# HEDGE FUND ASSETS RATES OF RETURN – THEORY AND EMPIRICAL TESTS

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#### Abstract

The paper pays attention to contradictions in the literature studies on hedge fund investments efficiency. Some scientists say that they achieve better results than traditional investment funds and some others emphasize that it is not true. The author pays attention to the assumption of the standard normal distribution which is taken when traditional risk measures such as standard deviation are used. In fact, the author presents the research which shows that hedge fund assets rates of return are not normally distributed. Histograms and probability plots of monthly rates of return of hedge fund assets were presented. The research suggests that traditional risk measures, although so widely used both in theoretical papers and in practice, are not adequate for hedge funds. The data comprise 2200 hedge funds. The examination period was from January 1990 up to march 2011.

**Keywords**: hedge funds, rates of return, Multistrategy, Merger Arbitrage strategy

JEL Classification: E44, O16

# INTRODUCTION

The aim of the paper is to present examinations of the distribution of hedge fund assets rates of return. The author shows that they are not normally distributed. The analysis of hedge funds should be conducted after having divided them into groups depending on the strategies used. This is why the author analyzed 9 different groups of hedge funds, that is: Merger Arbitrage, Short Bias, Emerging Markets, Event Driven, Macro, Relative Value, Fixed Income Convertible Arbitrage, Multistrategy, Long/Short Equity Index rates of return for each strategy applied by hedge funds were calculated. The examination period was from January 1990 up to march 2011. The monthly data for 2200 hedge funds were considered. The standard normal distribution hypothesis is used for standard models applied in the modern theory of finance, as well as in practice when hedge funds are evaluated by investors.

# THE EVOLUTION OF HEDGE FUNDS

The lack of regulations was the reason for the hedge funds evolution from institutions responsible for risk management to institutions that conduct speculative transactions linked with high risk level and avoid the supervision. However, it is not only the lack of regulations but at the same time too strict regulations concerning investment funds, especially restrictions on derivatives investments or financial leverage usage. Thanks to the creation of such institutions as hedge funds, investors have a choice if they want to give their capital to investment funds and keep the risk level low enough or bear higher risk and have the opportunity to generate higher rates of return than those typical for investment funds.

The research presented in the literature devoted to hedge funds is full of contradictions. There is some literature presenting the research which proves that hedge funds have generated high rates of return in general.<sup>1</sup> At the same time,

<sup>&</sup>lt;sup>1</sup> See for example: W. Fung, D. Hsieh, Empirical Characteristics of Dynamic Trading Strategies: The Case of Hedge Funds, Review of Financial Studies, Vol. 10, 1997, p. 275 – 302; B. Liang, Hedge Funds: The Living and the Dead, Journal of Financial and Quantitative Analysis, Vol. 35, 2000, p. 309 – 326; B. Liang, Hedge Fund Performance 1990 – 1999, Financial Analysts Journal, Vol. 57, 2001, p. 11 – 18; R. Kosowski, N.Y. Naik, M. Teo, Do Hedge Funds Deliver Alpha? A Bayesian and Bootstrap Approach, Journal of Financial Economics, Vol. 84, 2007, p. 229 – 264; W. Fung, D. Hsieh, N.Y. Naik, T. Ramadorai, Hedge Funds: Performance, Risk and Capital Formation, Journal of Finance, Vol. 63, 2008, p. 1777 – 1803; V. Agar-

however, there exists some research which shows that hedge funds are not able to generate extraordinary rates of returns. For instance, C.R. Asness, J. Krail and J. Liew<sup>2</sup> prove that after having taken into consideration inappropriate valuations of illiquid assets, it turns out that hedge funds do not generate especially attractive rates of return. The same conclusion is drawn by H.G. Fung, X.E. Xu and J. Yau who show that hedge funds managers do not generate any extraordinary rates of return when such things are considered as: the lack of liquidity, the lack of linearity of rates of return or survivorship bias.<sup>3</sup> All the above mentioned contradictions in the examination results are due to the lack of compulsory registration of these institutions for many years. Although since 22 July 2013 the Directive on Alternative Investment Fund Managers<sup>4</sup> was introduced, at least a few years is necessary to go before the data bases achieve sufficient complexity for future examinations of hedge funds rates of return. Besides it is only in Europe and in the United States where activities are conducted to make hedge funds more transparent. This is why there started the process of changing their headquarters from these countries to Asia where hedge funds are still unregulated and do not have to be registered.

# EXAMINATIONS OF RATES OF RETURN OF HEDGE FUND ASSETS

The research was conducted using the data base delivered by Hedge Fund Research (HFR).<sup>5</sup> Hedge funds were divided into 10 strategies because

wal, D. Naveen, N. Naik, Flows, Performance, and Managerial Incentives in Hedge Funds, George State University Working Paper 2004, p. 1 – 44, at: http://papers.ssrn.com/sol3/papers.cfm?abstract\_id=424369, 07.10.2014; G. Baquero, M. Verbeek, A portrait of Hedge Fund Investors: Flows, Performance and Smart Money, Erasmus University Rotterdam Working Paper 2009, p. 1 – 65, at: http://papers.ssrn.com/sol3/papers.cfm?abstract\_id=773384, 07.10.2014; W. Goetzmann, J. Ingersoll, S. Ross, High-Water Marks and Hedge Fund Management Contracts, Journal of Finance, Vol. 58, Nr 4, 2003, p. 1685 – 1717.

<sup>&</sup>lt;sup>2</sup> C.R. Asness, J. Krail, J. Liew, Do hedge funds hedge?, Journal of Portfolio Management, Vol. 28, 2001, p. 6 – 19.

<sup>&</sup>lt;sup>3</sup> H.G. Fung, X.E. Xu, J. Yau, Do Hedge Fund Managers Display Skill?, Journal of Alternative Investments, Vol. 6, 2004, p. 22 – 31.

<sup>&</sup>lt;sup>4</sup> Directive 2011/61/EU of the European Parliament and of the Council of 8 June 2011 on Alternative Investment Fund Managers and amending Directives 2003/41/EC and 2009/65/ EC and Regulations (EC) No 1060/2009 and (EU) No 1095/2010, Official Journal of the European Union, 2011.

<sup>&</sup>lt;sup>5</sup> The research was first published in Polish in: I. Pruchnicka-Grabias, Fundusze hedgingowe. Teoria i praktyka, Wydawnictwa fachowe CeDeWu, Warszawa 2013, p. 331 – 334.

there is no sense in making analysis of all hedge funds at the same time. They are not a homogenous group. Index rates of return for each strategy applied by hedge funds were calculated. The data were gathered monthly and 2200 hedge funds were taken into consideration. The examination period was from January 1990 up to march 2011.

The research was devoted to testing the hypothesis of standard normal distribution of rates of return on hedge fund assets for each of the strategies used by them. The hypothesis is used for standard models applied in the modern theory of finance.

# MERGER ARBITRAGE

**Chart 1.** Histogram of monthly rates of return of hedge fund assets for the Merger Arbitrage strategy in 1990 - 2011 and the corresponding normal distribution



H<sub>0</sub>: E[|G(x) - F(x)|] = 0 dla x  $\in$  (- $\infty$ , + $\infty$ )

Where:

G(x) – values of the empirical distribution F(x) – values of the normal distribution

 $\Gamma(x) = values of the normal district$ 

H<sub>1</sub>: E[|G(x) - F(x)|] > 0

Assuming the significance level of  $\alpha = 0,01$ , the critical value  $\lambda_{0,01;3}^2 = 11,3449$ , which lets set the following critical range:  $<11,3449, +\infty$ ). The value 33,24835 is undoubtedly placed in the assessed range, which lets unquestionably reject the zero hypothesis and assert that the rates of return distribution generated by hedge funds applying the Merger Arbitrage strategy is different from the normal distribution and the difference is statistically significant. The decision is indisputable because the probability of changing it to the contrary one is 0 (the precision up to 5 items following the comma).

**Chart 2.** Normal probability plot for monthly rates of return of hedge fund assets for the Merger Arbitrage strategy in 1990 – 2011



# SHORT BIAS





Source: own study based on data from Hedge Fund Research (HFR).

H<sub>0</sub>: E[|G(x) - F(x)|] = 0 dla x  $\in$  (-  $\infty$ , I  $\cong$ )

Where:

G(x) – values of the empirical distribution

F(x) – values of the normal distribution

 $H_1: E[|G(x) - F(x)|] > 0$ 

Assuming the significance level  $\alpha = 0,01$ , the critical value is  $\lambda_{0,01;3}^2 = 11,3449$ , which lets set the following critical range:  $<11,3449,+\infty$ ). The value 12,03391 is placed in the assessed range, which lets indisputably reject the zero hypothesis and assert that the rates of return distribution for hedge funds applying the Short Bias strategy is different from the normal distribution and the difference is statistically significant. The decision is undeniable because the probability of changing the decision to the contrary one is near 0.

**Chart 4.** Normal probability plot for monthly rates of return of hedge fund assets for the Short Bias strategy in 1990 – 2011



Source: own study based on data from Hedge Fund Research (HFR).

## **EMERGING MARKETS**

**Chart 5.** Histogram of monthly rates of return of hedge fund assets for the Emerging Markets strategy in 1990 - 2011 and the corresponding normal distribution



Source: own study based on data from Hedge Fund Research (HFR).

H<sub>0</sub>: E[|G(x) - F(x)|] = 0 dla x  $\in$  (- $\infty$ , + $\infty$ )

Where:

G(x) – values of the empirical distribution

F(x) – values of the normal distribution

H<sub>1</sub>: E[|G(x) - F(x)|] > 0

Assuming the significance level of  $\alpha$  = 0,01, the critical value  $\lambda_{0.01:1}^2$  = 6,6349, which lets set the following critical range: <6,6349,  $+\infty$ ). The value 14,67661 is undoubtedly placed in the assessed range, which lets unquestionably reject the zero hypothesis and assert that the rates of return distribution generated by hedge funds applying the Emerging Markets strategy is different from the normal distribution and the difference is statistically significant. The decision is indisputable because the probability of changing it to the contrary one is near 0.

Chart 6. Normal probability plot for monthly rates of return of hedge fund assets for the Emerging Markets strategy in 1990 – 2011



Normal P-Plot: Emerging markets

#### **EVENT DRIVEN**





Source: own study based on data from Hedge Fund Research (HFR).

H<sub>0</sub>: E[|G(x) - F(x)|] = 0 dla x  $\in$  (-00, +••)

Where:

G(x) – values of the empirical distribution

F(x) – values of the normal distribution

 $H_1: E[|G(x) - F(x)|] > 0$ 

Assuming the significance level of  $\alpha = 0,01$ , the critical value  $\lambda_{0,01;7}^2 = 18,4753$ , which lets set the following critical range:  $<18,4753, +\infty$ ). The value 28,07531 is undoubtedly placed in the assessed range, which lets unquestionably reject the zero hypothesis and assert that the rates of return distribution generated by hedge funds applying the Event Driven strategy is different from the normal distribution and the difference is statistically significant. The decision is indisputable because the probability of changing it to the contrary one is near 0.

**Chart 8.** Normal probability plot for monthly rates of return of hedge fund assets for the Event Driven strategy in 1990 – 2011



Source: own study based on data from Hedge Fund Research (HFR).

## MACRO

Chart 9. Histogram of monthly rates of return of hedge fund assets for the Macro strategy in 1990 – 2011 and the corresponding normal distribution



H<sub>0</sub>: E[  $| G(x) - F(x) | ] = 0 \text{ dla } x \in (-\infty, +\infty)$ 

Where:

G(x) – values of the empirical distribution

F(x) – values of the normal distribution

 $H_1: E[|G(x) - F(x)|] > 0$ 

Assuming the significance level of  $\alpha = 0,01$ , the critical value  $\lambda_{0,01;7}^2 = 18,4753$ , which lets set the following critical range:  $<18,4753, +\infty$ ). The value 22,19975 is undoubtedly placed in the assessed range, which lets unquestionably reject the zero hypothesis and assert that the rates of return distribution generated by hedge funds applying the Macro strategy is different from the normal distribution and the difference is statistically significant. The decision is indisputable because the probability of changing it to the contrary one is near 0.

**Chart 10.** Normal probability plot for monthly rates of return of hedge fund assets for the Macro strategy in 1990 - 2011



# **RELATIVE VALUE**





Source: own study based on data from Hedge Fund Research (HFR).

H<sub>0</sub>: E[|G(x) - F(x)|] = 0 dla x  $\subset$  (- $\infty$ , + $\infty$ )

Where:

G(x) – values of the empirical distribution F(x) – values of the normal distribution

H<sub>1</sub>: E[|G(x) - F(x)|] > 0

Assuming the significance level of  $\alpha = 0,01$ , the critical value  $\lambda_{0,01;8}^2 = 11,3449$ , which lets set the following critical range:  $<11,3449, +\infty$ ). The value 31,13939 is undoubtedly placed in the assessed range, which lets unquestionably reject the zero hypothesis and assert that the rates of return distribution generated by hedge funds applying the Relative Value strategy is different from the normal distribution and the difference is statistically significant. The decision is indisputable because the probability of changing it to the contrary one is 0 (the precision up to 5 items following the comma).

**Chart 12.** Normal probability plot for monthly rates of return of hedge fund assets for the Relative Value strategy in 1990 – 2011



Source: own study based on data from Hedge Fund Research (HFR).

#### FIXED INCOME CONVERTIBLE ARBITRAGE

**Chart 13.** Histogram of monthly rates of return of hedge fund assets for the Fixed Income Convertible Arbitrage strategy in 1990 – 2011 and the corresponding normal distribution



Source: own study based on data from Hedge Fund Research (HFR).

H<sub>0</sub>: E[|G(x) - F(x)|] = 0 dla x  $\in$  (- $\infty$ , I  $\cap$ )

Where:

G(x) – values of the empirical distribution F(x) – values of the normal distribution

 $H_1: E[|G(x) - F(x)|] > 0$ 

Assuming the significance level of  $\alpha = 0,01$ , the critical value  $\lambda_{0,01;2}^2 = 9,2104$ , which lets set the following critical range:  $<9,2104, +\infty$ ). The value 100,90113 is undoubtedly placed in the assessed range, which lets unquestionably reject the zero hypothesis and assert that the rates of return distribution generated by hedge funds applying the Fixed Income Convertible Arbitrage strategy is different from the normal distribution and the difference is statistically significant. The decision is indisputable because the probability of changing it to the contrary one is 0 (the precision up to 5 items following the comma).

**Chart 14.** Normal probability plot for monthly rates of return of hedge fund assets for the Fixed Income Convertible Arbitrage strategy in 1990 – 2011



#### MULTISTRATEGY





Source: own study based on data from Hedge Fund Research (HFR).

H<sub>0</sub>: E[|G(x) - F(x)|] = 0 dla x  $\in$  (- $\infty, +\infty$ )

Where:

G(x) – values of the empirical distribution

F(x) – values of the normal distribution

 $H_1: E[|G(x) - F(x)|] > 0$ 

Assuming the significance level of  $\alpha = 0,01$ , the critical value  $\lambda_{0,01;3}^2 = 11,3449$ , which lets set the following critical range:  $<11,3449, +\infty$ ). The value 45,45881 is undoubtedly placed in the assessed range, which lets unquestionably reject the zero hypothesis and assert that the rates of return distribution generated by hedge funds applying the Multistrategy is different from the normal distribution and the difference is statistically significant. The decision is indisputable because the probability of changing it to the contrary one is 0 (the precision up to 5 items following the comma).

**Chart 16.** Normal probability plot for monthly rates of return of hedge fund assets for the Multistrategy in 1990 - 2011



Source: own study based on data from Hedge Fund Research (HFR).

## LONG/SHORT EQUITY

**Chart 17.** Histogram of monthly rates of return of hedge fund assets for the Long/ Short Equity strategy in 1990 – 2011 and the corresponding normal distribution



H<sub>0</sub>: E[ |G(x) - F(x)| ] = 0 dla x  $\in$  (- $\infty$ , + $\infty$ )

Where:

G(x) – values of the empirical distribution F(x) – values of the normal distribution

 $H_1: E[|G(x) - F(x)|] > 0$ 

Assuming the significance level of  $\alpha = 0.01$ , the critical value  $\lambda_{0.01;4}^2 = 13,2767$ , which lets set the following critical range:  $<13,2767, +\infty$ ). The value 4,96259 is not placed in the assessed range, which lets unquestionably accept the zero hypothesis and assert that the rates of return distribution generated by hedge funds applying the Long/Short Equity strategy is normal. The decision is disputable because the probability of changing it to the contrary one is 0.3.

**Chart 18.** Normal probability plot for monthly rates of return of hedge fund assets for the Long/Short Equity strategy in 1990 – 2011



Source: own study based on data from Hedge Fund Research (HFR).

As the research results show, there is no strategy used by hedge funds where hedge fund assets rates of return are normally distributed and confirmed with indisputable verification decision that the distribution really suits the data. In the case of 8 strategies (*Merger Arbitrage, Short Bias, Emerging Markets, Event Driven, Macro, Relative Value, Fixed Income Convertible Arbitrage, Multistrategy*) the hypothesis on the standard normal distribution was rejected indisputably at the significance level of  $\alpha = 0,01$  and all verification decisions were indisputable. For the *long/short equity* strategy only the hypothesis of the normal distribution was accepted at the significance level of  $\alpha = 0,01$ , however with the high probability of changing the verification decision to the contrary one (p = 0,3).

# DISCUSSION

Traditional risk measures based on the standard deviation and variance require the assumption that rates of return are normally distributed. Although many hedge fund managers use them to present the efficiency of their investment strategies, they may not present the real risk level because hedge fund assets rates of return are not normally distributed. It requires introducing new risk measures in the world of hedge funds. However, it sets the question, if modern risk indicators such as for instance Burke ratio, Calmar ratio, Sterling ratio or lower partial moments risk measures are really more adequate. It deserves further studies.

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