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MAXIMUM DRAWDOWN MEASURES IN HEDGE FUND EFFICIENCY APPRAISAL

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Abstract

The study concentrates on the comparison of hedge fund efficiency measured by maximum drawdown measures with traditional risk/return ratios. The examined period is from 1990 to 2011 and the data were provided by Hedge Fund Research. It is a continuation of the research done for a shorter period, that is for the years 2005 – 2011. The results obtained there were interesting and showed that the results of complex efficiency measures aren't much different from traditional measures. It posed the question of whether it is worth applying them with their entire complexity. The author wants to check if the same conclusions will be drawn for a longer period.

After having analyzed maximum drawdown measures, further research will be devoted to other groups of measures. It should give the answer to the question of whether complex efficiency measures are as useful as it is often stressed in the hedge fund literature.

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Introduction

For many years hedge fund performance has been measured by adjusting the rate of return with their standard deviation. It means using the volatility of rates of return as the risk measure. At the same time, the literature emphasizes that it is not an adequate measure for investments whose rates of return have negative skewness and high kurtosis (as it is for hedge funds). The author applies other, so-called alternative risk measures, based on the maximum drawdown generated in the assumed period and checks if results achieved with alternative tools are really different or more adequate than those with traditional measures

The story of hedge funds and methodological problems

The standard financial literature stresses that the first hedge fund was created in 1949. It is Alfred Winslow Jones who is thought to be its founder. His intention was to generate profits from market fluctuations, both up and down, not only when the market rises. In addition, he aimed at keeping risk at a reasonable level compared to the profit made. To establish his hedge fund, Jones gathered 20000 USD from investors and used 40000 USD of his own money, which let him pool the capital of 60000 USD. Next, he was using sophisticated strategies he thought would deliver returns during both up and down market fluctuations. The two main investment strategies he employed in his hedge funds were: short sale of assets and financial leverage. These two strategies are treated as two typical features of any hedge fund at present (Frush, 2007, p. 32). Caldwell (1995) also reports that the first hedge fund was brought to life by Albert Winslow Jones in 1949. During the early years of the hedge fund industry development (1950s – 1970s), the name hedge fund was used in order to reflect the hedging strategy applied by managers at that time (Vault, 2015). There are also some references in the literature that claim that the first fund was created much earlier, that is in the thirties, however it was not called a hedge fund. The analysis of strategies applied by it leads to the conclusion that it could be named a hedge fund. In the past hedge funds were created so as to generate rather low risk levels by hedging transactions. However, the term hedge evolved and now is used in a different context, meaning also arbitrage and speculative strategies which generate high risk levels. Hedging is also applied by hedge funds, however it is not the core of their investments.

Hedge funds have been designed for mostly institutional investors, including endowments and foundations and pension funds as well as for wealthy individuals, particularly among the advanced economies. Very often wealthy individuals treat them as a kind of investment which should be made by them in order to be proud of it and to have something to talk about with other participants of important parties. Thus, they are treated not as standard investment but rather something prestigious. These are also American universities which invest in hedge funds. Generally, hedge funds are a kind of alternative investments and it is not advised to put the whole investment capital into them. The main reason for making investments in hedge funds is that they generate absolute returns and very low correlations with traditional asset classes, like equities and bonds. This risk – return profile, to some extent, results from the unregulated and various investment strategies used by them (Baba & Goko, 2006). It is worth mentioning that hedge fund investments are sometimes treated as a must for some upper class people who want to boast of having them in their portfolios during different parties. By certain groups they are treated as prestigious investments for rich and successful people only.

During the past recent years, a lot has been done to regulate hedge funds in the USA and in Europe. Unfortunately, it turned out that hedge fund managers try to avoid regulations by taking their capital from Europe and the USA to Asia where hedge funds have not been regulated so far. This is why Asian fund assets have grown gradually since the end of 2013, following the strict European regulations on these investment vehicles and this trend has been continuing so far. It shows that without global hedge fund regulations the problem of them generating high systemic risk cannot be solved. At the same time, global regulations at this time seem impossible to be made.

The alternative investment sector aims at generating absolute rates of return, not relative ones. Contrary to traditional investment managers who use indexes as benchmarks, alternative investment managers invest for absolute returns, not returns dependent on the broad market. The majority of the rates of return from alternative investment strategies derive from the unique skill of the

manager rather than the returns of an asset class (Hedges IV, 2005, p. 5). These unique skills are measured with the so-called alpha which can show to what extent the manager's investments were better than the market.

Hedge funds are pretty difficult to research because one can get different results depending on what period is taken for the analysis, what measures are applied or what data base is used. For example, there is some literature presenting the research which proves that hedge funds have generated high rates of return in general (Fung & Hsieh, 1997; Liang, 2000; Liang, 2001; Kosowski, Naik & Teo, 2007; Fung, Hsieh & Naik, 2008; Agarwal, Naveen & Naik, 2004; Baquero & Verbeek, 2009; Goetzman, Ingersoll & Ross, 2003; Ferreira et al., 2015). Simultaneously however, there exists some research which shows that hedge funds are not able to generate extraordinary rates of returns. For instance, Asness, Krail and Liew (2001) 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 given by Fung, Xu and Yau who show that hedge fund 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 (2004). Some of 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 (2011) was introduced, at least a few years are necessary before the data bases achieve sufficient complexity for future examinations of hedge fund 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 the process of changing their headquarters from these countries to Asia has begun, where hedge funds are still unregulated and do not have to be registered. It may turn out that these regulations will not be sufficient to make hedge funds more transparent both to market participants and for financial market supervisors. These are especially the latter who worry about the systemic risk generated by hedge funds. This is why the subject requires further studies and further changes in the functioning of these institutions. After having done the research focused on traditional hedge fund efficiency measures, the author decided to move on and check if alternative risk measures appear to be more adequate for hedge funds. A part of this research is presented in this report.

The scope of this research and the author's research on hedge fund efficiency measures

The study concentrates on the comparison of hedge fund efficiency measured by maximum drawdown measures with traditional risk/return ratios. The efficiency should be understood here as the relation between the excess rate of return above the risk-free interest rate made by a hedge fund and the risk generated to achieve it.

The examined period is from 1990 to 2011 and the data were provided by Hedge Fund Research. It is a continuation of the research done for a different period, that is for the years 2005 – 2011. The results obtained there were interesting and showed that complex efficiency measures don't give much different results than traditional measures. It posed the question of whether it is worth applying them with their whole complexity. The author wants to check if the same conclusions will be drawn for a longer period.

After having analysed maximum drawdown measures, further research will be devoted to other groups of measures. It should give the answer to the question of whether complex efficiency measures are as useful as it is often stressed in the hedge fund literature.

Traditional efficiency measures

Among standard methods of investment efficiency valuation one can name the following (Pruchnicka-Grabias 2015a; Pruchnicka-Grabias 2015b; Pruchnicka-Grabias, 2016): Sharpe ratio, Jensen ratio and Treynor ratio. The Sharpe ratio can be defined as (Sharpe, 1994):

$$\text{Sharpe Ratio} = \frac{r_i^d - r_f}{\sigma(r_i)} \quad (1)$$

where:

Sharpe Ratio – the investment result on the portfolio of i assets

r_i^d – the average value of the rate of return on the portfolio of i assets

$\sigma(r_i)$ – the standard deviation on rates of return on the portfolio of i assets

r_f – risk-free interest rate

Sharpe ratio defined above can be used to measure the relative efficiency of an investment. Its application can only admit the comparison of different funds. Sharpe created it in order to assess the relation of risk and excess return for various investment funds. However, at the moment it is also used for hedge funds or other types of investments. At the same time it is being criticized for applying the standard deviation in its construction, which makes that it has the same drawbacks as this risk measure. Furthermore, the Sharpe ratio cannot measure the efficiency of one fund. Its result cannot be interpreted in a different way than by making a comparison with other types of investments or other hedge funds. The Sharpe ratio is a golden standard for hedge fund companies. They use it usually to present their result to potential investors on their web pages (compare for example internet pages of Credit Suisse First Boston Group). Apart from practice, it widely appears in the literature as well (for example Chan, Getmansky, Haas & Lo, 2011). Simultaneously, the literature emphasizes that those who applying the Sharpe ratio makes that we do not consider that it is only a "more or less" and viable efficiency measure which can be liable to substantial calculation errors (Lo, 2002). Another traditional efficiency measure is the Jensen ratio. Usually it is depicted as follows (Breuer, Guertler & Schuhmacher, 2004; Eling & Schuhmacher, 2007):

$$JR = \left(r_i^d - r_f\right) - \left(r_{ip}^d - r_f\right) \times \beta_i \qquad (2)$$

where:

β_i – the sensitivity of hedge fund rates of return changes compared with the market. The market stands for some benchmark portfolio, for instance an index

r_{ip}^d – the average rate of return on the market portfolio

The weak side of the Jensen ratio is that it can show higher rates of return than they really are in the case of managers using the financial leverage.

The Treynor ratio is usually depicted as:

$$\text{Treynor Ratio} = \frac{r_i^d - r_f}{\beta_i} \qquad (3)$$

The Treynor ratio has the same numerator as the Sharpe ratio. It measures the excess rate of return over the risk-free interest rate. They differ from each other with the denominator that is with the way of risk measurement.

Speaking about the Treynor and Jensen ratios, it is also worth stressing here that both of them are suitable as efficiency measures only if the investor puts only a part of its capital in hedge funds.

Types of alternative hedge fund effectiveness measures

The paper draws attention to other efficiency measures than such traditional ratios as Sharpe, Treynor or Jensen. Its aim is not to present the whole theory of alternative measures, but to pay attention to their existence and to use them in practice in the field of hedge funds. They can be divided into such beneath presented groups (Pruchnicka-Grabias, 2015a, pp. 133-140; Pruchnicka-Grabias, 2015b, pp. 15-20; Pruchnicka-Grabias, 2016):

1) maximum drawdown measures such as Calmar, Sterling or Burke ratios (Young, 1991);
2) measures based on the value at risk such as: excess return on the value at risk (VaR), conditional Sharpe ratio or modified Sharpe ratio (Eling & Schuhmacher, 2007);
3) measures based on lower partial moments, Omega, Sortino and Kappa ratios (Harlow, 1991);
4) measures made with the example of the Sharpe ratio but taking into consideration the skewness and kurtosis of rates of return (Dowd, 1998);
5) measures based on higher partial moments which value the upside potential of the profit and are thus called upside potential ratios (Sortino & Meer, 1999).
6) Data Envelopment Analysis, often abbreviated to DEA which is a non-parametrical approach based on linear programming in order to value the inputs and results (Eling, 2006).

As far as the first above mention group of measures is concerned (maximum drawdown measures), they are based on the rate of return realized in comparison to the specified benchmark. Its role is usually played by some risk – free interest rate, however it is not a must. Differences among discussed ratios appear in their denominators. To be exact, in the Calmar ratio risk is treated as the maximum loss of capital in the analysed time. Such a construction helps include the so called extreme risk (that is the risk which occurs pretty rare, however if it appears, losses are extremely high, compare: Jajuga ed. (2007, p. 38)). A different understanding of risk can be met in the Sterling ratio which in turn calculates it as the arithmetic average out of a few highest losses generated in the examined period of time. The number of highest capital losses can be

specified by the user in an arbitral way, depending on the situation. Thanks to such a construction, the Calmar ratio compared with the Sterling one, reduces its sensitivity to extreme losses which appear very rarely. It makes it not to fluctuate too much. Simultaneously, when one applies the Sterling ratio to measure hedge funds efficiency, some problems may appear because of some special features of these subjects. For instance, hedge funds use really complex strategies, which means that they may achieve attractive investment results for a very long period of time and suddenly generate a huge loss which will not be well reflected by the Sterling ratio. Although being a singular loss, it can be high enough to create the necessity of a hedge fund liquidation or an investor bankruptcy. Thus, it is a weak side of the Sterling ratio that owing to the process of averaging it would might not reflect it properly. Another ratio in this group, the Burke ratio, its sensitivity to single substantial capital loss is also limited. Moreover, all of discussed ratios (Calmar, Sterling and Burke) are not really sensitive to maximum losses. This in turn means that they may be a good tool for risk-averse investors instead of the traditional measure like the Sharpe ratio. Apart from that, their exceptional features make them more appropriate for hedge funds analysis than the Sharpe ratio.

To sum up, it would be difficult or even impossible to choose one best efficiency measure, even just in the discussed group of ratios. What's more, the beneath tables present the research results showing that there are certain differences among analysed ratios. Perhaps it would be a good idea to make hedge fund rankings which take into consideration the average value of different measures. In such a situation however, another problem arises: what weights should be used then? It makes a challenge for further studies.

Most of all, risk measures mentioned above measure only the chosen part of risk. For example, the Omega, Sortino and Kappa consider partial moments, maximum drawdown measures – the highest loss or the average from the highest losses, conditional Sharpe ratio or modified Sharpe ratio – the Value at Risk, skewness, kurtosis, etc. This problem can be avoided in the method called the Data Envelopment Analysis. At the beginning of its usage, it was applied in the public sector as a measure of its efficiency. It was to check the relation between the resources used (taken as inputs) and goods and services created (taken as outputs). M. Eling (2006, p. 2, 26) suggested to apply it for hedge funds, however under the specified rules. To be exact, various risk measures can be treated as inputs and at the same time their rates of return can play a role of outputs. Next the optimization process was conducted whose final result gives the proposed efficiency measure. However, Data Envelopment Analysis may not be a golden mean for any investment because it requires choosing appropriate risk measures. These are investor's preferences which decides which ones will be the best idea. What's more, the mentioned research done by M. Elling does not show that this method created more adequate hedge funds rankings than any other.

The application of alternative efficiency measures to hedge funds

Harlow (1991) pays attention that risk-return measures based on the maximum loss of capital have many strong sides if one compares them to the traditional Sharpe ratio which considers the standard deviation a reflection of risk generated by an investor. In fact such an attitude is more suitable for risk-averse investors who are hardly afraid of losses and even potential profits cannot compensate for them. In practice, such measures based on the maximum loss of capital are popular tools in so called CTA funds which are actively managed subjects. At the same investors who put their capital in CTAs are not those with risk aversion. However, there may be other reasons. For instance, such alternative measures may seem better for them because they do not show the volatility of the whole market like the standard deviation does. In contrast, they consider the potential probability of making a loss of capital. Such an explanation stays in line with the so called behavioural finance theory. Exactly speaking, Kahneman and Tversky (1979) conclude that investors are less happy when they make profits than they are angry if the loss of the same amount of capital is realised. For example, Harlow emphasizes that the optimization based on measures of risk understood as losses only lets build strategies with real rates of return less exposed to risk treated as a negative event than the optimization based on variance risk measures (Harlow, 1991). Eling and Schuhmacher (2007) conclude that alternative risk-return measures should be used instead of the Sharpe ratio in such cases where there are problems with the distribution of rates of return (they do not behave in agreement with the standard normal

distribution). This rule works for hedge funds, which is why alternative measures could seem a better tool for their risk-return analysis.

The group of risk-return ratios that measure risk as something only negative (that is a loss) are so called maximum drawdown measures. They relate the excess return (above the risk – free interest rate) to differently understood, depending on the chosen measure, capital losses in the specified time period. In this group of measures one can mention: the Calmar ratio, Sterling and Burke ratios. The Calmar ratio is defined as follows (Young, 1991, p. 40; Eling & Schuhmacher, 2007, p. 6):

$$CR = \frac{r_i^d - r_f}{-MD_i} \quad (4)$$

where:

r_f – risk-free interest rate

r_i^d – the average value of the rate of return on i assets

MD_i – the lowest rate of return on i assets in the assumed period.

The given formula shows that the Calmar ratio reflects the worst scenario from the past results by taking the lowest negative rate of return in the analysed period of time in its denominator. Thanks to such a construction it may overestimate the real risk level, however for extremely risk-averse investors this feature may be a virtue. It is however sensitive to extreme events which can generate substantial losses but happen pretty rarely, so are hardly probable. Some investors can treat is as a drawback. When the ratio increases, the investment efficiency goes up. It was achieved thanks to including the minus sign in the denominator. This in turn means that the desired situation is the one reflected by the following relation:

CR → max

If some investor is interested in making the Calmar ratio sensitivity to random events lower, one can apply the Sterling ratio. It is based on the arithmetic average of a few lowest rates of return generated in the examined period of time. It is investor's choice how many of them to consider, which may depend both on historical records of a hedge fund or investor's attitude to risk. The mathematical version of the Sterling ratio is usually given as (Kestner, 1996; Eling, Schuhmacher, 2007, p. 6):

$$SR = \frac{r_i^d - r_f}{\frac{1}{N}\sum_{j=1}^{N}(-MD_{ij})} \quad (5)$$

Where:

N – the number of lowest rates of return on i assets taken into consideration. Other mathematical signs were defined above.

The higher the Sterling ratio, the more efficient an investment is. It means that the situation desired by an investor can be defined as:

SR → max

The Burke ratio relates the excess rate of return over the risk-free interest rate to the square root of the sum of N powered lowest rates of return made in the examined period of time.

The Burke ratio is usually presented in the following

Table 1: Values of Sharpe, Calmar, Sterling and Burke ratios for different strategies applied by hedge funds

Strategy	Sharpe ratio	Calmar ratio	5-period Sterling ratio	10-period Sterling ratio	5-period Burke ratio	10-period Burke ratio
Merger Arbitrage	0,386555	0,071207	0,102925	0,142454	0,043687	0,040165
Macro	0,347826	0,111498	0,100643	0,144115	0,042175	0,03952
Relative Value	-0,02523	-0,0066	-0,00888	-0,01066	-0,0039	-0,00326
Emerging Markets	0,217391	0,042816	0,06693	0,089906	0,028593	0,025872
Event Driven	0,32197	0,089852	0,124917	0,156564	0,053465	0,046417
Equity Hedge	0,363636	0,080899	0,108052	0,140669	0,04694	0,041533
Multistrategy	0,36036	0,125	0,187529	0,225138	0,081356	0,068149
Fixed Income Convertible Arbitrage	0,453125	0,072229	0,118249	0,190445	0,048207	0,04698
Equity Market Neutral	0,248705	0,029981	0,063217	0,095224	0,023118	0,022322
Short Bias	0,346094	0,052738	0,091948	0,131105	0,037351	0,035064

Source: Author's own calculations

Table 2: Ranking of strategies applied by hedge funds from the point of view of Sharpe, Sterling, Calmar and Burke ratios

Ratios/ Number	Sharpe ratio	Calmar ratio	5-period Sterling ratio	10-period Sterling ratio	5-period Burke ratio	10-period Burke ratio
1	Relative Value	Macro	Macro	Macro	Macro	Macro
2	Merger arbitrage	Equity Market Neutral	Equity Hedge	Relative Value	Equity Hedge	Relative Value
3	Event Driven	Equity Hedge	Relative Value	Equity Hedge	Relative Value	Equity Hedge
4	Macro	Event Driven	Event Driven	Equity Market Neutral	Event Driven	Evene Driven
5	Equity Market Neutral	Relative Value	Merger Arbitrage	Merger Arbitrage	Merger Arbitrage	Merger Arbitrage
6	Multistrategy	Merger Arbitrage	Equity Market Neutral	Event Driven	Equity Market Neutral	Equity Market Neutral
7	Equity Hedge	Multistrategy	Multistrategy	Multistrategy	Multistrategy	Multistrategy
8	Fixed Income Convertible Arbitrage	Emerging Markets	Emerging Markets	Fixed Income Convertible Arbitrage	Emerging Markets	Emerging Markets
9	Emerging Markets	Fixed Income Convertible Arbitrage	Fixed Income Convertible Arbitrage	Emerging Markets	Fixed Income Convertible Arbitrage	Fixed Income Convertible Arbitrage
10	Short Bias	Short Bias	Short Bias	Short Bias	Short Bias	Short bias

Source: Author's own calculations

Table 3: Pearson linear correlation coefficients between efficiency ratios measuring results of different strategies applied by hedge funds, significant for 0,1

	Sharpe	Calmar	Sterling for N=5	Sterling for N=10	Burke for N=5	Burke for N=10
Sharpe	1	0,76	0,82	0,9	0,94	0,85
Calmar	0,76	1	0,91	0,89	0,92	0,92
Sterling for N=5	0,82	0,91	1	0,97	0,998	0,997
Sterling for N=10	0,9	0,89	0,97	1	0,96	0,98
Burke for N=5	0,94	0,92	0,998	0,96	1	0,99
Burke for N=10	0,85	0,92	0,997	0,98	0,99	1

Source: Author's own calculations

way (Burke, 1994, p. 56; Eling, Schuhmacher, 2007, p. 6):

$$BR = \frac{r_i^d - r_f}{\sqrt[2]{\sum_{j=1}^{N} MD_{ij}^2}} \quad (6)$$

Similarly to other above presented ratios, the burke ratio is optimised when it is the highest, which can be mathematically written as:

$BR \rightarrow max$

To sum up, the traditional efficiency measure - Sharpe ratio – concentrates on relating the excess return over the risk-free interest rate to the standard deviation which presents both the negative and the positive side of risk. It stays in contrast with maximum drawdown measures depicted in the paper which relate the excess return to the negative part of risk only. (Pruchnicka-Grabias, 2015a, pp. 133-140; Pruchnicka-Grabias, 2015b, pp. 15-20; Pruchnicka-Grabias, 2016).

Research results are presented in Tables 1 – 3.

Conclusions

Pearson linear correlation coefficients among efficiency measures are high or very high (see table 3). This is the same conclusion as the one made for a shorter research period, that is 2005 – 2011 (Pruchnicka-Grabias, 2015a, pp. 140 - 143). This in turn puts applying complex efficiency measures in question. They require more time – consuming calculations but are not based on the assumption of the standard normal distribution. The question is if they are really more useful than traditional measures if they give similar results and require more time and knowledge to calculate them. It deserves further studies. It is also worth checking if the examination period influences obtained results, which may be possible. In particular, the economic cycle could influence research results.

Further studies will include other groups of hedge fund efficiency measures mentioned in the text. The overall research should show if alternative measures are really more adequate to hedge funds if one takes into consideration the degree of their complexity and the model risk understood not only as an inadequacy of the model, but also as a human factor risk. The final question is: are potential human mistakes worth applying complex alternative risk measures. The whole research should answer this question. In case of the "yes" answer, many hedge funds will have to change methods of their performance presentation because they would turn out to be misleading. However, so far the answer to this research question is "no".

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