How well can multi-manager funds diversify?

Received (in revised form): 25th June, 2007

Jürg Tobler-Oswald

is with the City of Zurich Pension Fund since March 2006. He is responsible for the analysis on the fund's overall investment strategy and oversees hedge fund investments, bond investments and securitised real estate investments. Previously, he was with Cantonal Bank of Zurich with varying responsibilities. He holds a PhD in Finance from the University of St Gallen and was a post-graduate researcher at the University of British Columbia in Vancouver.

City of Zurich Pension Fund, Strassburgstrasse 9, 8026 Zurich, Switzerland.
Tel: +41 (0) 44 412 52 28; Fax: +41 (0) 44 270 91 00; E-mail: juerg.tobler@pkzh.ch

Abstract Multi-manager concepts are popular among institutional investors as they promise to deliver a better risk-adjusted performance than a single manager, thanks to diversification. A new measure of diversification, the diversification ratio, is introduced, which complements the usually used correlation coefficient. The diversification ratio provides information on the persistence of diversification and enables the investor to evaluate the potential diversification two managers with given skills may possibly provide.
Journal of Asset Management (2008) **9,** 61–66. doi:10.1057/jam.2008.4

Keywords: *diversification, correlation, multi-manager funds*

Introduction

Diversification is a well-established and powerful way to construct portfolios. It is used on different levels in the investment process, for example across asset classes or on the stock level. In a multi-manager fund, different active managers with the same investment universe but different sources of information are combined to make use of diversification on a manager level. Thus, a multi-manager fund should achieve a higher risk-adjusted performance than a single active manager with comparable skills.

The degree of diversification is usually assessed with the coefficient of correlation. A weakness of this measure, however, is that it does not provide any information on how persistently two managers diversify each other through time. For example, a correlation coefficient of -0.3 might reflect two managers who produce strongly opposing outperformances in only a few investment periods or two managers who diversify each other a little bit in most periods. The diversification ratio, which is introduced in this paper, is a simple and intuitive measure of diversification persistence. Also, lower and upper boundaries of the diversification ratio of two managers with given skills can be computed, which allows an easy assessment of their diversification potential, that is, how well they at worst or at best may diversify each other.

Diversification ratio

The diversification ratio is defined as the percentage number of investment periods in which the outperformances of two active managers have opposite signs. It thus directly reflects how often the managers take offsetting bets. Obviously, managers with a high diversification ratio are highly dissimilar. The diversification ratio measures the degree of diversification between two managers in an analogous way as the widely used hit ratio or batting average assesses the

average outperformance of a single manager (see eg Constable and Armitage (2006)).[1]

The diversification ratio can be analysed most easily in the following simple framework. Two active managers A and B are considered, both of whom invest in the same single asset and take one decision every period (eg every month). They distinguish themselves from each other by basing their decisions on different information what makes them eligible for inclusion in a multi-manager fund. The quality of their respective decisions is measured by the hit ratio and the dissimilarity of the two managers with the diversification ratio. This setup can be fully characterised graphically with a four-field chart (see Figure 1).

The four quadrants represent the possible situations at the end of an investment period: both managers have taken the right or wrong decision (quadrants I and III, respectively) or one of them took the right and the other the wrong decision (quadrants II and IV, respectively). The diversification ratio is obtained as the sum of quadrants II and IV, while their respective hit ratios are given as the sum of quadrants I and II for manager A and the sum of quadrants I and IV for manager B.

Given the managers' respective hit ratios and their diversification ratio, the probabilities for each quadrant in Figure 1 can be uniquely determined as follows:

$$\begin{aligned} x_{\mathrm{I}} &= \frac{1}{2}(H_{\mathrm{A}} + H_{\mathrm{B}} - \delta) \\ x_{\mathrm{II}} &= \frac{1}{2}(H_{\mathrm{A}} - H_{\mathrm{B}} + \delta) \\ x_{\mathrm{III}} &= \frac{1}{2}(2 - H_{\mathrm{A}} - H_{\mathrm{B}} - \delta) \\ x_{\mathrm{IV}} &= \frac{1}{2}(-H_{\mathrm{A}} + H_{\mathrm{B}} + \delta) \end{aligned} \tag{1}$$

where $x_{\mathrm{I}}, \ldots, x_{\mathrm{IV}}$ denote the percentage of all decisions falling in quadrants I, …, IV. H_{A} is the hit ratio of manager A, H_{B} is the hit ratio of manager B and δ is the diversification ratio of the two managers. Equation (1) provides the probabilities of all possible outcomes given the quality of the two managers (measured by their respective hit ratios) and the dissimilarity of their decisions (measured by the diversification ratio). For example, assume two managers with hit ratios of 60 per cent and a diversification ratio of 20 per cent. The decision distribution over the four quadrants is then given as shown in Figure 2. The sum of quadrants I and II yields manager A's hit ratio of 60 per cent, whereas the sum of quadrants I and IV gives the assumed hit ratio also of 60 per cent for manager B. The managers' diversification ratio of 20 per cent is recovered as the sum of quadrants II and IV. In 30 per cent of all cases, the bets of the

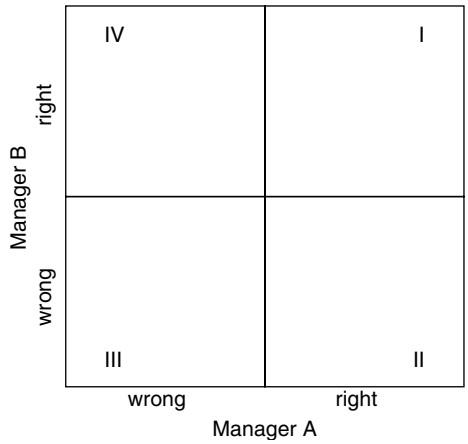

Figure 1 Multi-manager model

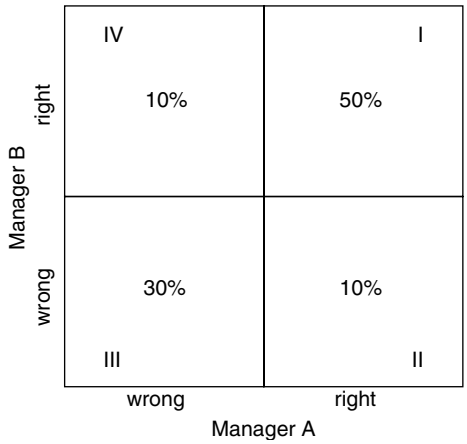

Figure 2 Decision distribution: numerical example

managers turn out to be wrong at the same time.

Diversification persistence

There is obviously a close relationship between the diversification ratio and the correlation coefficient. The latter can be easily computed from the simple model presented in the last section if a profit and loss distribution is defined. The simplest assumption is that the profit of a successful bet is one dollar and the loss from a wrong decision minus one dollar.[2] A multi-manager fund with two equally weighted managers delivers a gain of one dollar if both managers win (quadrant one), a loss of a dollar if both managers lose (quadrant III) and a zero gain if one manager wins and the other loses (quadrants II and IV). Given the distribution of bets across the four quadrants, the correlation coefficient can be easily computed. With the bet distribution given in Figure 2, the correlation coefficient is 0.58.

The information the diversification ratio provides on the persistence of diversification between two managers can now be exemplified. Let us consider two multi-manager funds each consisting of two active managers. All four managers show a track record of five years of monthly outperformances, which are depicted in Figure 3 in the form of scatter plots. In this example, all managers have an information ratio of 0.5 and the correlation coefficient between the managers in both funds is −0.3. Thus, according to the usually applied performance measures, the two funds have an equivalent track record. A visual inspection shows, however, that the distributions of the outperformances in the two funds are substantially different. Particularly in fund II, there are two extreme months in the track record in which manager B strongly outperforms whereas manager A strongly underperforms. These outliers distort the estimate for the correlation coefficient downwards. In fact, omitting the two extreme months in fund II results in a correlation coefficient of 0.04. Thus, the managers in fund I diversify each other in a much more persistent way than the managers in fund II. The diversification ratio directly reveals this different degree in diversification persistence: In fund I, the two managers diversify each other in 73 per cent of all periods whereas in fund II this is only the case in 33 per cent of all cases.

As this example shows, the diversification ratio as a measure of diversification persistence provides insights not available from the correlation coefficient. This complementary information is helpful, for example when selecting active managers for a multi-manager fund as it helps to identify critical characteristics in which the investment processes of the managers under scrutiny differ from each other. The two outliers in fund II may provide valuable diversification in some rare events when the

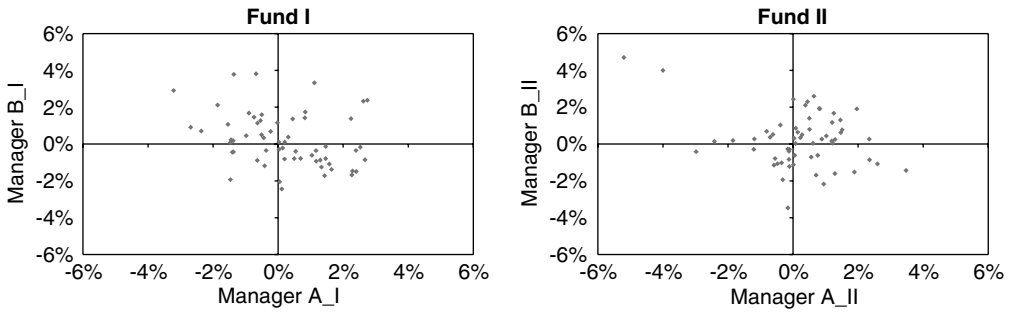

Figure 3 Example: track records of two multi-manager funds

investment process of manager A is expected to provide heavy losses. Or the two outliers may have occurred by pure chance and it is not to be expected that similar outcomes arise again. The conclusion, then, will be that the historically measured correlation of -0.3 is purely spurious. In any case, if the multi-manager fund is looking for a persistent diversification and is not concerned with some specific events, fund I will be preferable.

Diversification potential

In addition to providing information on how persistently managers diversify each other through time, the diversification ratio allows for an easy assessment of the diversification potential two managers with given skills have. Intuitively, if two managers are both highly skilful, they should display a high degree of similarity, because otherwise it would not be possible that both of them produce a good track record with bets on the same asset. Using the simple setup of the section Diversification ratio, that is measuring the skill level of a single manager with the hit ratio, lower and upper boundaries for the diversification ratio can be derived, which reflect this intuition (the convention used is that manager A is equivalent to or better than manager B):

$$\begin{aligned}\delta_{\min} &= H_A - H_B \\ \delta_{\max} &= \begin{cases} 2 - (H_A + H_B) & \text{for } H_A + H_B \geq 1 \\ H_A + H_B & \text{for } H_A + H_B < 1 \end{cases}\end{aligned} \tag{2}$$

The minimal diversification ratio two managers with given hit ratios may achieve depends on how different their respective skill levels are, that is, on the difference between their hit ratios. The maximal possible diversification ratio on the other hand depends on the sum of the managers' hit ratios. To provide some intuition on these formulas, the numerical example of the section Diversification ratio, where the hit ratios H_A and H_B of the two managers are both 60 per cent and where a correct bet pays one dollar and a wrong bet minus one dollar, is considered again. The minimal diversification ratio is 0 per cent, that is, the two managers may be perfectly similar, which obviously was the case if the two managers take the same bet in every period. This situation is shown in panel (a) of Figure 4. The expected return of the multi-manager fund is then 0.2 and its volatility 0.98. For the upper boundary, the first condition applies in this example. The maximal diversification ratio in this case is found to be 80 per cent and is obtained with the bet distribution shown in panel (b) of Figure 4; in order to achieve this high degree of dissimilarity, the two managers are never to take a wrong bet in the same period. The fund's expected return in this case is also 0.2 as the managers' skill is unaffected by the degree of diversification. Owing to the high degree of diversification however, the volatility is much lower with only 0.40.

Assuming another fund with two managers providing hit ratios of 60 and 35 per cent, respectively, the second condition for the maximal diversification ratio applies, whereas the formula for the minimal diversification ratio is the same as in the first example. The minimal diversification ratio in this case is 25 per cent, which is obtained with the bet distribution displayed in panel (c) of Figure 4. Finally, the maximal diversification ratio amounts to 95 per cent, that is, the two managers may take opposite bets in almost all periods. This situation arises if the two managers never take a right bet at the same time (see panel (d) of Figure 4). Again, the expected return is the same, namely -0.05, irrespective of how well the two managers diversify each other. When they are the least dissimilar however, a high volatility of 0.86 results, whereas the volatility is as low as 0.22 when the managers achieve the maximal diversification ratio. Thus, the realised diversification ratio of two managers can be compared with the upper

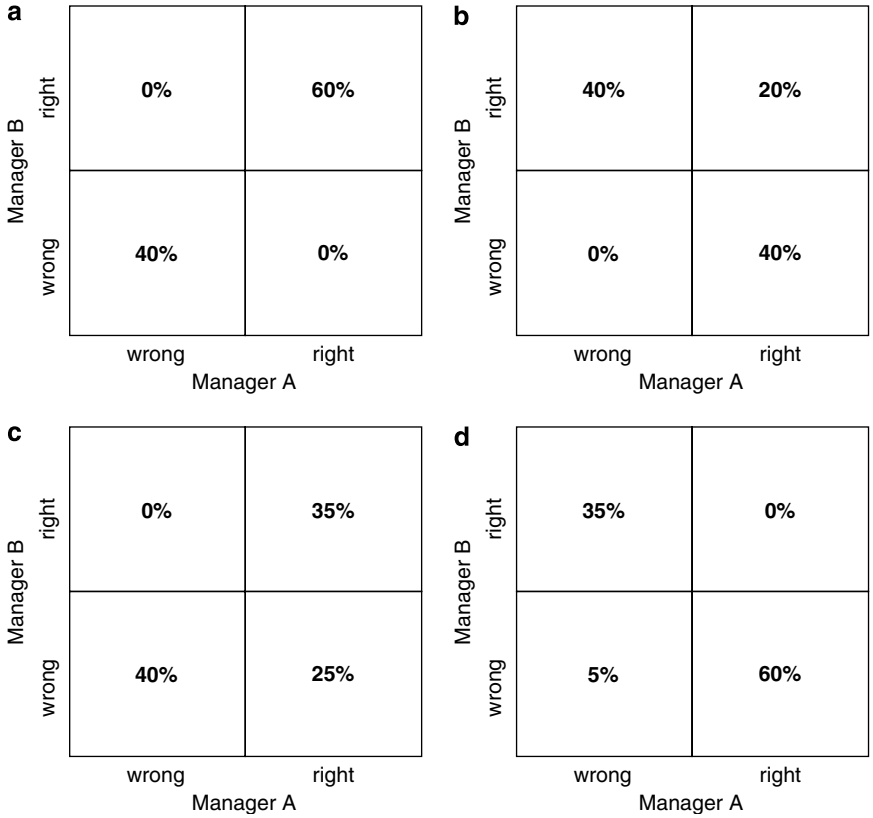

Figure 4 Diversification potential

and lower boundaries implied by the managers' hit ratios. This enables the investor to easily assess how well the managers diversified each other. Such an analysis is helpful in evaluating the investment processes of different managers with respect to the degree of diversification they might provide.

The correlation coefficient does not allow a similar analysis. The reason is that it is centered around the managers' respective average outperformances.[3] To put it differently, the correlation coefficient answers the question of how strongly the above average outperformance of manager A coincides with the above average outperformance of manager B. As such, the correlation coefficient is not affected by different average outperformances and does not reflect the above-stated intuition that two highly skilful managers should show a high degree of similarity. Rather, depending on the assumed distribution, the correlation coefficient of two highly skilled managers may be negative or even -1.

Conclusions

Diversification is an important aspect in selecting active managers in a multi-manager fund or in constructing portfolios. The diversification ratio introduced in this paper complements the correlation coefficient in that it provides information on how persistent through time two managers — or more generally two assets — diversify each other. By counting the number of periods in which managers deliver offsetting results, the measure allows to discriminate between managers who diversify each other strongly in only few periods and managers who

provide a smaller but persistent degree of diversification. Furthermore, the diversification ratio allows one to easily assess the diversification potential of two managers with given skill levels. It reflects the intuition that two highly skilful managers who deliver positive outperformance in most periods should be very similar. The correlation coefficient, which is corrected for the respective average outperformances of the managers, on the other hand, does not comply with this intuition. Summing up, the diversification ratio provides important information on the dissimilarity of managers or assets not available from the usually used correlation coefficient.

Acknowledgments

The views expressed in this paper are those of the author and may not be shared by the City of Zurich Pension Fund. An earlier version of the paper was presented at the 10th Conference of the Swiss Society for Financial Market Research.

Notes

1. The hit ratio is defined as the percentage number of periods a manager yields a positive outperformance.
2. With bivariate normally distributed outperformances, the relationship between the diversification ratio and the central correlation coefficient is also easily obtained. Lee (2000) shows the relationship between the hit and information ratio for normally distributed returns; the relationship between the diversification ratio and the correlation coefficient is given in an analogous way.
3. The noncentral correlation coefficient could be used instead. It is centred around zero outperformance and can be conveniently computed from the usual central correlation coefficient ρ and the information ratios IR_A und IR_B of the two involved managers:

$$\rho* = \frac{IR_A \times IR_B}{\sqrt{(1+IR_A^2)(1+IR_B^2)}} + \frac{\rho}{\sqrt{(1+IR_A^2)(1+IR_B^2)}}$$

The usefulness of noncentral moments has been demonstrated in another context by Ammann *et al*. (2006).

References

Ammann, M., Kessler, S. and Tobler, J. (2006) 'Analyzing Active Investment Strategies', *Journal of Portfolio Management*, 33, 56–67.

Constable, N. and Armitage, J. (2006) 'Information Ratios and Batting Averages', *Financial Analysts Journal*, 62(3), 24–31.

Lee, W. (2000) *Theory and Methodology of Tactical Asset Allocation*, Frank J. Fabozzi Associates, New Hope.