Journal of Finance and Investment Analysis, vol.1, no.3, 2012, 181-195
ISSN: 2241-0988 (print version), 2241-0996 (online)
Scienpress Ltd, 2012

Further Evidence on the Role of Ratio Choice in Hedge Fund Performance Evaluation

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Abstract

Prior research reports a remarkable homogeneity of hedge fund performance rankings produced by common risk-adjusted performance ratios. The paper at hand contributes to the discussion by studying the behavior of, and the relationship between these performance ratios over the time period from 1994 to 2010, and by validating the robustness of the findings for shorter sub-periods characterized by specific economic conditions. The results suggest that although the general result that most of the ratios considered provide very similar performance rankings is supported, the degree of their congruency varies over time.

JEL classification numbers: G10, G19
Keywords: Alternative investment, hedge fund, return, performance, rank correlation, risk

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Article Info: *Received* : June 20, 2012. *Revised* : July 24, 2012
Published online : August 31, 2012

1 Introduction

The purpose of this paper is to study the influence of ratio choice on hedge fund performance evaluation. Risk-adjusted performance measures typically employed in portfolio management focus on different aspects of an investment asset's return distribution. Some of them treat positive and negative returns in the same way, some emphasize the upside potential, and some put more weight on avoiding downside risk. From a conceptual point of view, the measure chosen should be in line with the specific investor's investment objectives, and it should capture the attributes of the asset's risk-and-return profile that are most important to him or her. Thus, performance evaluation is an inherently subjective, investor-specific task.

However, prior research shows that several performance ratios basically lead to the same ranking of investment opportunities, and thus to the same investment decision [3, 4, 5]. If this finding proves robust, it is of immediate relevance to investment practice: Identifying a performance measure – preferably one that can be determined easily – that may serve as a robust proxy for a larger number of other ratios could significantly facilitate performance measurement both by professional and by private investors.

In this context, the paper at hand ties in with findings by Eling and Schumacher [4, 5] regarding the adequacy of the Sharpe ratio as such a 'universal' ratio in hedge fund performance evaluation. In particular, I contribute to the discussion by studying the behavior of, and the relationship between the respective performance ratios over a long time horizon, and by validating the robustness of the results for shorter sub-periods characterized by specific economic conditions – namely, the boom periods 1994-1999 and 2003-2007, and the crisis periods 2000-2002, and 2008-2010. In this vein, I scrutinize whether there is any empirical evidence that the latter two events have come along with structural breaks in the patterns identified by Eling and Schumacher [4, 5].

In line with Eling and Schumacher [4, 5], I show that most of the performance measures considered lead to similar rankings of the respective investment indices. In particular, the rank orders based on the Sharpe ratio are close to those derived from more sophisticated performance ratios. Moreover, I find that performance rank orders are more homogeneous for the best and for the worst performing portfolios, and more diverse for the middle-ranking strategies especially during the period 1994-1999. Therefore, although the general result that the Sharpe ratio provides remarkably robust performance evaluations is supported, I conclude that investors are still well advised to exercise due care in choosing a performance measure that adequately reflects their individual investment objectives, and risk preferences.

The next section briefly reviews the main studies relevant to this paper's topic. Section three specifies the data and the methodology used. Section four develops the results, and section five concludes.

2 Literature Review

Compared to other finance topics, the analysis of hedge fund performance is a relatively young area of scholarly research. Nevertheless, since the emergence of the first academic papers during the mid-1990s, a considerable body of literature explicitly addressing hedge fund performance measurement issues has evolved. Most of these studies tie in with Fung and Hsieh [6], who propose a framework for the analysis of hedge fund investment styles based on a Sharpe [8]-type multifactor model. Besides, a second main area of hedge fund research is the analysis of performance persistence [1].

In contrast, the paper at hand concentrates on the influence of ratio choice on hedge fund performance evaluation. This issue has also been addressed in prior studies by Eling and Schumacher [4, 5], who provide a detailed discussion of the robustness of a variety of performance ratios for the time period 1994-2004. They find that most of the ratios considered produce similar rank orders of hedge fund index returns [4] and of individual hedge fund returns [5]. In particular, they show that performance rankings based on the Sharpe ratio do not differ significantly from those based on more sophisticated downside risk-related ratios, and they conclude that in spite of potential conceptual concerns, using the Sharpe ratio to assess hedge fund performance may be justified from a practical point of view. In a conceptually similar study, Eling [6] also finds a high correlation of performance measures when applying them to mutual fund returns.

Zakamouline [9] challenges Eling and Schumacher's [5] approach, mainly claiming that the majority of the return distributions they analyze is close to normal, and that the Spearman rank correlation coefficient they base their conclusions on may be biased. In the following study, I take this critique into account by showing that the return distributions underlying my study are non-normal, and by corroborating the results of the Spearman rank correlation coefficient with two alternative homogeneity measures, the mean absolute and the mean squared deviation.

3 Data and Methodology

The study is based on monthly return data between January 1994 and December 2010 for the Dow Jones Credit Suisse Hedge Fund Index (HFI), and for twelve hedge fund strategy sub-indices belonging to the Dow Jones Credit Suisse family of hedge fund indexes. The composite index HFI is an asset-weighted index tracking about 8000 hedge funds, each with a minimum of US$50 million under management, a 12-month track record, and audited financial statements. The respective strategy sub-indices contain hedge funds following the investment strategies outlined in Table 1 (cf. http://www.hedgeindex.com). In addition, monthly return data for the MSCI World equity index (MSCI), the Standard and Poor's 500 (S&P 500) and the US federal funds rate (Fed) are employed.

Table 1: Hedge fund strategy definitions

Strategy	Abbre-viation	Description
Convertible Arbitrage	CA	Investment strategies trying to exploit pricing anomalies between convertible securities and the corresponding stock.
Dedicated Short Bias	SB	Investment strategies relying mainly on short positions in equities.
Emerging Markets	EM	Investment strategies involving various types of securities in emerging markets.
Equity Market Neutral	MN	Investment strategies taking long and short positions in stocks, while trying to avoid exposure to systematic risk.
Event Driven	ED	Investment strategies trying to exploit security pricing anomalies due to certain company-specific or market-specific events.
Event Driven – Distressed	EDD	Subset of event-driven strategies focusing on securities of companies in financial or operational difficulties.
Event Driven – Multi-Strategy	EDM	Subset of event-driven strategies trying to exploit various types of event-related security pricing anomalies.
Event Driven – Risk Arbitrage	EDA	Subset of event-driven strategies focusing on companies involved in a merger or acquisition transaction.
Fixed Income Arbitrage	FI	Investment strategies trying to exploit pricing anomalies between similar or related fixed income instruments.
Global Macro	GM	Investment strategies focusing on the anticipated effects of political and macroeconomic developments on security prices in various markets.
Long/Short Equity	LS	Investment strategies involving long and short positions in equity.
Managed Futures	MF	Investment strategies focusing on financial futures and commodity futures.

The analysis proceeds as follows: First, I discuss the respective assets' return distributions and their correlation structures for the entire observation period, as well as for four sub-periods representing different stock and fixed income market environments, as shown in Figure 1. Period I (1/1994-12/1999) is characterized by a bullish stock market, and relatively stable interest rates. In period II (1/2000-12/2002), stock prices as well as interest rates decreased considerably. Period III (1/2003-12/2007) is characterized by a steady increase in stock prices and interest rates. During the first half of period IV (1/2008-12/2010), stock markets declined strongly, but recovered afterwards, while interest rates declined substantially, and then remained stable at a very low level.

Then, I apply the performance measures listed in Table 2 to derive performance rank orders for the respective hedge fund strategies over the observation period, and over each of the four sub-periods.[2] Finally, the rank orders are analyzed with respect to their homogeneity, and inter-temporal robustness. In particular, I determine each ratio's Spearman rank order coefficients, and I study the deviation of the rank orders provided by each performance measure from the average results of all other ratios.

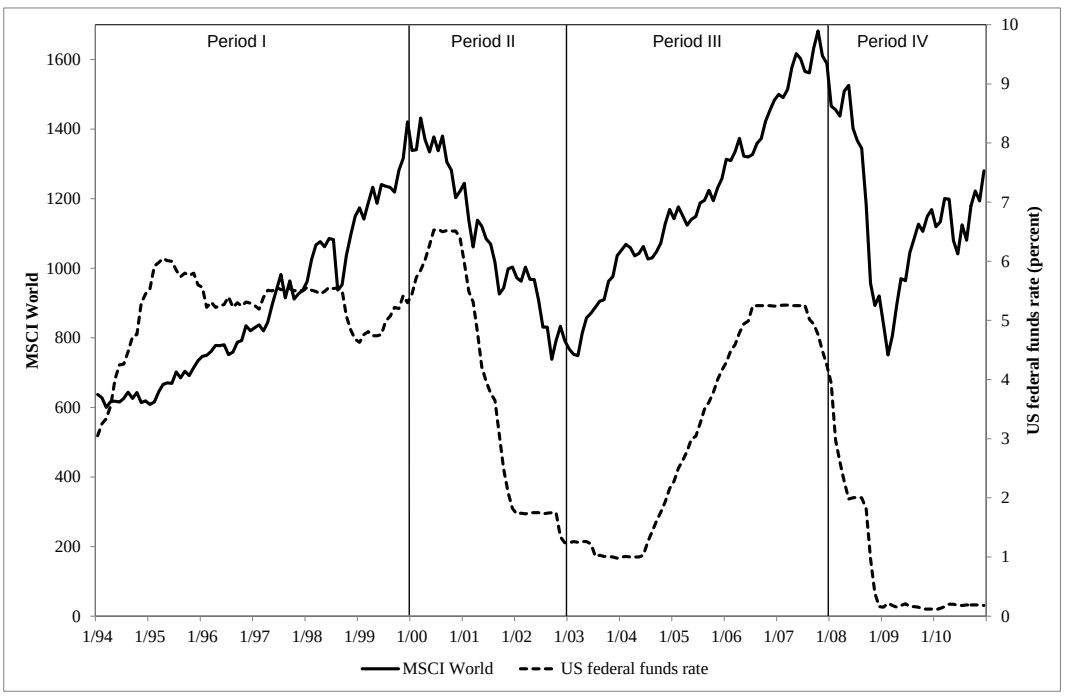

Figure 1: MSCI World performance and US federal funds rate 1994-2010

[2] For a detailed discussion of the respective ratios, see Lhabitant [7].

Table 2: Performance ratio definitions

Sharpe ratio:

$$SR_i = \frac{r_i - r_f}{\sigma_i}$$

Modified Sharpe ratio:

$$MSR_i = \frac{r_i - r_f}{(\sigma_i - \{\min[0, \varphi_i]\}^{1/3} + \{\max[0, \omega_i]\}^{1/4})}$$

Calmar ratio:

$$CR_i = \frac{r_i - r_f}{-MD_{i1}}$$

Gain-loss ratio:

$$GLR_i(r_T) = \frac{HPM_i^1(r_T)}{LPM_i^1(r_T)}$$

Sterling ratio:

$$StR_i = \frac{r_i - r_f}{\frac{1}{N}\sum_{j=1}^{N} -MD_{ij}}$$

Upside potential:

$$UPR_i(r_T) = \frac{HPM_i^1(r_T)}{\sqrt{LPM_i^2(r_T)}}$$

Burke ratio:

$$BR_i = \frac{r_i - r_f}{\sqrt{\sum_{j=1}^{N} MD_{ij}^2}}$$

Omega:

$$\Omega_i(r_T) = \frac{r_i - r_T}{LPM_i^1(r_T)}$$

Excess return on VaR:

$$ESVaR_i = \frac{r_i - r_f}{VaR_i}$$

Sortino ratio:

$$SoR_i(r_T) = \frac{r_i - r_T}{\sqrt{LPM_i^2(r_T)}}$$

Conditional Sharpe ratio:

$$CSR_i = \frac{r_i - r_f}{CVaR_i}$$

Kappa 3:

$$\mathrm{K}_{3,i}(r_T) = \frac{r_i - r_T}{\sqrt[3]{LPM_i^3(r_T)}}$$

r_i	Average return on asset *i*
r_f	Risk-free rate of return
r_M	Return on market portfolio
r_T	Threshold (minimum) return
σ_i	Standard deviation of asset *i* returns
φ_i	Skewness of asset *i* returns
ω_i	Kurtosis of asset *i* returns
$LPM_i^j(r_T)$	*j*-th order lower partial moment of asset *i* returns, given the threshold return r_T
$HPM_i^j(r_T)$	*j*-th order higher partial moment of asset *i* returns, given the threshold return r_T
VaR_i	Value at Risk of asset *i* returns
$CVaR_i$	Conditional Value at Risk of asset *i* returns
MD_{ij}	*j*-th biggest drawdown of asset t*i* returns

4 Results

4.1 Distribution of hedge fund returns

As a survey by Auckenthaler, Skaanes and Marin [2, p. 24] indicates, the standard deviation of returns (i.e., return volatility) is a common risk measure for hedge fund managers and investors in practice. Figure 2 shows the risk-versus-return characteristics of the aforementioned hedge fund strategies, the MSCI World stock market index (MSCI), the Standard & Poor's US stock market index (S&P 500), and the US federal funds effective interest rate (Fed) between 1/1994 and 12/2010. Out of these investments, Fed, ED, EDD, EDA and GM seem to be those closest to risk-return-efficiency. In addition, both traditional stock market indices analyzed seem to be clearly dominated by most of the alternative investment strategies.

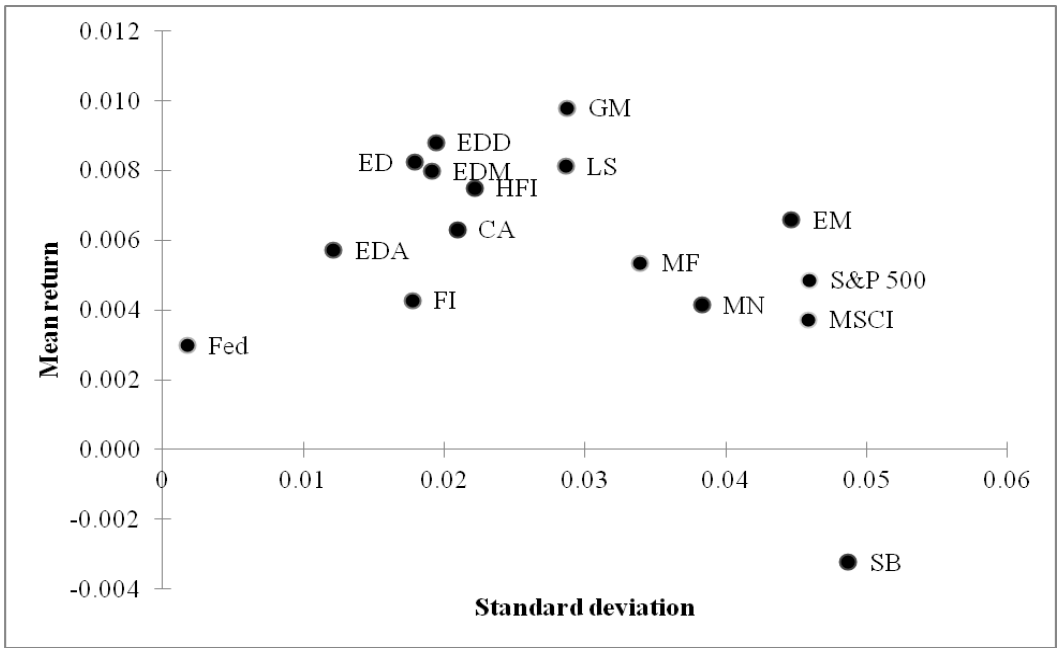

Figure 2: Selected risk-return-profiles between 1/1994 and 12/2010

Notes: Hedge fund strategies are defined according to Table 1. All values are calculated on a monthly basis for the period from 1/1994 to 12/2010.

However, defining risk as the standard deviation of returns only yields meaningful insights if returns are normally distributed. As Table 3 suggests, this does not necessarily apply to hedge fund returns. The analysis of the respective assets' return distributions shows that most of them tend to be skewed and exhibit

leptokurtosis ('fat tails'), leading to significant deviations from normality, as indicated by the Jarque-Bera test. Only in case of the MF strategy, the normality hypothesis cannot be rejected at a sufficiently high level of confidence. Therefore, from the perspective of a risk averse investor, performance ratios based on symmetric measures of risk – such as the Sharpe ratio – could underestimate the probability of severe losses, and should be less suitable performance indicators than downside risk-based measures.

Table 3: Return distribution characteristics of selected assets

	Mean monthly return	Standard deviation	Skewness	Kurtosis	Jarque-Bera p
HFI	0.008	0.022	-0.365	5.588	0.000
CA	0.006	0.021	-3.093	21.659	0.000
SB	-0.003	0.049	0.498	3.837	0.002
EM	0.007	0.045	-1.238	9.929	0.000
MN	0.004	0.038	-12.660	176.096	0.000
ED	0.008	0.018	-2.704	18.691	0.000
EDD	0.009	0.019	-2.561	17.407	0.000
EDM	0.008	0.019	-2.081	14.189	0.000
EDA	0.006	0.012	-1.186	8.626	0.000
FI	0.004	0.018	-4.647	35.836	0.000
GM	0.010	0.029	-0.269	6.780	0.000
LS	0.008	0.029	-0.240	6.557	0.000
MF	0.005	0.034	-0.097	3.058	0.855
MSCI	0.004	0.046	-1.027	5.436	0.000
S&P 500	0.005	0.046	-0.891	4.499	0.000
Fed	0.003	0.002	-0.410	1.628	0.000

Notes: All values are calculated on a monthly basis for the period from 1/1994 to 12/2010. In case of normally distributed returns, skewness should be zero, and kurtosis should be three. The Jarque-Bera p-value shows the significance level at which the hypothesis of normally distributed returns can be rejected.

The investment styles reflected by the respective hedge fund strategy indices differ substantially. Panel A.1 in Table 4 shows how the mean returns generated by each strategy vary across the observation period. However, as panel A.2 indicates, average hedge fund returns (HFI) were similar to those of the general stock market when the latter was increasing, while being substantially higher in decreasing markets. Moreover, looking at the average correlation coefficients between each of the eleven hedge fund sub-strategies and the other sub-indices (panel B) reveals that the correlation matrix of hedge fund strategy returns is also unstable across time.

Table 4: HF strategy indices' return characteristics across the observation period

Panel A.1: Mean HF strategy index returns (annualized)

	1994-1999	2000-2002	2003-2007	2008-2010	1994-2010
HFI	0.13	0.04	0.11	0.02	0.09
CA	0.08	0.13	0.06	0.04	0.08
SB	-0.03	0.09	-0.07	-0.13	-0.04
EM	0.06	0.02	0.18	0.00	0.08
MN	0.11	0.10	0.08	-0.16	0.05
ED	0.12	0.06	0.13	0.04	0.10
EDD	0.14	0.06	0.14	0.02	0.11
EDM	0.11	0.06	0.13	0.05	0.10
EDA	0.09	0.05	0.07	0.04	0.07
FI	0.06	0.06	0.05	0.01	0.05
GM	0.13	0.14	0.12	0.06	0.12
LS	0.17	-0.01	0.12	0.02	0.10
MF	0.05	0.08	0.06	0.07	0.06

Panel A.2: Mean stock market index returns (annualized)

	1994-1999	2000-2002	2003-2007	2008-2010	1994-2010
MSCI	0.14	-0.19	0.14	-0.07	0.04
S&P 500	0.19	-0.17	0.10	-0.05	0.06

Panel B: Average monthly return correlation coefficients between each HF sub-index and all other sub-indices

	1994-1999	2000-2002	2003-2007	2008-2010	1994-2010
CA	0.35	0.10	0.41	0.52	0.36
SB	-0.38	-0.28	-0.46	-0.34	-0.34
EM	0.33	0.14	0.45	0.55	0.34
MN	0.23	0.07	0.31	0.16	0.14
EDD	0.37	0.17	0.44	0.53	0.39
EDM	0.40	0.25	0.46	0.54	0.42
EDA	0.25	0.22	0.40	0.48	0.30
FI	0.26	0.06	0.35	0.49	0.34
GM	0.30	0.13	0.47	0.47	0.29
LS	0.31	0.19	0.50	0.53	0.35
MF	-0.07	-0.08	0.33	0.06	0.01
Average	0.21	0.09	0.33	0.36	0.24

Similarly, this observation holds for several other variables which characterize the respective return distributions, and which are typically used in

performance evaluation – like higher moments (standard deviation, skewness, kurtosis), value at risk measures (VaR, modified VaR, conditional VaR), drawdown, and higher as well as lower partial moments (results not reported).

Table 5: Correlation coefficients between traditional assets and HF strategies

	HFI	CA	SB	EM	MN	ED	EDD	EDM	EDA	FI	GM	LS	MF	Fed	MSCI
Fed															
1994-1999	0.25	0.28	-0.06	-0.12	0.27	0.03	0.08	-0.01	0.03	0.17	0.28	0.18	-0.08	1.00	0.01
2000-2002	0.01	0.49	0.09	-0.18	0.46	0.20	0.07	0.25	0.52	0.08	0.04	-0.01	-0.07	1.00	0.00
2003-2007	0.06	0.10	0.17	0.01	0.22	-0.04	-0.23	0.05	0.08	-0.07	0.05	0.04	0.00	1.00	-0.06
2008-2010	-0.34	-0.41	0.26	-0.37	0.07	-0.39	-0.35	-0.40	-0.21	-0.31	-0.08	-0.37	0.15	1.00	-0.29
1994-2010	0.10	0.07	0.12	-0.06	0.19	0.06	0.07	0.04	0.19	0.03	0.10	0.09	-0.02	1.00	0.03
MSCI															
1994-1999	0.55	0.23	-0.75	0.57	0.48	0.68	0.69	0.58	0.49	0.09	0.29	0.75	0.02	0.01	1.00
2000-2002	0.34	0.12	-0.8	0.65	0.29	0.49	0.39	0.49	0.34	-0.12	-0.01	0.35	-0.53	0.00	1.00
2003-2007	0.78	0.39	-0.76	0.71	0.31	0.67	0.64	0.61	0.71	0.33	0.47	0.86	0.49	-0.06	1.00
2008-2010	0.81	0.67	-0.74	0.87	0.28	0.80	0.77	0.79	0.74	0.68	0.41	0.88	-0.05	-0.29	1.00
1994-2010	0.59	0.43	-0.72	0.60	0.25	0.68	0.64	0.63	0.54	0.41	0.24	0.70	-0.04	0.03	1.00
S&P 500															
1994-1999	0.60	0.23	-0.78	0.51	0.50	0.66	0.67	0.56	0.51	0.11	0.38	0.78	-0.05	0.13	0.91
2000-2002	0.24	0.17	-0.79	0.61	0.32	0.45	0.39	0.43	0.29	-0.18	-0.08	0.25	-0.56	0.04	0.97
2003-2007	0.63	0.31	-0.77	0.53	0.16	0.57	0.54	0.52	0.60	0.24	0.31	0.73	0.45	-0.08	0.95
2008-2010	0.75	0.60	-0.79	0.79	0.31	0.76	0.75	0.74	0.64	0.65	0.33	0.82	-0.11	-0.27	0.98
1994-2010	0.57	0.37	-0.75	0.54	0.25	0.63	0.62	0.58	0.50	0.35	0.25	0.66	-0.10	0.07	0.95

At first glance, given the low or even negative correlations between the traditional stock or fixed income investments and the hedge fund indices, the latter seem to provide interesting diversification opportunities to investors. However, given the non-normality of the underlying return distributions, the variance-covariance-based correlation coefficient may be biased, and therefore does not suffice to substantiate the investment decision of risk averse market participants. Thus, further investigation of the respective strategies' risk-return characteristics is required.

4.2 Performance evaluation

To assess the aforementioned hedge fund strategy indices' performance, I use the measures shown in Table 2. I assume a monthly risk-free interest rate of 0.03 percent (i.e. 3.6 percent annually), which is the average of the US Federal Funds rate between 1994 and 2010, and a threshold rate equaling the risk-free rate.

Table 6: Rank orders produced by selected performance ratios, 1994-2010

Strategy	Sharpe ratio	Calmar ratio	Sterling ratio	Burke ratio	Excess return on VaR	Conditional Sharpe ratio	Modified Sharpe ratio	Gain-loss ratio	Sortino ratio	Kappa 3	Omega	Upside potential	Average rank	Standard deviation of ranks
HFI	6	7	5	7	5	5	5	6	6	4	6	3	5.42	1.16
CA	8	9	9	9	7	7	8	7	8	8	7	11	8.17	1.19
SB	15	15	15	15	15	15	14	15	15	15	15	13	14.75	0.62
EM	9	10	11	10	11	11	11	10	9	10	10	10	10.17	0.72
MN	13	13	12	13	12	12	15	11	13	14	11	15	12.83	1.34
ED	2	2	2	2	2	2	2	2	2	3	2	6	2.42	1.16
EDD	1	4	6	5	3	3	3	1	1	2	1	2	2.67	1.67
EDM	3	3	3	3	4	4	4	3	4	5	3	7	3.83	1.19
EDA	5	1	1	1	1	1	1	5	5	6	5	5	3.08	2.19
FI	10	11	10	11	8	8	9	9	11	11	9	14	10.08	1.68
GM	4	5	7	4	6	6	6	4	3	1	4	1	4.25	1.91
LS	7	6	8	6	9	9	7	8	7	7	8	4	7.17	1.40
MF	11	8	4	8	10	10	10	12	10	9	12	8	9.33	2.19
MSCI	14	14	14	14	14	14	13	14	14	13	14	12	13.67	0.65
S&P 500	12	12	13	12	13	13	12	13	12	12	13	9	12.17	1.11

Table 7: Spearman's rank correlation coefficient for selected performance ratios, 1994-2010

Ratio	Sharpe ratio	Calmar ratio	Sterling ratio	Burke ratio	Excess return on VaR	Conditional Sharpe ratio	Modified Sharpe ratio	Gain-loss ratio	Sortino ratio	Kappa 3	Omega	Upside potential
Sharpe ratio		0.93***	0.81***	0.92***	0.93***	0.93***	0.93***	0.98***	0.99***	0.95***	0.98***	0.79***
Calmar ratio	0.93***		0.94***	1.00***	0.94***	0.94***	0.96***	0.89***	0.93***	0.89***	0.89***	0.78***
Sterling ratio	0.81***	0.94***		0.93***	0.90***	0.90***	0.89***	0.78***	0.81***	0.79***	0.78***	0.66***
Burke ratio	0.92***	1.00***	0.93***		0.93***	0.93***	0.95***	0.88***	0.93***	0.89***	0.88***	0.79***
Excess return on VaR	0.93***	0.94***	0.90***	0.93***		1.00***	0.97***	0.94***	0.91***	0.86***	0.94***	0.67***
Conditional Sharpe ratio	0.93***	0.94***	0.90***	0.93***	1.00***		0.97***	0.94***	0.91***	0.86***	0.94***	0.67***
Modified Sharpe ratio	0.93***	0.96***	0.89***	0.95***	0.97***	0.97***		0.91***	0.92***	0.89***	0.91***	0.77***
Gain-loss ratio	0.98***	0.89***	0.78***	0.88***	0.94***	0.94***	0.91***		0.97***	0.92***	1.00***	0.71***
Sortino ratio	0.99***	0.93***	0.81***	0.93***	0.91***	0.91***	0.92***	0.97***		0.97***	0.97***	0.84***
Kappa 3	0.95***	0.89***	0.79***	0.89***	0.86***	0.86***	0.89***	0.92***	0.97***		0.92***	0.90***
Omega	0.98***	0.89***	0.78***	0.88***	0.94***	0.94***	0.91***	1.00***	0.97***	0.92***		0.71***
Upside potential	0.79***	0.78***	0.66***	0.79***	0.67***	0.67***	0.77***	0.71***	0.84***	0.90***	0.71***	
Average correlation	0.92	0.92	0.84	0.91	0.91	0.91	0.91	0.90	0.92	0.89	0.90	0.75
Rank	2	3	11	5	6	6	4	8	1	10	8	12

Notes: Asterisks indicate parameter significance at the 0.01 (***), 0.05 (**), and 0.1 (*) level. Ranks are calculated on the basis of the respective average Spearman rho.

Table 8: Period-specific average rank correlation coefficients for each performance ratio

Period	Sharpe ratio	Calmar ratio	Sterling ratio	Burke ratio	Excess return on VaR	Cond. Sharpe ratio
94-99	0.87	0.84	0.84	0.83	0.73	0.71
00-02	0.98	0.97	0.95	0.96	0.97	0.97
03-07	0.95	0.96	0.95	0.95	0.93	0.91
08-10	0.95	0.95	0.94	0.95	0.94	0.94
94-10	0.92	0.92	0.84	0.91	0.91	0.91

Period	Mod. Sharpe ratio	Gain-loss ratio	Sortino ratio	Kappa 3	Omega	Upside potential
94-99	0.79	0.83	0.88	0.83	0.83	0.73
00-02	0.97	0.98	0.98	0.98	0.98	0.93
03-07	0.91	0.95	0.96	0.96	0.95	0.96
08-10	0.93	0.95	0.95	0.93	0.95	0.80
94-10	0.91	0.90	0.92	0.89	0.90	0.75

Where applicable, the MSCI World index serves as a benchmark portfolio[3].

Table 6 summarizes the rank orders of the investment strategies resulting from each of the performance measures employed. Interestingly, rank orders of the investment strategies are similar. To assess the degree of homogeneity of the rank orders across all ratios, we determine bivariate rank correlation coefficients using Spearman's rho. As the results summarized in Table 7 show, the rank correlations for most of the ratios are high, ranging between 0.7 and 1.0. I.e., the effect of choosing a particular performance measure instead of another on the final strategy ranking seems to be smaller than one could expect given how differently the ratios are constructed.

To determine whether this observation also holds for specific market environments, I repeat the above analysis for the aforementioned sub-periods. The resulting average Spearman rank correlations are summarized in Table 8. Interestingly, average correlations were lowest during the 1994-1999 bull market, and highest during the subsequent bear period.

[3] As robustness checks (not reported), I also use period-specific average risk-free interest rates, as well as alternative strategy-specific benchmark portfolios. However, the main results of the study are not affected by these changes.

Figure 3 shows to which extent the investment strategies' ranks differ across performance ratios, as measured by the respective ranks' standard deviations. On average, rank orders seem to be more homogeneous for the best and for the worst performing strategies than for the middle-ranking ones, especially during the first and the second period.

Finally, I study to which extent each individual ratio proxies for a hypothetical 'average' rank order produced by all other performance ratios considered. I determine the mean absolute deviation (MAD), and the mean squared deviation (MSD) of each ratio's rank order from the average rank order for the whole observation period as well as for the four sub-periods. As Figure 4 shows, the Sharpe ratio and the Sortino ratio exhibit the lowest mean deviations over the full observation period. Moreover, they also provide performance rank orders which are close to the mean rank order for all sub-periods. Thus, I can confirm Eling and Schumacher's [5] conclusion that in spite of the conceptual shortcomings of a symmetric measure given non-normal hedge fund returns, the Sharpe ratio seems to serve as a good proxy for most of the other, more sophisticated performance measures. As I have shown, this observation holds not only for increasing stock markets, but also in times of a tensed stock market environment, as during the periods 2000-2002, and 2008-2010.

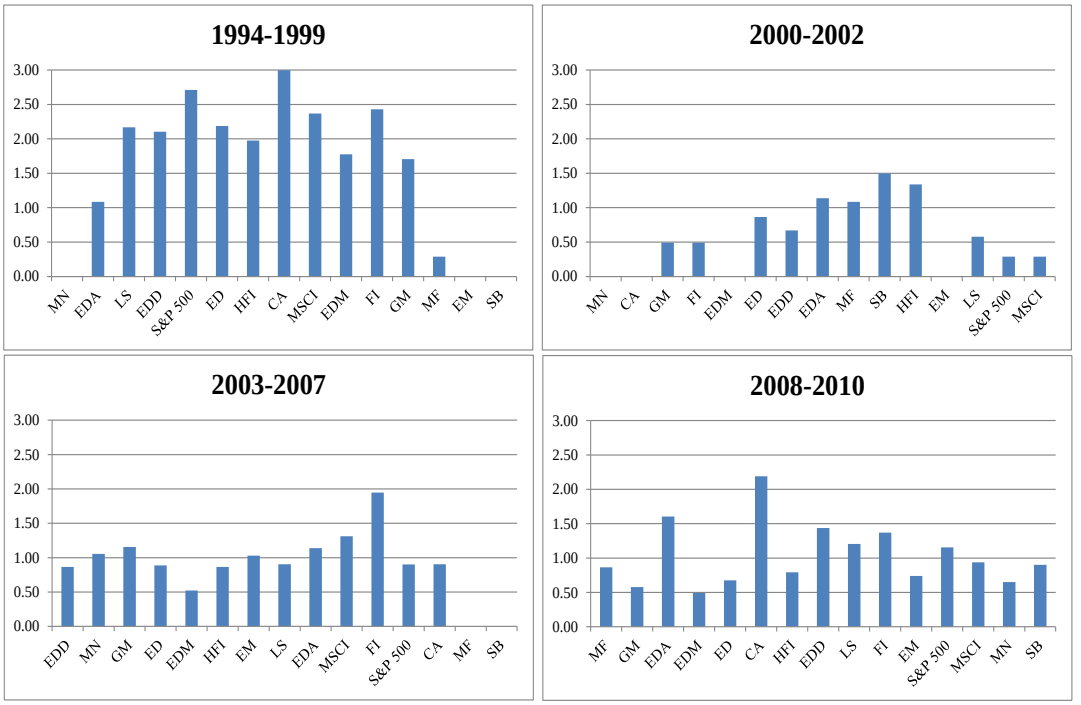

Figure 3: Standard deviations of investment strategy ranks across performance ratios

Notes: In Figure 3, each diagram shows the standard deviation of the ranks assigned to each investment strategy index for the respective period. Strategies are sorted from left to right according to their average rank. E.g., for the period 1994-1999, the average rank of MN is '1' (best), and the average rank of SB is '15' (worst).

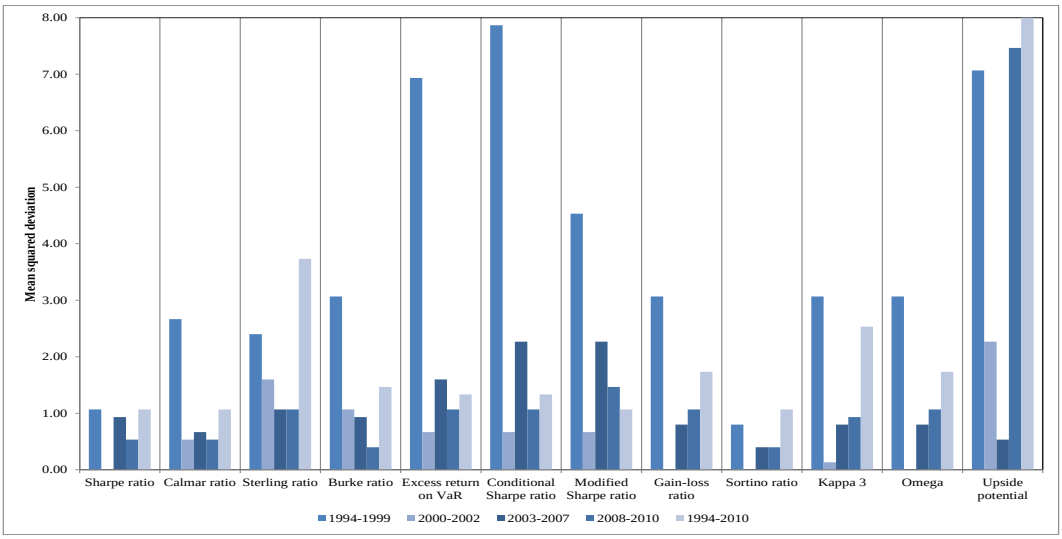

Figure 4: Performance ratios' mean absolute deviations from average rank orders

5 Conclusion

In line with prior research, this study shows that most of the risk-adjusted performance measures considered produce to similar rankings of the respective investment indices, thus leading to virtually the same investment decision. In particular, the rank orders based on the Sharpe ratio are close to those derived from more sophisticated performance ratios, suggesting the former as a good, parsimonious alternative for practical purposes.

However, some of the ratios repeatedly lead to rankings that show stronger deviations from the other ratios' individual rank orders, and from the overall average rank orders. Namely, these are the upside potential ratio, and, to a lesser extent, the conditional Sharpe ratio and the modified Sharpe ratio. Moreover, I find that performance rank orders are more homogeneous for the best and for the worst performing portfolios, and more diverse for the middle-ranking strategies especially during the period 1994-1999. Therefore, although the general result that the Sharpe ratio provides remarkably robust performance evaluations is supported, I conclude that investors are still well advised to exercise due care in choosing a performance measure that adequately reflects their individual investment objectives, and risk preferences.

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