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EVALUATION OF THE RESULTS OF THE EQUITY FUNDS IN THE YEARS 2004–2015 USING VaR AND CVaR MEASURES

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ABSTRACT

The paper presents analysis of the risk and effectiveness of investments in equity funds using value at risk (VaR) and conditional value at risk measures, i.e. reward to value at risk (RVaR) and conditional Sharpe ratio (CS). The study was conducted for 2004–2015, divided into shorter sub-periods (two-, three-, four- and five-year). The stability of the rankings of funds was examined and its significance was verified using the Spearman rank correlation coefficient between subsequent sub-periods. The highest values of measures were observed for 2004–2005. Even then, they were not satisfactory, and the lack of stability of the results does not guarantee that they will be repeated in the future.

Key words: investment efficiency, value at risk (VaR), conditional value at risk (CVaR), reward to value at risk ratio, conditional Sharpe ratio (CS)

INTRODUCTION

By entrusting their financial surpluses to collective investment institutions, the investor expects such management of his assets to achieve the greatest profits. However, one must remember about the risks associated with this type of investment. Investor's fear of a potential loss is often greater than the prospect of profit. Therefore, it is important to relate the investment results of the funds to a possible loss, which should be easy to determine. Such tools provide the value at risk measure. Originally, it used to assess credit risk, and now is the basis for evaluating the effectiveness of the investment. Value at risk was widespread by J.P. Morgan/Reuters [1996]. Technical documents prepared by J.P. Morgan/Reuters can be found in Zangari [1994], Longerstaey and Spencer [1996] or Mina and Yi Xiao [2001].

The aim of the study is to evaluate mutual funds in terms of their investment effectiveness. The investment efficiency measures based on value at risk (VaR) and conditional value at risk (CVaR) are used. The risk assessment and investment efficiency will be analyzed taking into account the length of the investment.

The issue of investment efficiency is a frequent topic discussed in the literature, both foreign and Polish. The basic measure of investment effectiveness assessment is the rate of return. However, it does not take into account the risk associated with the investment. Therefore, indicators that combine both the rate of return and the risk are more appropriate. The following ratios can be mentioned here: Sharpe, Treynor and Jensen, which are one of the most commonly used measures. To study the effectiveness of investment funds, among others, in the papers of Grau-Carles and Sainz [2009] or Kumar and Devi [2011].

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Grau-Carles's and Sainz's research for 239 UK investment funds over 11 years indicates a correlation between Sharpe's and Treynor's ratios. Kumar and Devi [2011] analyzed various types of Indian funds using the Sharpe, Treynor and Jensen indicators, and compared the results with the benchmark to indicate better-performing funds than the market.

Sharpe, Treynor and Jensen ratios are counted among classical measures due to the normality requirements of the return rate breakdown. An alternative to them are non-classical measures in which the risk is perceived from the point of view of loss for the investor. Classical and non-classical measurements compared, among others, Elling and Schuhmacher [2007] or Bacon [2009]. They pointed to the strong correlation of most indicators.

On the Polish market, investment funds were researched by: Kompa and Witkowska [2010], Mentel [2011], Perez [2011, 2012], Kopiński [2013, 2014], Zamojska [2015] or Rutkowska-Ziarko and Sobieska [2016], Karpio and Żebrowska-Suchodolska [2017]. Perez focused primarily on hedge funds using both classic and non-classical measures for research. Kompa and Witkowska [2010] or Kopiński [2013, 2014] used taxonomic measures, Karpio and Żebrowska-Suchodolska – non-classical investment performance indicators, and Zamojska [2015] – wavelet analysis. In Polish literature, the valuation of VaR value on the Polish capital market were dealt with, among others, Mentel [2011], or Rutkowska-Ziarko and Sobieska [2016], who studied the risk of equity funds.

MATERIAL AND METHODS

The work is a continuation of the research presented in [Żebrowska-Suchodolska 2018]. The investment risk of equity funds using VaR and CVaR was examined there. Value at risk is understood as the value of a potential loss that will be achieved or not exceeded with a certain probability of alpha in a given time horizon of t [Jajuga 2007]. If the loss value exceeds VaR level, CVaR is used, which is a coherent measure.

Because in most cases the distribution of rates of return is a normal distribution, VaR and CVaR can be estimated from the formulas [Jorion 2006][1]:

$$VaR = -(r_p + z\delta) \tag{1}$$

$$CVaR = r_p - \frac{\varphi_z}{\alpha}\delta \tag{2}$$

where:

r_p – average rate of return;

z – negative value of the quantile of standard normal distribution;

δ – standard deviation of return rates;

φ_z – density of standardized normal distribution.

On the basis of VaR and CVaR, measures were developed to assess the effectiveness of risk-based investments as VaR. The following measures may be mentioned reward to value at risk (RVaR) or conditional Sharpe ratio (CS).

The reward to value at risk ratio was proposed by Dowd [2000]. It is a Sharpe indicator, except that the standard deviation is replaced by VaR. The reward to value at risk ratio has the following form:

$$RVaR = \frac{r_p - r_f}{VaR} \tag{3}$$

The conditional Sharpe ratio in which CVaR is used is represented by the pattern [Argawal and Naik 2004]:

$$CS = \frac{r_p - r_f}{CVaR} \tag{4}$$

The Spearman correlation coefficient was calculated between the sub-periods examined and its significance was examined by hypotheses:

- H_0: the correlation coefficient is not statistically significant;
- H_1: the correlation coefficient is statistically significant.

[1] Estimating VaR is possible using several methods. One of them is the variance-covariance method. The Monte Carlo simulation gives lower results than the parametric method [Mina and Yi Xiao 2001]. The use of the parametric approach seems justified here due to the large variability of results associated with the occurrence of large falls.

The test statistic expressed by the formula:

$$t = \frac{r_s}{\sqrt{1 - r_s^2}}\sqrt{n-2} \quad (5)$$

has a Student *t*-distribution with $v = n - 2$ degrees of freedom. In all tests the level of significance equal to 0.05 [Luszniewicz and Słaby 2003].

RESULTS

The research focuses on 16 equity funds that existed on the Polish market since 2004. These were: Arka BZWBK Akcji, BPH Akcji, BPH Akcji Dynamicznych Spółek, CU Akcji Polskich, DWS Akcji, DWS Akcji Plus, DWS Top 25, ING Akcji, Legg Mason Akcji, Millennium Akcji, Pioneer Akcji Polskich, PKO/CS Akcji, PZU Akcji Krakowiak, SEB 3, Skarbiec Akcja, UniKorona Akcje. The initial nomenclature of the fund was adopted. The research was completed in 2015 due to the fact that at the end of 2015 Pekao CS Akcji was merged with the PKO Akcji Plus and long-term research should be done without this fund.

The period 2004–2015 was divided into sub-periods: two years (2004–2005, 2006–2007, 2008–2009, 2010–2011, 2012–2013), three years (2004–2006, 2007–2009, 2010–2012), four years (2004–2007, 2008–2011) and five years (2004–2008, 2009–2013). The monthly return rates for units provided the basis for VaR measure.

Calculations started with the determination of the average rate of return and standard deviation, which allowed estimating VaR value at significance level of 0.05. The results of VaR and CVaR were presented in more detail in Żebrowska-Suchodolska [2018]. The results of VaR for two-year periods are presented in Table 1.

Table 1. Values VaR of for equity funds in two-year periods

Equity fund	2004–2005	2006–2007	2008–2009	2010–2011	2012–2013	2014–2015
Arka BZWBK Akcji	0.038	0.071	0.158	0.092	0.059	0.048
BPH Akcji	0.037	0.077	0.135	0.089	0.059	0.056
BPH Akcji Dynamicznych Spółek	0.058	0.107	0.162	0.089	0.049	0.053
CU Akcji Polskich	0.036	0.082	0.154	0.089	0.042	0.050
DWS Akcji	0.043	0.073	0.148	0.088	0.056	0.047
DWS AkcjiPlus	0.037	0.075	0.144	0.094	0.051	0.052
DWS Top 25	0.043	0.087	0.169	0.100	0.045	0.060
ING Akcji	0.047	0.078	0.136	0.095	0.060	0.046
Legg Mason Akcji	0.044	0.074	0.135	0.071	0.055	0.058
Millennium Akcji	0.050	0.077	0.130	0.086	0.053	0.052
Pioneer Akcji Polskich	0.048	0.084	0.182	0.128	0.063	0.059
PKO/CS Akcji	0.036	0.068	0.161	0.077	0.048	0.032
PZU Akcji Krakowiak	0.043	0.069	0.141	0.086	0.067	0.067
SEB 3	0.044	0.072	0.155	0.079	0.071	0.080
Skarbiec Akcja	0.045	0.062	0.128	0.088	0.063	0.062
UniKorona Akcje	0.043	0.071	0.129	0.086	0.061	0.046

Source: Own study.

The highest VaR values were observed in the years 2008–2009, in the period of financial crisis. They were often four times higher than the years 2004–2005, where VaR turned out to be the lowest. The exception was the BPH Akcji Dynamicznych Spółek, for which VaR values for the periods 2012–2013 and 2014–2015 were lower than in the years 2004–2005. In terms of the three-year sub-periods, the highest VaR occurred in the 2007–2009 sub-period and the lowest in the 2004–2006 and 2013–2015 periods. Among the four-year sub-periods, the greatest loss of value occurred in 2008–2011, and in the five-year sub-periods: 2004–2008.

Table 2 shows CVaR values obtained for two-year periods. The order of the sub-periods, both in terms of biennial and three-, four- and five-year periods, was similar to that of VaR. However, all CVaR values were higher than VaR, which is justified by the definition of this measure.

The next step was to measure investment efficiency based on VaR and CVaR risk measures, i.e. RVaR and CS. The values of these measures for two-year periods are shown in Table 3. The highest values of RVaR and the CS were recorded for the years 2004––2005. This resulted in both the highest average return over the benchmark and the lowest risk weighted VaR and CVaR. The exception were BPH Akcji Dynamicznych Spółek, DWS Top 25 and Legg Mason Akcji, for which values of ratios were higher in other periods. The worst results were observed in 2008–2009 and 2010–2011 when the values of the indicators turned out to be negative. The result was a negative return and a high VaR and CVaR risk.

Under the three-year sub-periods, the highest values for RVAR and CS were in the years 2004–2006, with the exception of the BPH Akcji Dynamicznych Spółek, and the lowest in 2007–2009, which was important influenced by the 2008–2009 results. Results from the years 2004–2005 continued to influence the results of the 2004–2007 period.

Table 2. Values of CVaR in the two-year sub-periods

Equity fund	2004–2005	2006–2007	2008–2009	2010–2011	2012–2013	2014–2015
Arka BZWBK Akcji	0.055	0.094	0.198	0.113	0.075	0.059
BPH Akcji	0.052	0.101	0.168	0.110	0.076	0.069
BPH Akcji Dynamicznych Spółek	0.071	0.140	0.200	0.109	0.065	0.066
CU Akcji Polskich	0.050	0.109	0.192	0.111	0.055	0.061
DWS Akcji	0.058	0.094	0.184	0.11	0.072	0.058
DWS AkcjiPlus	0.051	0.099	0.177	0.116	0.068	0.066
DWS Top 25	0.056	0.116	0.206	0.123	0.062	0.073
ING Akcji	0.064	0.102	0.169	0.118	0.077	0.057
Legg Mason Akcji	0.059	0.100	0.168	0.089	0.072	0.071
Millennium Akcji	0.066	0.100	0.161	0.107	0.069	0.064
Pioneer Akcji Polskich	0.065	0.110	0.225	0.156	0.081	0.071
PKO/CS Akcji	0.049	0.089	0.197	0.096	0.062	0.041
PZU Akcji Krakowiak	0.057	0.092	0.174	0.107	0.086	0.081
SEB 3	0.060	0.094	0.193	0.098	0.089	0.097
Skarbiec Akcja	0.061	0.082	0.159	0.109	0.081	0.077
UniKorona Akcje	0.059	0.093	0.162	0.108	0.079	0.058

Source: Own study.

Table 3. Ratios of RVaR and CS for biennial periods

Equity fund	2004–2005	2006–2007	2008–2009	2010–2011	2012–2013	2014–2015
	RVaR					
Arka BZWBK Akcji	0.576	0.248	–0.047	–0.155	0.054	–0.119
BPH Akcji	0.446	0.182	–0.074	–0.114	0.069	–0.099
BPH Akcji Dynamicznych Spółek	–0.214	0.164	–0.106	–0.141	0.197	–0.016
CU Akcji Polskich	0.375	0.223	–0.055	–0.053	0.220	–0.111
DWS Akcji	0.280	0.114	–0.069	–0.063	0.059	–0.120
DWS AkcjiPlus	0.431	0.190	–0.118	–0.120	0.224	0.022
DWS Top 25	0.099	0.308	–0.178	–0.121	0.399	–0.131
ING Akcji	0.254	0.161	–0.088	–0.083	0.116	–0.051
Legg Mason Akcji	0.297	0.321	–0.060	–0.058	0.124	–0.162
Millennium Akcji	0.192	0.149	–0.083	–0.090	0.112	–0.111
Pioneer Akcji Polskich	0.250	0.135	–0.077	–0.172	0.044	–0.185
PKO/CS Akcji	0.380	0.179	–0.145	–0.079	0.134	0.094
PZU Akcji Krakowiak	0.238	0.219	–0.085	–0.103	0.084	–0.169
SEB 3	0.277	0.169	–0.057	–0.089	–0.037	–0.149
Skarbiec Akcja	0.330	0.231	–0.054	–0.114	0.105	–0.121
UniKorona Akcje	0.380	0.195	–0.036	–0.034	0.075	–0.089
	CS					
Arka BZWBK Akcji	0.399	0.188	–0.038	–0.126	0.043	–0.097
BPH Akcji	0.318	0.139	–0.059	–0.092	0.054	–0.080
BPH Akcji Dynamicznych Spółek	–0.174	0.125	–0.086	–0.115	0.149	–0.013
CU Akcji Polskich	0.272	0.168	–0.044	–0.043	0.168	–0.091
DWS Akcji	0.209	0.089	–0.055	–0.050	0.046	–0.097
DWS AkcjiPlus	0.311	0.144	–0.096	–0.097	0.168	0.018
DWS Top 25	0.076	0.231	–0.146	–0.098	0.289	–0.107
ING Akcji	0.187	0.123	–0.071	–0.067	0.090	–0.041
Legg Mason Akcji	0.222	0.238	–0.048	–0.046	0.095	–0.132
Millennium Akcji	0.145	0.115	–0.067	–0.072	0.086	–0.090
Pioneer Akcji Polskich	0.185	0.103	–0.062	–0.141	0.034	–0.154
PKO/CS Akcji	0.279	0.137	–0.119	–0.063	0.104	0.073
PZU Akcji Krakowiak	0.180	0.164	–0.069	–0.083	0.066	–0.140
SEB 3	0.203	0.130	–0.046	–0.072	–0.029	–0.123
Skarbiec Akcja	0.243	0.175	–0.044	–0.092	0.082	–0.097
UniKorona Akcje	0.277	0.149	–0.029	–0.027	0.058	–0.071

Source: Own study.

The lowest values were in the years 2008–2011. Extending the time horizon to the five-year sub-periods completely reversed the order of the sub-periods. Better performance indicators were found in 2009––2013 than in 2004–2008 years. The 2008 results were so significant for the period 2004–2008 that even average returns above the benchmark and small losses in 2004–2005 were not decisive.

ANALYSIS OF RANKINGS BASED ON RATIOS OF THE RVAR AND THE CS

When calculating VaR and CVaR value, the fund rankings were also determined. They are included in Tables 4, 5 and 6. CS rankings differed only in two cases in the two-year sub-periods (2014–2015). Therefore, it focused on the analysis of ranking positions based on RVaR.

The division of the whole period of research into two-year sub-periods shows a large variability of ranking positions in particular sub-periods, often changing market conditions. Funds occupy the top positions in the ranking in one period, in the next period are already at the distant positions in the ranking. Exceptions are only two funds: CU Akcji Polskich and Pioneer Akcji Polskich. The first one in all two-year sub-seasons occupies positions in the first half of the ranking, while the second one in the second half.

Breaking down into three-year sub-periods, the situation is very similar to the shorter time horizon. The exception is only two funds: CU Akcji Polskich and Pioneer Akcji Polskich. In addition to the mentioned funds, it can also add the UniKorona Akcje, which can be listed among the better ones.

Table 4. Rankings derived from RVaR for two-year periods

Equity fund	2004–2005	2006–2007	2008–2009	2010–2011	2012–2013	2014–2015
Arka BZWBK Akcji	1	3	2	15	14	9
BPH Akcji	2	9	8	11	12	6
BPH Akcji Dynamicznych Spółek	16	12	13	14	4	3
CU Akcji Polskich	6	5	4	2	3	8
DWS Akcji	9	16	7	4	13	10
DWS AkcjiPlus	3	8	14	12	2	2
DWS Top 25	15	2	16	13	1	12
ING Akcji	11	13	12	6	7	4
Legg Mason Akcji	8	1	6	3	6	14
Millennium Akcji	14	14	10	8	8	7
Pioneer Akcji Polskich	12	15	9	16	15	16
PKO/CS Akcji	4	10	15	5	5	1
PZU Akcji Krakowiak	13	6	11	9	10	15
SEB 3	10	11	5	7	16	13
Skarbiec Akcja	7	4	3	10	9	11
UniKorona Akcje	5	7	1	1	11	5

Source: Own study.

Table 5. Rankings derived from RVaR for three-year periods

Equity fund	2004–2006	2007–2009	2010–2012	2013–2015
Arka BZWBK Akcji	1	4	15	13
BPH Akcji	5	7	10	9
BPH Akcji Dynamicznych Spółek	16	11	14	4
CU Akcji Polskich	7	5	2	6
DWS Akcji	15	8	6	12
DWS AkcjiPlus	2	14	12	1
DWS Top 25	6	16	11	3
ING Akcji	12	13	4	5
Legg Mason Akcji	4	1	3	10
Millennium Akcji	13	10	7	8
Pioneer Akcji Polskich	14	9	16	15
PKO/CS Akcji	11	15	5	2
PZU Akcji Krakowiak	9	12	9	14
SEB 3	10	6	13	16
Skarbiec Akcja	8	3	8	11
UniKorona Akcje	3	2	1	7

Source: Own study.

Table 6. Rankings derived from RVaR for four- and five-year periods

Equity fund	2004–2007	2008–2011	2012–2015	2004–2008	2009–2013
Arka BZWBK Akcji	1	7	13	2	13
BPH Akcji	6	10	10	5	14
BPH Akcji Dynamicznych Spółek	16	13	4	16	5
CU Akcji Polskich	7	2	6	6	1
DWS Akcji	13	4	12	12	9
DWS AkcjiPlus	5	14	1	7	6
DWS Top 25	9	16	3	13	3
ING Akcji	12	9	5	10	10
Legg Mason Akcji	2	3	11	1	2
Millennium Akcji	15	8	7	11	8
Pioneer Akcji Polskich	14	12	15	15	16
PKO/CS Akcji	8	15	2	14	7
PZU Akcji Krakowiak	10	11	14	8	12
SEB 3	11	5	16	9	15
Skarbiec Akcja	3	6	9	3	11
UniKorona Akcje	4	1	8	4	4

Source: Own study.

Extending the time horizon slightly increases the number of better and worse funds. In the four-year periods, the better are: CU Akcji Polskich, UniKorona Akcje, and worse: Pioneer Akcji Polskich, PZU Akcji Krakowiak. Increasing the time horizon slightly increases the number of better and worse funds. Such a small number of better and worse funds have confirmed the lack of relevance of Spearman's correlation coefficients between successive sub-periods.

SUMMARY

Indicators based on risk measures such as VaR and CVaR are one of the categories of non-classical measures used to assess the effectiveness of an investment. The probability of CVaR losses estimated for equity funds exceeds VaR risk.

Investment efficiency measures, based on VaR and CVaR, have yielded different values, but the effect – the same rankings with one exception. Thus failure to meet the corresponding VaR values does not translate into the results obtained. The results obtained are not satisfactory (and in many sub-periods the average rate of return does not exceed the benchmark) or stable which does not guarantee the investor to repeat the results over time. The highest value of the indicator was 0.58 (for the period 2004–2005). Such results do not allow to compensate for the potential loss of profit. This is not an optimistic conclusion for potential future investors.

Previous studies conducted using the Pain and Martin index testify to the poor results of equity funds in the period 2004–2014. Only in two sub-periods, the values of ratios calculated for funds exceeded the values obtained for the benchmark. So it cannot talk about investing in funds effectively. As the time horizon increased, the stability of the funds also deteriorated [Żebrowska-Suchodolska 2017].

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OCENA WYNIKÓW FUNDUSZY AKCYJNYCH W LATACH 2004–2015 Z WYKORZYSTANIEM METOD VaR I CVaR

STRESZCZENIE

Praca analizuje ryzyko i efektywność inwestycji w fundusze akcyjne z użyciem miar, których podstawą są wartość zagrożona (VaR) i warunkowa wartość zagrożona (CVaR), tj. wskaźnik RVaR i wskaźnik conditional Sharpe (CS). Badania przeprowadzono dla okresu 2004–2015, który podzielono na krótsze podokresy (dwu-, trzy-, cztero- i pięcioletnie). Zbadano także stabilność rankingów funduszy z użyciem współczynnika korelacji rang Spearmana wyznaczonego dla kolejnych podokresów, jednocześnie weryfikując istotność tego współczynnika. Największe wartości mierników zaobserwowano w okresie 2004–2005. Nawet wtedy nie były to wartości zadowalające, a brak stabilności wyników nie daje gwarancji powtórzenia się ich w przyszłości.

Słowa kluczowe: efektywność inwestycyjna, wartość zagrożona (VaR), warunkowa wartość zagrożona (CVaR), wskaźnik RVaR, wskaźnik conditional Sharpe (CS)