfolio mimic the number of stocks of investors. More precisely, the first portfolio created contains exactly the same number of stocks than the portfolio of the investor #1; The second portfolio created contains exactly the same number of stocks than the portfolio of the investor #2; and so on.

Our goal in this section is to analyze the rank of the market index among these random portfolios. As table 12 shows, with the 3 versions of the Farinelli-Tibiletti ratio, the market index is each year in the bottom part of the ranking. In other words, 90% of the random portfolios outperform the market index. Comparing this large proportion with the results reported in table 10, we remark that investors do not perform better than the randomly chosen portfolios.

Though the Farinelli-Tibiletti ratio enhances investors performance, an under-diversified random strategy is even more promoted. Interestingly, the random strategy is promoted by the measures that fit the 3 models of decision making considered in our study. Yet, though the Behavioral Portfolio model implies to underdiversify for capturing skewness, it is the opposite for the Expected Utility Theory. Indeed, EUT penalizes the deviations from the target return that arise due to a lack of diversification. We assume that the good performance of stocks randomly selected overcome this effect.

Consequently,it is the shape of their distribution of returns which boosts investors' performance. The overall increase in performance is not due to the particular stocks chosen.

With the Sharpe ratio, the Omega ratio, and the Upside potential ratio, the market index is, as expected, in the top of the ranking. Yet, in 2003, though the index is ranked in higher deciles with these measures than with the Farinelli-Tibiletti ratios, the outperformance is not so clear. Indeed, at least 60% of the randomly created portfolios are ranked in a better decile. We observed a similar effect with the portfolios of investors (see table 10).

3 Conclusions

In this paper we evidence that it is not reasonable to evaluate investor's performance according to a standard ratio that does not consider their investing criteria. We compare the evaluation of performance resulting from the Sharpe ratio with the ones resulting from alternative performance measures. We consider five measures, designed as the Sharpe ratio (return to risk ratio). Yet those measures are always positive and enable a ranking among investors in all cases, whereas the Sharpe ratio has no meaning when it is negative. Besides this main difference, risk is defined by negative deviation from a target, rather than by the variance.

Alternative measures are built with partial moments and are designed to take into consideration several preferences of investors. The Omega ratio represents neutral attitude towards risk for gains and losses. The Upside Potential ratio integrates the concept of loss aversion with a stronger weight allocated to losses than to gains. Investors within the Expected Utility Theory, who are risk averse throughout, are considered with the

Farinelli-Tibiletti(0.5-2) ratio. Investors whose preferences are consistent with the Value function in Prospect Theory (i.e., risk averse for gains and risk seeking for losses) are represented in the Farinelli-Tibiletti(0.8-0.85) ratio. Lastly, investors who behave as it is assumed in the Behavioral Portfolio Theory (i.e., risk seeking for gains and risk averse for losses) are taken into consideration with the Farinelli-Tibiletti(1.5-2) ratio. Considering the tendancy to seek skewness through underdiversification reported by Mitton and Vorkink (2007), this model seems to best fit the behavior of individual investors.

We first show that the choice of the performance measure does influence the ranking of investors. Indeed, a significant part of investors moves to a higher/lower decile when we estimate their performance with an alternative measure. Second, we find that a greater proportion of investors outperform the market index with alternative measures, notably with the Farinelli-Tibiletti(1.5-2) ratio. Furthermore, 30% of investors beat persistently (over 4 consecutive years) the market with the Farinelli-Tibiletti(1.5-2), compared to 0.3% with the Sharpe ratio.

Hence estimating performance with a measure that correctly weights skewness seeking of investors provide evidence that their risk-adjusted returns is far better than it is usually reported with performance measures that stem from the Mean-Variance paradigm. Yet, we find that the improvement of portfolios performance with alternative measure is mainly due to mechanical effects due to skewness rather than stock picking skills. Indeed, even when they are evaluated with adequate alternative measures, individual investors underperform a random investing strategy.

Figure 1 – Lower Partial Moments

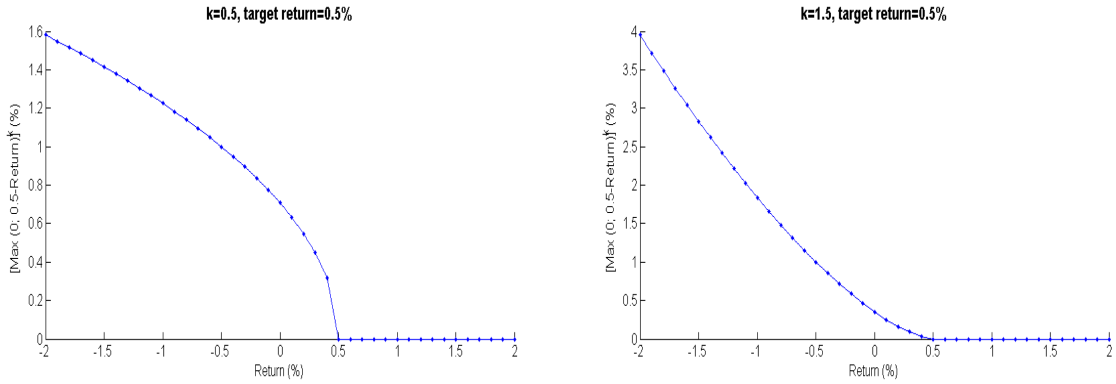

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Figure 2 – Upper Partial Moments

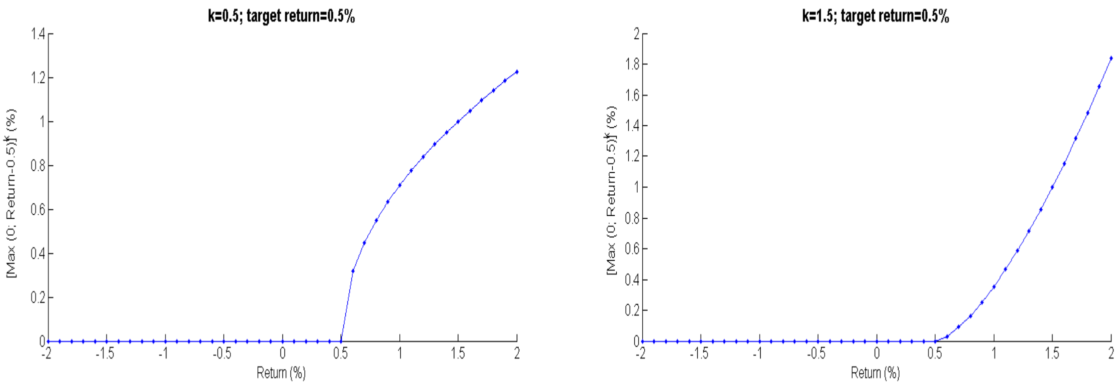

Table 1 – Alternative performance measures

This table presents the alternatives performance measures considered in that paper. Attitude towards gain and losses implied by the parameters' values are detailed for each measure.

Alternative performance measures	Attitude towards gains	Attitude towards losses
$Omega\,ratio(r_i) = \frac{(UPM_1(r_i))}{(LPM_1(r_i))}$	Small gains and large gains are weighted equally	Small losses and large losses are weighted equally
	Always positive and Downside risk	
$Upside\,potential\,ratio(r_i) = \frac{(UPM_1(r_i))}{\sqrt{(LPM_2(r_i))}}$	Small gains and large gains are weighted equally	Large losses are undesired
	Integration of loss aversion	
$Farinelli - Tibiletti_{(0.5-2)}\ ratio(r_i) = \frac{(UPM_{0.5}(r_i))^{1/0.5}}{\sqrt{(LPM_2(r_i))}}$	Small gains are favored over large but low probable gains	Large losses are undesired
	Consideration of the Expected utility function	
$Farinelli - Tibiletti_{(0.8-0.85)}\,ratio(r_i) = \frac{(UPM_{0.8}(r_i))^{1/0.85}}{(LPM_{0.8}(r_i))^{1/0.85}}$	Small gains are favored over large but low probable gains	Losses are undesired, no matter their magnitude
	Consideration of the S-Shaped Value function	
$Farinelli - Tibiletti_{(1.5-2)}\,ratio(r_i) = \frac{(UPM_{1.5}(r_i))^{1/1.5}}{\sqrt{(LPM_2(r_i))}}$	Large but low probable gains are favored	Large losses are undesired
	Consideration of the Behavioral Portfolio Theory	

Table 2 – Descriptive statistics

This table presents statistics on the dataset during the period 2003 to 2006. Panel A is related to investors. Panel B provides yearly information on transactions, averaged across investors. The monthly turnover is computed as the market value of shares purchased in month t, or sold in month t, divided by the mean market value of all shares held in the portfolio during month t. Panel C reports yearly information on investors' portfolios, averaged across investors. The portfolio value and the number of stocks are calculated in the mi-year. Annual returns and skewness are computed based on weekly returns. Medians are reported in parentheses.

	2003	**2004**	**2005**	**2006**
Panel A : Investors				
Number of investors	24,766			
Proportion of men	80.4 %			
Panel B : Transactions				
Total number of trades	444,155	431,022	512,309	651,801
Average number of trades per investor	17.9 (2)	17.4 (2)	20.7 (4)	26.3 (5)
Purchase monthly turnover (%)	7.2 (1.3)	5.9 (1.1)	6.4 (1.2)	7.8 (1.7)
Sale monthly turnover (%)	7.2 (1.5)	6.2 (1.6)	7.1 (2.2)	8.7 (2.9)
Panel C: Portfolios				
Portfolio value (Euros)	24,241	27,901	31,259	36,629
	(9455)	(10,935)	(11,293)	(13,252)
Number of different stocks in portfolio	8.6 (6.3)	8.4 (6.2)	8 (6)	7.8 (5.5)
Annual return (%)	31.40 (27.53)	8.16 (8.47)	28.03 (26.94)	22.05 (20.27)
Annual Jensen α (%)	6.99 (5.71)	-3.83 (-2.95)	2.54 (3.04)	-2.38 (-2.44)
Annual Skewness	0.76 (0.74)	-0.09 (-0.16)	-0.06 (-0.16)	-0.38 (-0.50)

Table 3 – Rank correlations

This table presents the relationship between the rankings of investors resulting from the evaluation of investor's performance with alternative measures and the Sharpe ratio. The Spearman ρ and the Kendall τ are computed each year between 2003 and 2006.

	2003	*2004*	*2005*	*2006*
	Spearman correlations (%)			
Omega ratio	97.92	98,.44	97.90	98.79
Upside Potential ratio	91.81	94.88	91.71	89.59
Farinelli-Tibiletti(0.5-2) ratio	70.74	71.11	85.11	79.72
Farinelli-Tibiletti(0.8-0.85) ratio	66.11	64.38	82.77	76.70
Farinelli-Tibiletti(1.5-2) ratio	33.72	30.59	41.58	42.26
	Kendall correlations (%)			
Omega ratio	93.22	94.74	93.52	96.06
Upside Potential ratio	81.71	86.35	81.18	77.71
Farinelli-Tibiletti(0.5-2) ratio	57.42	57.04	71.70	65.61
Farinelli-Tibiletti(0.8-0.85) ratio	52.79	51.26	69.74	62.78
Farinelli-Tibiletti(1.5-2) ratio	25.86	23.17	30.94	32.60

Table 4 – Transition matrices - Sharpe ratio/Omega ratio

This table presents the transition matrices between the ranking resulting from the Sharpe ratio evaluation and the Omega ratio evaluation for 2003, 2004, 2005 and 2006. We report the conditional probability to be ranked in decile j with the Omega ratio (in columns) knowing that the investor is ranked in decile i according to the Sharpe ratio (in rows).

Sharpe/Omega - 2003

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	100,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	55,9	43,9	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	0,0	49,8	49,3	0,8	0,0	0,0	0,0	0,0	0,0	0,0
4	0,0	0,0	43,8	52,8	2,9	0,4	0,0	0,0	0,0	0,0
5	0,0	0,0	0,5	39,6	52,6	6,4	0,5	0,2	0,1	0,1
6	0,0	0,0	0,0	0,6	37,7	52,7	8,0	0,6	0,3	0,1
7	0,0	0,0	0,0	0,0	0,6	33,6	56,0	9,2	0,4	0,2
8	0,0	0,0	0,0	0,0	0,0	0,6	28,9	56,7	13,2	0,6
9	0,0	0,0	0,0	0,0	0,0	0,0	0,4	27,1	61,9	10,6
10	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	17,9	82,1

Sharpe/Omega - 2004

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	40,4	40,4	19,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	0,0	0,0	63,0	37,0	0,0	0,0	0,0	0,0	0,0	0,0
3	0,0	0,0	0,0	79,8	20,1	0,0	0,0	0,0	0,0	0,0
4	0,0	0,0	0,0	0,3	95,2	4,5	0,0	0,0	0,0	0,0
5	0,0	0,0	0,0	0,0	6,6	91,4	2,0	0,0	0,0	0,0
6	0,0	0,0	0,0	0,0	0,0	23,8	74,7	1,4	0,0	0,0
7	0,0	0,0	0,0	0,0	0,0	0,0	42,8	56,5	0,6	0,0
8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	61,6	38,2	0,2
9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	79,7	20,3
10	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	99,0

Sharpe/Omega - 2005

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	100,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	29,8	69,5	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	0,0	27,1	70,9	1,8	0,1	0,1	0,0	0,0	0,0	0,0
4	0,0	0,0	25,1	69,0	5,0	0,4	0,2	0,1	0,1	0,0
5	0,0	0,0	0,0	26,0	65,8	6,2	1,1	0,4	0,2	0,4
6	0,0	0,0	0,0	0,0	25,8	63,6	8,5	1,4	0,4	0,4
7	0,0	0,0	0,0	0,0	0,0	26,4	55,2	16,8	1,3	0,4
8	0,0	0,0	0,0	0,0	0,0	0,1	30,8	54,4	13,2	1,6
9	0,0	0,0	0,0	0,0	0,0	0,0	0,2	24,4	64,8	10,7
10	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	16,7	83,3

Sharpe/Omega - 2006

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	100,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	3,7	94,6	1,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	0,0	4,9	89,9	5,1	0,1	0,0	0,0	0,0	0,0	0,0
4	0,0	0,0	8,0	83,8	7,9	0,2	0,0	0,0	0,0	0,0
5	0,0	0,0	0,0	10,7	78,1	10,3	0,8	0,1	0,0	0,1
6	0,0	0,0	0,0	0,0	13,6	73,7	10,9	1,5	0,2	0,2
7	0,0	0,0	0,0	0,0	0,0	15,4	71,7	11,7	0,8	0,4
8	0,0	0,0	0,0	0,0	0,0	0,0	16,2	72,0	10,8	1,0
9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	14,4	75,6	10,1
10	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	12,2	87,8

Table 5 – Transition matrices - Sharpe ratio/Upside Potential ratio
This table presents the transition matrices between the ranking resulting from the Sharpe ratio evaluation and the Upside Potential ratio evaluation for 2003, 2004, 2005 and 2006. We report the conditional probability to be ranked in decile j with the Upside Potential ratio (in columns) knowing that the investor is ranked in decile i according to the Sharpe ratio (in rows).

Sharpe/UPR - 2003

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	97,9	2,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	47,3	39,0	10,4	2,5	0,5	0,3	0,0	0,0	0,0	0,0
3	8,0	36,2	32,1	15,9	5,3	1,7	0,6	0,3	0,0	0,0
4	1,0	12,1	32,3	28,9	16,0	6,6	2,0	0,8	0,2	0,0
5	0,3	3,6	12,8	26,8	30,3	17,5	6,2	1,8	0,5	0,2
6	0,0	1,2	4,2	13,3	26,3	30,2	17,8	5,8	1,2	0,1
7	0,1	0,6	1,3	4,2	11,6	25,3	32,5	19,4	4,5	0,6
8	0,0	0,2	0,5	1,7	3,0	8,9	26,1	36,1	21,5	2,0
9	0,0	0,1	0,2	0,4	0,8	3,0	7,6	25,3	46,6	16,0
10	0,0	0,0	0,0	0,0	0,1	0,5	1,1	4,3	19,1	74,9

Sharpe/UPR - 2004

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	39,4	34,4	21,2	4,4	0,4	0,1	0,0	0,0	0,0	0,0
2	2,3	12,5	34,2	38,9	11,1	1,1	0,0	0,0	0,0	0,0
3	0,3	3,5	14,6	36,6	31,1	13,5	0,4	0,0	0,0	0,0
4	0,2	1,0	5,5	19,3	42,6	26,1	5,0	0,4	0,0	0,0
5	0,1	0,6	1,8	8,4	23,3	39,6	23,4	2,4	0,4	0,0
6	0,0	0,1	0,5	2,3	8,9	27,8	42,1	16,6	1,7	0,0
7	0,0	0,0	0,0	0,6	1,5	10,0	34,6	42,8	10,1	0,1
8	0,0	0,0	0,0	0,0	0,3	1,1	11,4	42,8	41,8	2,5
9	0,0	0,0	0,0	0,0	0,0	0,4	2,6	14,1	57,6	25,3
10	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	7,9	91,6

Sharpe/UPR - 2005

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	97,4	2,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	29,9	58,3	10,7	0,8	0,0	0,2	0,0	0,0	0,0	0,0
3	1,5	32,5	44,0	17,4	3,6	0,9	0,1	0,0	0,0	0,0
4	0,0	4,0	32,6	36,0	17,3	6,8	2,2	0,7	0,3	0,1
5	0,0	0,2	8,7	28,7	29,5	19,1	8,1	3,6	1,0	1,0
6	0,0	0,0	0,7	11,8	28,0	25,2	18,1	11,3	3,6	1,3
7	0,0	0,0	0,0	1,8	13,9	24,4	23,1	16,8	17,5	2,5
8	0,0	0,0	0,0	0,1	3,4	17,0	25,5	23,1	18,7	12,2
9	0,0	0,0	0,0	0,0	0,2	3,9	17,8	28,2	26,8	23,2
10	0,0	0,0	0,0	0,0	0,0	0,0	1,8	13,0	28,8	56,4

Sharpe/UPR - 2006

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	72,8	20,7	5,7	0,8	0,1	0,0	0,0	0,0	0,0	0,0
2	22,1	40,1	19,2	15,9	2,0	0,4	0,1	0,3	0,0	0,0
3	6,3	26,7	32,3	20,3	9,1	3,5	1,5	0,3	0,0	0,0
4	1,2	9,4	25,1	25,7	20,8	11,9	4,5	1,1	0,4	0,0
5	0,1	2,9	11,2	20,8	24,7	17,9	15,2	5,6	1,3	0,2
6	0,0	0,6	4,9	10,5	22,1	26,4	15,3	12,3	6,8	1,0
7	0,0	0,0	1,3	4,2	13,6	21,5	29,5	18,6	8,8	2,5
8	0,0	0,0	0,3	1,4	6,2	13,2	23,1	29,5	20,0	6,3
9	0,0	0,0	0,0	0,1	1,0	4,4	9,4	26,8	37,8	20,5
10	0,0	0,0	0,0	0,0	0,1	0,4	0,9	5,2	24,4	69,0

Table 6 – Transition matrices - Sharpe ratio/Farinelli-Tibiletti(0.5-2) ratio

This table presents the transition matrices between the ranking resulting from the Sharpe ratio evaluation and the Farinelli-Tibiletti(0.5-2) ratio evaluation for 2003, 2004, 2005 and 2006. We report the conditional probability to be ranked in decile j with the Farinelli-Tibiletti(0.5-2) ratio (in columns) knowing that the investor is ranked in decile i according to the Sharpe ratio (in rows).

Sharpe/Farinelli-Tibiletti(0.5-2) - 2003

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	83,2	12,4	2,9	0,8	0,4	0,2	0,1	0,0	0,0	0,0
2	30,4	32,8	18,0	7,7	4,8	3,6	0,9	0,6	0,3	0,8
3	12,1	22,5	21,7	17,7	11,4	6,7	4,2	2,5	1,0	0,3
4	6,6	10,5	17,1	19,9	15,2	12,0	11,3	4,2	2,3	0,8
5	3,1	7,5	12,8	15,4	16,4	15,9	13,9	10,1	4,2	0,9
6	5,5	5,8	8,0	11,3	14,1	16,4	17,0	13,0	6,8	2,2
7	1,6	4,2	5,8	8,5	11,7	15,5	16,9	17,7	13,3	4,9
8	1,9	2,8	4,3	6,5	10,5	12,2	14,0	19,5	20,8	7,6
9	0,5	2,0	3,2	3,9	5,8	6,9	10,0	17,1	26,6	24,0
10	0,6	1,1	2,0	2,7	3,7	4,5	5,6	9,1	18,4	52,3

Sharpe/Farinelli-Tibiletti(0.5-2) - 2004

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	34,1	23,8	15,4	10,1	7,1	4,3	2,6	1,5	1,1	0,0
2	8,5	15,8	17,5	17,8	14,9	11,0	8,7	3,3	2,3	0,3
3	3,8	10,5	12,9	15,2	14,6	13,1	11,8	8,2	8,9	1,0
4	3,8	8,3	13,0	13,2	14,1	12,5	12,4	16,8	5,0	0,9
5	1,5	6,3	10,9	14,5	13,2	14,7	13,9	13,2	9,2	2,7
6	0,5	4,2	7,5	10,1	14,7	15,7	16,1	12,5	12,5	6,2
7	0,2	1,4	4,9	10,3	12,7	15,5	15,6	15,5	14,2	9,7
8	0,2	1,0	2,0	5,2	9,6	14,7	16,7	19,5	19,4	11,8
9	0,2	1,5	5,3	2,8	4,5	8,1	13,4	18,7	24,1	21,4
10	0,0	0,0	0,1	0,6	0,4	1,7	3,4	7,8	20,6	65,4

Sharpe/Farinelli-Tibiletti(0.5-2) - 2005

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	72,2	23,0	4,4	0,3	0,0	0,0	0,1	0,0	0,0	0,0
2	35,7	30,3	18,9	10,2	2,6	1,6	0,4	0,2	0,1	0,0
3	10,4	29,5	27,6	16,6	9,1	3,6	1,4	0,9	0,5	0,3
4	2,2	16,1	23,7	21,4	15,3	9,1	5,9	4,0	1,7	0,5
5	0,1	4,3	15,1	24,4	20,5	13,8	9,8	6,8	3,0	2,0
6	0,0	1,0	6,9	15,6	23,2	19,7	14,3	10,1	5,6	3,7
7	0,0	0,0	1,3	6,5	16,8	21,6	23,0	13,1	10,2	7,5
8	0,0	0,0	0,3	1,5	7,6	17,2	22,0	21,4	15,3	14,7
9	0,0	0,0	0,0	0,2	1,5	7,2	17,9	26,1	30,2	17,0
10	0,0	0,0	0,0	0,0	0,0	0,9	3,9	14,1	30,1	51,0

Sharpe/Farinelli-Tibiletti(0.5-2) - 2006

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	66,7	20,3	8,1	3,9	0,7	0,3	0,0	0,1	0,0	0,0
2	18,9	28,0	19,1	16,2	6,2	9,9	1,1	0,4	0,2	0,0
3	10,4	24,3	24,6	14,7	10,1	7,3	4,5	2,6	1,4	0,1
4	4,2	13,3	20,1	19,9	14,9	9,4	7,5	6,6	3,3	0,7
5	1,0	9,7	14,6	18,2	19,2	14,1	9,5	7,9	4,2	1,6
6	0,6	2,9	7,8	13,2	19,6	16,8	14,6	11,1	8,0	5,5
7	0,2	1,0	3,5	8,0	13,3	19,3	24,7	13,8	10,3	5,8
8	0,2	0,7	1,5	4,0	10,9	13,9	19,5	21,9	17,1	10,3
9	0,1	0,1	0,6	1,3	4,1	7,2	14,0	24,6	26,0	21,9
10	0,0	0,1	0,1	0,5	0,6	1,4	4,1	10,7	29,0	53,6

Table 7 – **Transition matrices - Sharpe ratio/Farinelli-Tibiletti(0.8-0.85) ratio**
This table presents the transition matrices between the ranking resulting from the Sharpe ratio evaluation and the Farinelli-Tibiletti(0.8-0.85) ratio evaluation for 2003, 2004, 2005 and 2006. We report the conditional probability to be ranked in decile j with the Farinelli-Tibiletti(0.8-0.85) ratio (in columns) knowing that the investor is ranked in decile i according to the Sharpe ratio (in rows).

Sharpe/Farinelli-Tibiletti(0.8-0.85) - 2003

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	50,3	22,6	13,2	8,8	3,6	1,4	0,0	0,1	0,0	0,0
2	30,2	21,7	16,3	11,7	7,2	6,0	3,4	1,7	1,5	0,2
3	16,9	21,1	17,9	13,9	12,1	7,5	4,3	4,2	1,9	0,2
4	8,9	13,8	15,9	18,0	13,4	10,5	8,2	7,6	3,0	0,8
5	4,9	9,3	12,3	16,2	16,5	15,1	12,7	7,7	3,9	1,4
6	6,8	6,7	9,2	10,9	15,6	16,4	16,3	9,7	6,1	2,2
7	2,5	5,2	6,7	7,6	11,4	16,8	18,1	16,6	10,5	4,7
8	2,5	3,2	5,3	5,9	7,5	9,7	15,5	20,5	22,6	7,3
9	1,3	2,7	3,2	3,8	4,8	6,6	9,6	16,8	26,9	24,4
10	0,9	1,6	1,9	2,6	3,8	4,7	5,6	9,0	17,4	52,6

Sharpe/Farinelli-Tibiletti(0.8-0.85) - 2004

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	34,3	20,1	12,9	9,5	7,1	4,9	4,2	3,0	2,2	1,7
2	8,9	19,1	17,0	14,3	10,7	9,8	7,2	6,9	4,4	1,7
3	4,7	13,3	14,2	13,0	11,1	10,6	8,9	7,2	14,8	2,3
4	2,7	12,1	15,2	13,1	13,1	10,2	14,6	8,8	7,3	3,0
5	1,3	8,5	14,2	15,4	13,0	13,2	11,9	9,7	8,1	4,7
6	0,4	4,7	10,0	14,0	15,5	15,0	13,0	10,9	8,9	7,4
7	0,1	1,9	7,2	12,3	15,7	15,4	14,1	13,0	13,3	6,9
8	0,0	0,4	3,1	7,0	13,0	16,8	16,5	20,3	13,3	9,5
9	0,0	0,0	0,4	2,4	6,1	12,6	17,0	23,1	19,3	19,0
10	0,0	0,0	0,0	0,0	0,4	1,5	4,1	10,8	23,3	59,9

Sharpe/Farinelli-Tibiletti(0.8-0.85) - 2005

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	73,1	22,1	3,4	1,0	0,3	0,1	0,0	0,1	0,0	0,0
2	37,2	29,6	14,2	8,5	4,3	2,0	1,6	1,2	1,0	0,3
3	9,5	31,5	27,0	12,7	7,6	4,6	3,2	2,0	1,0	0,8
4	1,1	17,2	27,2	20,8	11,8	7,7	6,5	3,6	2,2	2,0
5	0,0	3,2	19,1	26,6	18,2	11,6	7,3	6,6	4,1	3,4
6	0,0	0,4	5,9	20,0	25,7	18,2	10,8	8,2	5,7	4,9
7	0,0	0,0	0,7	6,5	19,4	23,7	21,8	10,7	8,9	8,2
8	0,0	0,0	0,1	1,1	8,3	21,0	22,6	19,3	13,4	14,3
9	0,0	0,0	0,0	0,2	1,1	7,3	19,6	29,0	28,2	14,7
10	0,0	0,0	0,0	0,0	0,1	0,4	3,2	16,1	32,1	48,1

Sharpe/Farinelli-Tibiletti(0.8-0.85) - 2006

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	63,7	17,7	6,6	4,9	2,9	1,7	1,2	1,1	0,3	0,0
2	20,6	25,5	21,6	9,8	14,0	3,1	2,0	1,6	1,2	0,7
3	11,0	29,2	19,9	13,1	7,0	7,2	4,8	4,1	2,9	0,9
4	4,5	14,5	23,2	18,9	11,0	8,6	7,0	6,4	4,4	1,5
5	1,2	9,3	16,7	21,1	16,5	11,4	8,8	6,8	5,8	2,5
6	0,8	2,6	7,3	18,0	18,5	16,9	12,0	10,4	7,3	6,3
7	0,2	1,0	3,1	8,7	15,7	21,8	20,9	11,7	9,8	6,9
8	0,2	0,6	1,1	4,3	10,8	18,5	20,6	18,3	14,4	11,1
9	0,0	0,0	0,4	0,8	2,8	9,2	18,5	25,7	22,8	19,7
10	0,0	0,0	0,0	0,1	0,4	1,4	3,8	13,5	30,4	50,3

Table 8 – Transition matrices - Sharpe ratio/Farinelli-Tibiletti(1.5-2) ratio
This table presents the transition matrices between the ranking resulting from the Sharpe ratio evaluation and the Farinelli-Tibiletti(1.5-2) ratio evaluation for 2003, 2004, 2005 and 2006. We report the conditional probability to be ranked in decile j with the Farinelli-Tibiletti(1.5-2) ratio (in columns) knowing that the investor is ranked in decile i according to the Sharpe ratio (in rows).

Sharpe/Farinelli-Tibiletti(1.5-2) - 2003

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	16,4	9,6	9,1	7,3	6,7	8,8	9,0	12,3	11,1	9,7
2	16,5	15,2	12,1	11,2	10,0	8,5	8,8	7,8	6,1	3,9
3	13,9	16,3	15,5	12,9	11,0	9,3	7,1	6,6	4,8	2,6
4	10,6	13,3	15,3	13,1	11,3	9,9	8,9	8,7	4,9	3,9
5	8,8	11,5	13,4	13,6	12,6	13,1	9,8	8,0	5,1	4,1
6	11,3	9,7	10,6	13,4	12,6	13,5	10,6	7,9	6,5	3,9
7	7,1	7,5	8,3	11,0	14,1	12,6	13,0	11,0	9,7	5,7
8	6,8	6,4	6,9	7,0	9,7	11,8	12,2	14,1	13,9	11,0
9	5,5	5,7	3,9	5,3	5,8	7,4	12,2	15,2	21,7	17,3
10	7,2	4,5	4,2	3,4	4,1	4,4	7,8	9,8	16,8	37,8

Sharpe/Farinelli-Tibiletti(1.5-2) - 2004

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	23,9	13,8	10,9	8,6	7,8	7,8	7,2	7,8	6,7	5,5
2	12,9	14,1	11,6	8,9	8,6	8,7	8,9	10,2	8,7	7,3
3	8,8	12,2	10,4	10,0	7,7	7,5	9,4	8,5	9,3	16,2
4	8,8	11,4	10,8	11,1	9,1	9,0	14,2	8,0	8,6	9,1
5	7,0	10,9	13,2	11,4	11,7	10,2	9,2	10,1	8,4	7,9
6	5,2	10,5	12,0	11,1	10,6	12,1	9,6	10,5	10,0	8,4
7	3,3	8,1	11,1	13,5	11,6	12,4	10,7	9,4	12,5	7,4
8	2,0	6,5	9,5	11,9	13,0	14,0	12,5	14,1	9,8	6,7
9	0,9	4,2	7,3	11,8	16,6	12,2	12,1	11,5	12,3	11,1
10	0,0	0,6	1,5	4,5	7,7	10,4	11,8	14,3	20,1	29,0

Sharpe/Farinelli-Tibiletti(1.5-2) - 2005

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	37,0	20,7	9,7	9,2	15,1	2,3	2,0	1,7	1,4	0,9
2	26,7	15,0	11,6	10,2	7,2	6,3	6,6	4,8	4,8	6,8
3	16,9	17,1	11,5	9,8	7,4	9,8	7,5	7,3	6,6	6,2
4	12,0	12,0	12,7	11,3	10,0	8,5	9,1	8,5	8,6	7,3
5	7,7	12,5	12,8	10,1	10,4	9,4	9,8	8,6	9,4	9,3
6	4,6	10,3	12,5	9,5	10,5	11,3	11,6	11,1	9,1	9,5
7	2,1	8,0	9,4	11,2	9,9	10,4	10,4	11,3	16,0	11,2
8	1,4	4,9	9,6	11,0	10,5	12,6	11,1	11,2	12,8	15,0
9	0,3	2,5	7,3	11,0	11,8	12,1	12,5	15,5	12,4	14,7
10	0,1	0,5	2,9	6,5	9,0	14,8	16,8	17,4	16,1	15,9

Sharpe/Farinelli-Tibiletti(1.5-2) - 2006

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	40,6	11,8	8,8	8,0	5,4	5,8	6,0	5,4	4,3	4,0
2	17,1	13,4	15,6	7,8	6,6	5,4	8,2	7,3	11,7	6,6
3	17,3	18,1	11,3	10,3	8,5	7,4	6,9	7,8	6,1	6,2
4	10,4	16,7	12,5	12,1	10,9	10,5	7,7	6,9	7,2	5,0
5	6,7	12,9	13,7	13,0	14,6	10,9	9,7	6,1	7,7	4,9
6	4,3	10,5	12,1	14,0	12,1	11,5	11,3	7,2	8,6	8,4
7	1,9	8,0	10,4	11,8	13,0	12,0	13,5	14,5	8,1	6,8
8	1,7	5,6	9,1	12,1	13,3	14,2	12,0	12,7	10,4	9,1
9	0,9	2,4	4,9	7,8	10,8	14,1	13,6	15,3	15,8	14,4
10	0,4	0,8	1,6	3,0	4,7	8,0	10,7	14,9	21,5	34,3

Table 9 – Impact of the choice of alternative measures

This table contains the change in decile of investors when their performance is evaluated with alternative measures rather than with the Sharpe ratio. The maximum downgrade and upgrade are presented as well as the proportion of investors who remain in the same decile, who are downgraded and upgraded.

	Max. down-grade	Max. up-grade	No change (%)	Down-graded (%)	Up-graded (%)
			2003		
Omega ratio	-5	2	58.20	5.85	35.94
Upside Potential ratio	-6	8	41.34	19.07	39.59
Farinelli-Tibiletti(0.5-2) ratio	-8	9	27.09	32.50	40.41
Farinelli-Tibiletti(0.8-0.85) ratio	-8	9	24.28	33.65	42.07
Farinelli-Tibiletti(1.5-2) ratio	-9	9	17.35	36.19	46.45
			2004		
Omega ratio	-3	1	36.25	63.67	0.08
Upside Potential ratio	-5	6	36.84	55.96	7.20
Farinelli-Tibiletti(0.5-2) ratio	-9	8	24.78	50.04	25.19
Farinelli-Tibiletti(0.8-0.85) ratio	-9	7	24.22	46.35	29.43
Farinelli-Tibiletti(1.5-2) ratio	-9	9	16.40	47.33	36.27
			2005		
Omega ratio	-6	2	68.61	7.36	24.03
Upside Potential ratio	-6	4	40.07	22.84	37.09
Farinelli-Tibiletti(0.5-2) ratio	-8	5	30.36	27.76	41.88
Farinelli-Tibiletti(0.8-0.85) ratio	-8	5	28.97	25.83	45.20
Farinelli-Tibiletti(1.5-2) ratio	-9	9	13.87	38.85	47.28
			2006		
Omega ratio	-5	1	82.64	7.41	9.95
Upside Potential ratio	-6	5	38.65	29.09	32.26
Farinelli-Tibiletti(0.5-2) ratio	-8	8	29.99	32.54	37.47
Farinelli-Tibiletti(0.8-0.85) ratio	-8	7	27.21	31.38	41.41
Farinelli-Tibiletti(1.5-2) ratio	-9	9	17.90	36.74	45.35

Table 10 – Decile of the market index performance

This table reports each year between 2003 and 2006 the decile of the market index according to 6 performance measures. These grades are based on the initial ranking computed each year for each measure across 24,766 investors.

	2003	**2004**	**2005**	**2006**
Sharpe ratio	6	9	9	9
Omega ratio	6	9	9	9
Upside Potential ratio	4	7	9	10
Farinelli-Tibiletti(0.5-2) ratio	3	7	8	6
Farinelli-Tibiletti(0.8-0.85) ratio	3	6	7	5
Farinelli-Tibiletti(1.5-2) ratio	1	1	4	5

Figure 3 – Variations of (p-q) in the Farinelli-Tibiletti ratio - 2003

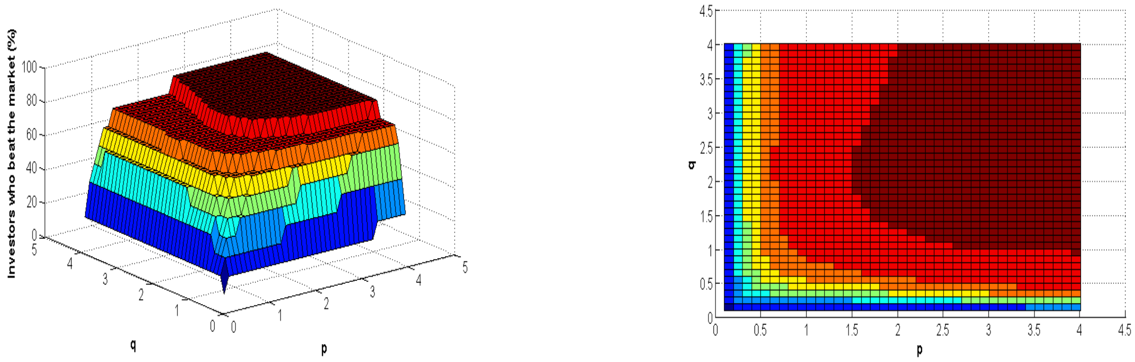

Figure 4 – Variations of (p-q) in the Farinelli-Tibiletti ratio - 2004

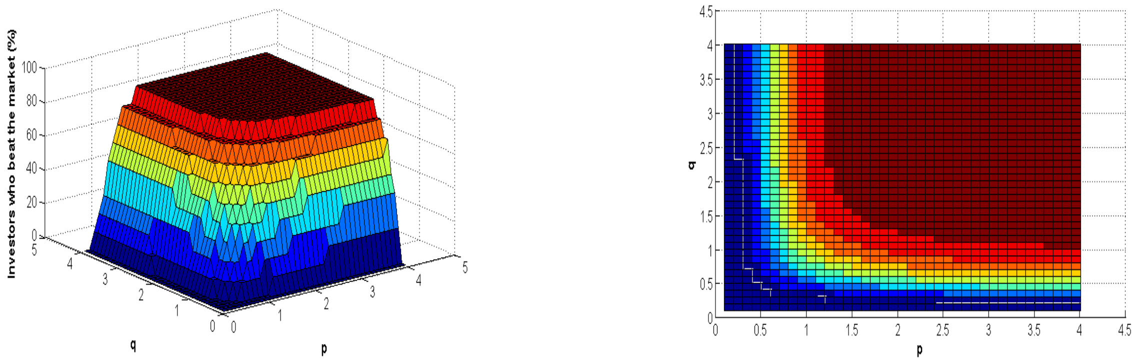

Figure 5 – Variations of (p-q) in the Farinelli-Tibiletti ratio - 2005

Figure 6 – Variations of (p-q) in the Farinelli-Tibiletti ratio - 2006

Table 11 – Performance persistance

This table reports the number and the proportion of investors who are ranked in a higher decile than the market index with each alternative performance measure. The first row indicates the number of consecutive year (1, 2, 3 or 4 starting from 2003) for which investors beat the market.

	1 year	%	2 years	%	3 years	%	4 years	%
Sharpe ratio	10564	42.66	1157	4.67	277	1.12	66	0.27
Omega ratio	9906	40.00	1249	5.04	254	1.03	56	0.23
Upside Potential ratio	14860	60.00	4469	18.04	609	2.46	0	0.00
Farinelli-Tibiletti(0.5-2) ratio	17336	70.00	5436	21.95	1136	4.59	640	2.58
Farinelli-Tibiletti(0.8-0.85) ratio	17336	70.00	7204	29.09	2118	8.55	1471	5.94
Farinelli-Tibiletti(1.5-2) ratio	22289	90.00	20151	81.37	11927	48.16	7549	30.48

Table 12 – Market index decile among hazard portfolio

This table reports each year between 2003 and 2006 the decile of the performance of the market index according to 6 performance measures. These grades are based on the ranking of 24,677 randomly created portfolios that mimic the diversification level of investors in our sample.

	2003	2004	2004	2006
Sharpe ratio	4	9	10	7
Omega ratio	3	9	10	9
Upside Potential ratio	2	7	9	9
Farinelli-Tibiletti$_{(0.5\text{-}2)}$ ratio	1	1	1	1
Farinelli-Tibiletti$_{(0.8\text{-}0.85)}$ ratio	1	1	1	1
Farinelli-Tibiletti$_{(1.5\text{-}2)}$ ratio	1	1	1	1

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