Available online at www.sciencedirect.com
ScienceDirect
European Journal of Operational Research 192 (2009) 209–215
EUROPEAN JOURNAL OF OPERATIONAL RESEARCH
www.elsevier.com/locate/ejor

Decision Support

Optimal asset allocation aid system: From "one-size" vs "tailor-made" performance ratio

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Received 2 December 2006; accepted 31 August 2007
Available online 11 September 2007

Abstract

Optimal asset allocation well-fitting investors' goals is a pressing challenge in risk management. Making a step forward to the Sharpe ratio, the parameter-dependent Sortino–Satchell, Generalized Rachev and Farinelli–Tibiletti performance ratios are suggested for personalizing asset allocation. Tailor-made optimal asset paths for five different investor risk profiles are traced over a rolling 12 month investing horizon. Our simulations show a satisfactorily good match between asset allocation and correspondent risk profile. Specifically, Generalized Rachev ratios outperform in personalized allocation for "extreme" risk profiles, i.e. conservative and aggressive investors, whereas Sortino–Satchell and Farinelli–Tibiletti ratios for those that are more moderate. Sharpe ratio confirms its ability in constructing steady-diversified portfolios, although underperformed.

Keywords: Risk management; Decision support system; Asset allocation

1. Introduction[1]

How to choose the best decision support system for making optimal asset allocation well-fitting investors goals is an evergreen challenge in risk management. In 1966 a ratio was developed (see Sharpe, 1966), originally named reward-to-variability, giving the trade-off between the expected return and standard deviation. Subsequently, drawbacks of Sharpe ratio for non-gaussian assets had been highlighted and new performance indexes for asymmetrical distributions were introduced (see Biglova et al., 2005; Sortino and Satchell, 2001). To capture downside-risk, standard deviation was replaced by VaR, CVaR and partial moments of different orders and numerous ex-post empirical investigation questioning what the best performer ratio was, have been carried out (see Biglova et al., 2004b).

Recently, a new challenge has been pressing practitioners. Strategical asset allocation is not only expected to drive to the best cumulated wealth, but also to be tailored to the investor risk profile. So, a performance ratio should not only take advantage of the peculiar assets distribution features (skewness and leptokurtosis, etc.) but also to meet personalized goals. Clearly, at the first step, one can simply impose sector constraints to each risky asset category.

Our task is to go a step forward using a fully personalized decision aid system. The parameter-dependent

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[1] The views expressed herein are those of the authors and do not necessarily reflect opinions shared by UBS and Cantonal Bank of Zurich.

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doi:10.1016/j.ejor.2007.08.035

performance ratios seem to service our request. Specifically we focused on Sortino–Satchell, Generalized Rachev (see Biglova et al., 2004a,b) and Farinelli–Tibiletti ratios (see Farinelli and Tibiletti, 2003, 2008; Menn et al., 2005, pp. 208–209). By a proper parameter balancing, ratios can be crafted to the investor profile interpreting its subjective attitude toward the upside and downside deviations from the benchmark. So, we focus on five standard investor prototypes. For each of them we tailor personalized Sortino–Satchell, Generalized Rachev and Farinelli–Tibiletti ratios and simulate active investment strategies. At last, we do the same using the Sharpe ratio.

Since joint distributions of prospective returns are unknown, empirical analysis have been carried out. Historical monthly data covering the period from January 29, 1993 to October 31, 2005 of eight financial indexes show evidence of high volatility in returns. To empirically forecast expected returns and covariance matrix the exponential weighted moving average approach (EWMA) is applied.

At first, our analysis has been oriented to check the risk profile and risk allocation match over time. Our empirical results show that almost all parameter-dependent ratios lead to a satisfactorily coherent risk allocation over time. Specifically, "extremal" risk profiles, i.e. defensive and aggressive investors, are best fit by Generalized Rachev ratios, whereas "intermediate" risk profiles, i.e. conservative, moderate and growth, are most satisfactorily fit by Sortino–Satchell and Farinelli–Tibiletti ratios. Second, we questioned whether the best tailored ratio for a given risk profile is also the best performer in cumulated wealth. As intuition suggests, the answer is not necessarily positive.

Eventually, a comparison with the Sharpe ratio is stressed. The correspondent risk allocation shows a steady balanced portfolio over time, confirming the Sharpe ratio as a good tool for diversification. On the other hand, the Sharpe ratio leads to the worst final cumulated wealth.

The paper is organized as follows: In Section 2 five investor profiles are described and parameter-dependent ratios crafted. The set-up of portfolio optimization is in Section 3. In Section 4 for each risk profile, optimal asset allocation paths are drawn for each parameter-dependent ratios. Backtests are carried over a 12 month rolling period. At the end, we test the optimal asset allocation compatibility with the ex-ante chosen risk profile. Conclusion and final remarks are collected in Section 5.

2. From "one-size" vs "tailor-made" reward-risk performance ratios

As mentioned in Section 1, the different the investor risk profile, the different the optimal risk allocation should be. So in following investors are classified into five standard investor prototypes increasing in risk attitude:

(1) defensive, if the investor is seeking stability and she is less concerned about growth of final wealth;
(2) conservative, if she is seeking stability with a modest potential for increased investment value;
(3) moderate, if she is a long-term investor and she is seeking steady growth potential without the need for current income;
(4) growth, if she is a long-term investor seeking good growth potential;
(5) aggressive, if she is a long-term investor seeking high growth potential.

In order to custom-tailor asset allocation, we optimize the portfolio according to a number of parameter-dependent ratios belonging to (1) the Sortino–Satchell, (2) the Generalized Rachev and (3) the Farinelli–Tibiletti ratio families. To make the paper self-contained we recall their definitions.

The Sortino and Satchell ratio (2001)

$$\Phi_{\mathrm{SS}}(R;q;b) := \frac{\mathbf{E}(R-b)}{\mathbf{E}^{1/q}[\{(R-b)^-\}^q]},$$

uses as a measure of risk the left partial moment of order $q > 0$ for the excess return $R - b$, where b denotes the benchmark.

The Generalized Rachev ratio (see Biglova et al., 2004a,b) is defined as

$$\Phi_{\mathrm{GR}}(R;\boldsymbol{\theta};b) := \frac{\mathbf{E}[\{(R-b)^+\}^\gamma | R \geqslant -VaR_{1-\alpha}(R)]}{\mathbf{E}[\{(R-b)^-\}^\delta | R \leqslant -VaR_{1-\beta}(R)]},$$

where $\boldsymbol{\theta} := (\alpha, \beta, \gamma, \delta)$ with probabilities $\alpha, \beta \in (0, 1)$, parameters $\gamma, \delta > 0$ and $VaR_c(R) := -\inf\{x | P(R \leqslant x) > c\}$.

The Farinelli–Tibiletti ratio (see Farinelli and Tibiletti, 2003, 2008; Menn et al., 2005, pp. 208–209)

$$\Phi_{\mathrm{FT}}(R;\boldsymbol{\theta};b) := \frac{\mathbf{E}^{1/p}[\{(R-b)^+\}^p]}{\mathbf{E}^{1/q}[\{(R-b)^-\}^q]},$$

uses partial moments of different orders $\boldsymbol{\theta} := (p, q)$ with p, $q > 0$. Note that if $p = q = 1$, the index reduces to the Omega index introduced in Keating and Shadwick (2002).

By a proper balancing of parameters p, q and γ, δ investor's attitude toward consequences of under/over performing, we can tailor the ratio to the above investor prototypes (see the theoretical discussion in Fishburn, 1977; Farinelli and Tibiletti, 2008).

3. Portfolio optimization

As the performance ratio is chosen, the portfolio optimization procedure can be set up. Following the portfolio optimization approach introduced in Biglova et al. (2004b), at first, we check the possible non-gaussian behavior of the assets. In such a case, expectation and variance are not appropriate measures for the reward and risk in