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Iwona Dittmann

Wrocław University of Economics
Faculty of Economic Sciences
Department of Finance
iwona.dittmann@ue.wroc.pl

THE ASSESSMENT OF THE SUITABILITY OF EQUITY INVESTMENT FUNDS FOR THE INVESTOR. THE USE OF DISTRIBUTION RETURNS PARAMETERS

Summary: The aim of this research was to show the possibilities and methods of applying the parameters of return distributions in assessing the suitability of an equity investment fund for an investor. The study was conducted for 15 Polish equity funds. The empirical return distributions were constructed on the daily quotation from the period 2005-2016 for 10 investment horizons. It was stated that: 1) due to the significant variability which can occur in the values of the parameters of the return distributions, the investor should not rely exclusively on the average values, 2) the choice of equity fund can be narrowed down to a group of 2 to 4 of the best based on all or most of the parameters of the return distribution, 3) the investor does not always have to choose between funds with the lowest risk and funds giving the possibility of the highest above-average returns, 4) there was equity fund, which should not be the object of an investor's interest because of the worst parameters values.

Keywords: personal finance, suitability assessment, equity mutual funds, return distribution, comparative analysis.

JEL Classification: D14, G11, G32.

Introduction

The choice by an investor of a suitable investment instrument for their purposes is an important issue in the field of personal finance. Investors vary, among others, in their: knowledge of the financial market, investment experience, availa-

ble capital, financial situation, investment objectives, assumed (or accepted) investment horizon and risk tolerance. An assessment of the appropriateness and suitability of a financial instrument to the needs and capabilities of individual investors is presented in the MIFID recommendations that are addressed to institutions which offer the opportunity to invest in financial instruments. According to EU regulations, the term suitability refers to the investment objective, investment horizon and risk (especially to the acceptable losses). The results of the research presented in this article relate to the assessment of the suitability of an equity investment fund for an individual investor.

In determining the suitability of a fund for an investor, the parameters of the distribution of the rates of return on the investment fund, such as: the minimum value, the 10^{th} percentile, the first quartile (Q1), the median (Q2), the third quartile (Q3), the 90^{th} percentile and the maximum value, may be useful. They can serve as a measure of the investment risk in both positive and negative terms[1]. The minimum value indicates the maximum loss that can be incurred from the investment. The 10^{th} percentile can be interpreted as follows: the chances of the investor obtaining a rate of return lower than the 10th percentile value is 10%, and the probability of achieving a higher rate of return is 90%. The first quartile can be interpreted as follows: the chances of the investor obtaining a rate of return lower than the quartile value is 25%, and the probability of achieving a higher rate of return is 75%. The median means that the chances of getting a rate of return lower and higher than the median are the same (that is 50%). The third quartile is the value of the rate of return at which the chances of exceeding it amount to 25%, and the chances of not attaining it (of failure) – 75%. The 90^{th} percentile, can be interpreted as follows: the chances of the investor obtaining a rate of return lower than the 90^{th} percentile value is 90%, and the probability of achieving a higher rate of return is 10%. The maximum value indicates the greatest return on the investment. Using these distribution parameters one can, it seems, assess the suitability of a fund for the investor, both in terms of the risk accepted in a negative sense (the readiness declared by the investor to incur a loss of a certain amount), as well as the possibility of achieving the expected or above-average rate of return.

[1] According to Jajuga [2009, p. 45], the quantiles of the distribution can serve as a measure of investment risk. Similarly, DeFusco et al. [2007, p. 98] who consider using quantiles of the distribution of the rates of return in a study of fund efficiency. The quartiles were used by Dittmann [2016a] in comparative analysis of the returns on open-end debt investment funds in Poland.

The research on modelling of return distributions on Polish stock market were conducted among others by: Doman and Doman [2009], Piasecki and Tomasik [2013]. However the research did not cover return distributions on investment funds.

The extensive research the effectiveness of investment funds in Poland were carried out by Zamojska [2012] and Perez [2012]. The research on the effectiveness of the Polish mutual funds were conducted among others by: Kompa and Witkowska [2010]; Karkowska and Niewińska [2013]; Karpio and Żebrowska-Suchodolska [2013]; Dawidowicz [2009, 2012, 2013a, 2013b]; Jamróz [2013]; Jurek-Wasilewska [2014]; Pietrzyk [2014]; Miziołek [2015]; Dittmann [2016a]. The researchers calculated: return rates, standard deviation, classical and alternative measures of efficiency of funds (among others: Sharpe ratio, Treynor ratio, active share ratio, omega ratio, information ratio, Sortino ratio).

It is worth noting that in research papers, studies on the efficiency of investment funds are usually carried out for a single investment horizon (e.g., 1 week, 1 year). However, some researchers draw attention to the importance of investment horizons [Bierman, 1997; Sangbae and Francis, 2010; Chakrabarty et al., 2015; Malagon, Moreno and Rodríguez, 2015; Zamojska, 2015]. Moreover, to the best of the author's knowledge, no studies have been conducted in terms of suitability of funds for an investor.

The aim of this research is to show the possibilities and methods of applying the parameters of return distributions in assessing the suitability of an investment fund for an investor. Five research questions were formulated:

1) How large was the differentiation of the equity investment funds in terms of selected parameters of the distributions of returns in the studied time period?
2) Can the best fund, in terms of all parameters of the distribution, be identified?
3) Can a group of funds which are the best or nearly the best in terms of all of the parameters of the distribution be identified?
4) Are the best funds, in terms of some parameters of the distribution, at the same time the worst (or one of the worst) in terms of other parameters?
5) Can a fund or funds, which are the worst in terms of all or almost all parameters of the distribution, be identified?

The answers to these questions will allow for a determination whether: 1) when selecting an equity investment fund, one should be guided by the average values of the parameters of the distribution of returns for the group of equity funds, or rather should one assess the individual funds within the group because of the large differences in the values of these parameters; 2) the selection of an equity investment fund can be narrowed down to a group of 2-4 of the best funds; 3) the

investor must choose between equity funds with the lowest risk and equity funds offering the possibility of the highest above-average returns; 4) when selecting an equity investment fund, the investor must first determine which parameters of the distribution of rates of return are the most important, and which are less important; 5) there exist equity funds, which should not be the object of an investor's investment, regardless of the hierarchy of importance of the parameters of the distribution of the rates of return.

According to the best knowledge of the author, thus far in literature there has not yet been conducted an analysis of the investment funds suitability using the methodology which is presented in this paper.

1. Data and research methodology

Currently in Poland there are 41 universal equity open-ended investment funds (equity OEF). The selection of the funds constituting the research group and the choice of study period were made based on the following criteria: 1) maximization of the number of funds in the research group, 2) maximization of the longest[2] investment horizon adopted in the study[3]. The study was conducted for 15 equity OEF which have been in existence for at least 10 full years.

To carry out the study, the daily quotations of the funds' share values were used. The quotation were taken from the period 16.12.2005-29.09.2016 [www 1].

The course of the study, aiming to answer the research questions was as follows. For each of the 15 funds, the holding period rates of return (HPRs) were calculated repeatedly using a rolling window of observation. The window of observation was moved by 1 day each time. The window was equal to the assumed investment horizon. Next, the length of the rolling observation window (means investment horizon) was changed, and the procedure repeated. This gave the empirical distributions of HPRs on individual funds for different investment time horizons. The study adopted 10 different investment horizons – from 1 year to 10 years. The rolling window methodology was previously applied to construct return distribution by Dittmann [2016a, 2016b].

In the next step, the following values were calculated: minimums, 10^{th} percentiles, first quartiles, medians, third quartiles, maximums and the 90^{th} percentiles of the empirical distributions of the rates of return on individual funds.

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[2] The study was conducted for different investment horizons.

[3] The longest investment horizon which it was possible to adopt was determined by the date of the establishment of the fund.

2. Results

The empirical distributions of the holding rates of return for different investment horizons were determined based on the different number of observations (table 1). The periods of purchasing and selling shares by an investor were also determined by investment horizon.

Table 1. The number of observations (HPRs) for different investment horizons

Investment horizon (in years)	Number of observations (number of HPRs calculated)	Period of purchasing shares by an investor	Period of selling shares by an investor
1	2442	16.12.2005-29.09.2015	17.12.2006-29.09.2016
2	2192	16.12.2005-29.09.2014	17.12.2007-29.09.2016
3	1942	16.12.2005-29.09.2013	17.12.2008-29.09.2016
4	1692	16.12.2005-29.09.2012	17.12.2009-29.09.2016
5	1441	16.12.2005-29.09.2011	17.12.2010-29.09.2016
6	1190	16.12.2005-29.09.2010	17.12.2011-29.09.2016
7	941	16.12.2005-29.09.2009	17.12.2012-29.09.2016
8	694	16.12.2005-29.09.2008	17.12.2013-29.09.2016
9	445	16.12.2005-29.09.2007	17.12.2014-29.09.2016
10	195	16.12.2005-29.09.2006	17.12.2015-29.09.2016

Tables 2-11 present the calculated parameters of the empirical distributions of returns obtained for the different funds and for different investment horizons. These are: minimum values (MIN), 10th percentiles (10%), first quartiles (Q1), medians (Q2), third quartiles (Q3), 90th percentiles (90%) and maximum values (MAX). In order to assess the degree of diversification of the funds based on the above mentioned parameters of the distributions of rates of return, the following measures were used: range, standard deviation, and relative standard deviation[4]. The values calculated for the measurements of variation are provided in the lower parts of tables 2-11.

Table 2. The values of return distribution parameters (for 1-year horizon)

Funds	Distribution parameters						
	MIN	10%	Q1	Q2	Q3	90%	MAX
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Allianz Akcji	**−51.5%**	**−21.5%**	−12.7%	−1.6%	10.0%	27.5%	71.6%
Arka BZ WBK Akcji Polskich	−59.9%	−30.1%	−16.5%	2.4%	12.1%	42.4%	86.8%
Aviva Investors Polskich Akcji	−61.3%	−33.7%	−12.6%	5.8%	**22.0%**	47.0%	100.2%
BNP Paribas Akcji	−68.1%	−39.1%	−17.7%	5.3%	17.2%	**48.2%**	**115.9%**
BPH Akcji	−57.4%	−30.6%	−14.3%	3.4%	14.4%	34.9%	73.1%
Investor Akcji Dużych Spółek Dywidendowych	−59.5%	−27.6%	−15.2%	3.4%	14.4%	27.1%	67.8%

[4] Relative standard deviation (or RSD) is the absolute value of coefficient of variation. As the denominator is the absolute value of the mean, the RSD will always be positive.

Table 2 cont.

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Legg Mason Akcji	−55.4%	−26.1%	−12.7%	3.8%	18.5%	45.8%	103.3%
MetLife Akcji	−63.3%	−37.9%	−18.1%	1.2%	15.7%	43.3%	97.3%
Millennium Akcji	−57.5%	−31.2%	−15.0%	4.3%	15.1%	33.3%	79.8%
NN Akcji	−58.1%	−32.3%	−14.4%	6.0%	17.3%	33.6%	74.4%
Novo Akcji	−60.6%	−35.2%	−20.8%	0.4%	11.2%	38.8%	79.8%
Pioneer Akcji Polskich	−65.8%	−41.4%	−22.1%	−0.9%	11.1%	34.8%	88.2%
PZU Akcji KRAKOWIAK	−57.3%	−31.9%	−17.2%	0.2%	16.2%	34.8%	75.9%
Skarbiec Akcja	−52.9%	−24.6%	−15.8%	2.4%	14.6%	33.3%	64.7%
UniKorona Akcje	−55.9%	−27.1%	**−11.9%**	**6.2%**	16.7%	38.6%	77.4%
Total of funds							
mean	−59.0%	−31.3%	−15.8%	2.8%	15.1%	37.6%	83.8%
min	−68.1%	−41.4%	−22.1%	−1.6%	10.0%	27.1%	64.7%
max	−51.5%	−21.5%	−11.9%	6.2%	22.0%	48.2%	115.9%
range	16.6%	19.9%	10.2%	7.8%	12.0%	21.1%	51.2%
SD	4.5%	5.5%	3.0%	2.5%	3.2%	6.6%	14.6%
RSD	7.6%	17.7%	18.9%	89.6%	20.9%	17.7%	17.5%

Note for Tables 2-11: Four highest values of each parameter are on a gray background (the best is additionally in bold). The lowest values of each parameter are on a black background.

Source: Own calculations.

Table 3. The values of return distribution parameters (for 2-year horizon)

Funds	Distribution parameters						
	MIN	10%	Q1	Q2	Q3	90%	MAX
Allianz Akcji	−54.3%	**−28.9%**	−15.3%	−5.9%	4.1%	21.9%	92.9%
Arka BZ WBK Akcji Polskich	−60.8%	−37.2%	−18.0%	−8.7%	10.6%	32.3%	103.6%
Aviva Investors Polskich Akcji	−61.7%	−41.0%	**−8.2%**	−0.6%	21.0%	44.5%	**137.1%**
BNP Paribas Akcji	−66.8%	−47.9%	−20.5%	−7.0%	20.5%	33.2%	118.4%
BPH Akcji	−57.1%	−39.1%	−15.2%	−7.5%	15.3%	31.4%	90.0%
Investor Akcji Dużych Spółek Dywidendowych	−59.3%	−39.3%	−14.8%	−5.3%	11.4%	28.4%	97.6%
Legg Mason Akcji	**−50.1%**	−32.7%	−13.7%	0.1%	**22.8%**	**45.6%**	94.4%
MetLife Akcji	−65.6%	−50.1%	−19.0%	−8.8%	11.3%	33.8%	98.4%
Millennium Akcji	−57.4%	−41.6%	−13.5%	−6.4%	15.6%	31.2%	83.0%
NN Akcji	−60.7%	−41.4%	−13.3%	−4.0%	19.7%	35.2%	91.6%
Novo Akcji	−62.6%	−38.7%	−23.4%	−9.3%	7.2%	26.0%	104.8%
Pioneer Akcji Polskich	−70.5%	−49.2%	−35.6%	−19.5%	9.3%	23.7%	104.7%
PZU Akcji KRAKOWIAK	−60.7%	−42.8%	−18.2%	−9.9%	12.2%	30.8%	90.3%
Skarbiec Akcja	−51.3%	−30.6%	−14.7%	−5.6%	15.5%	32.7%	79.9%
UniKorona Akcje	−54.6%	−32.5%	−8.5%	**0.9%**	20.3%	36.2%	110.4%
Total of funds							
mean	−59.6%	−39.5%	−16.8%	−6.5%	14.5%	32.5%	99.8%
min	−70.5%	−50.1%	−35.6%	−19.5%	4.1%	21.9%	79.9%
max	−50.1%	−28.9%	−8.2%	0.9%	22.8%	45.6%	137.1%
range	20.4%	21.2%	27.4%	20.4%	18.7%	23.8%	57.1%
SD	5.6%	6.5%	6.6%	4.9%	5.6%	6.5%	14.4%
RSD	9.5%	16.4%	39.2%	76.0%	38.8%	20.1%	14.5%

Source: Own calculations.

Table 4. The values of return distribution parameters (for 3-year horizon)

Funds	Distribution parameters						
	MIN	10%	Q1	Q2	Q3	90%	MAX
Allianz Akcji	−41.0%	−22.4%	−16.5%	−7.0%	0.6%	8.9%	81.8%
Arka BZ WBK Akcji Polskich	−43.8%	−28.8%	−17.4%	−9.7%	1.5%	18.5%	59.3%
Aviva Investors Polskich Akcji	−42.4%	−29.5%	−12.6%	6.6%	**20.5%**	**35.9%**	**98.5%**
BNP Paribas Akcji	−52.5%	−37.8%	−22.3%	−7.8%	9.5%	29.1%	65.3%
BPH Akcji	−43.3%	−31.0%	−17.3%	−3.9%	6.9%	21.4%	56.8%
Investor Akcji Dużych Spółek Dywidendowych	−49.6%	−31.5%	−21.5%	−3.0%	9.1%	22.0%	72.8%
Legg Mason Akcji	−37.7%	**−16.6%**	**−7.0%**	5.9%	16.8%	27.7%	73.4%
MetLife Akcji	−53.9%	−40.9%	−27.9%	−9.2%	5.0%	16.5%	67.8%
Millennium Akcji	−47.5%	−33.5%	−20.9%	−1.4%	8.8%	23.6%	53.3%
NN Akcji	−45.1%	−34.6%	−21.9%	1.0%	13.2%	31.7%	56.8%
Novo Akcji	−47.7%	−34.1%	−25.5%	−11.1%	0.0%	12.8%	77.4%
Pioneer Akcji Polskich	−59.7%	−44.1%	−35.4%	−27.7%	−12.2%	9.5%	34.9%
PZU Akcji KRAKOWIAK	−46.0%	−33.9%	−23.2%	−7.1%	4.4%	14.5%	56.3%
Skarbiec Akcja	**−36.6%**	−23.3%	−13.0%	−2.8%	7.5%	20.2%	50.6%
UniKorona Akcje	−38.1%	−21.4%	−8.1%	**7.8%**	19.4%	34.1%	92.6%
Total of funds							
mean	−45.7%	−30.9%	−19.4%	−4.6%	7.4%	21.8%	66.5%
min	−59.7%	−44.1%	−35.4%	−27.7%	−12.2%	8.9%	34.9%
max	−36.6%	−16.6%	−7.0%	7.8%	20.5%	35.9%	98.5%
range	23.1%	27.5%	28.4%	35.5%	32.7%	27.0%	63.6%
SD	6.4%	7.5%	7.5%	8.8%	8.4%	8.6%	16.7%
RSD	14.1%	24.4%	38.7%	190.5%	113.4%	39.5%	25.1%

Source: Own calculations.

Table 5. The values of return distribution parameters (for 4-year horizon)

Funds	Distribution parameters						
	MIN	10%	Q1	Q2	Q3	90%	MAX
Allianz Akcji	**−34.1%**	−20.8%	−14.0%	−8.2%	2.1%	13.7%	83.3%
Arka BZ WBK Akcji Polskich	−47.8%	−32.5%	−16.3%	−5.6%	3.1%	18.5%	71.4%
Aviva Investors Polskich Akcji	−42.9%	−22.0%	0.1%	**12.1%**	25.5%	**55.7%**	**121.8%**
BNP Paribas Akcji	−57.5%	−43.9%	−15.7%	−2.6%	12.0%	22.2%	74.1%
BPH Akcji	−46.8%	−30.0%	−12.2%	−1.1%	9.5%	20.5%	70.7%
Investor Akcji Dużych Spółek Dywidendowych	−44.0%	−24.9%	−15.7%	−1.9%	9.2%	26.5%	84.9%
Legg Mason Akcji	−36.1%	−17.8%	0.2%	9.5%	**26.0%**	39.9%	84.2%
MetLife Akcji	−54.8%	−40.4%	−22.4%	−8.4%	2.9%	19.9%	71.3%
Millennium Akcji	−47.7%	−29.3%	−16.6%	1.2%	13.1%	24.1%	67.6%
NN Akcji	−47.8%	−30.3%	−17.0%	6.1%	20.0%	29.3%	78.2%
Novo Akcji	−44.8%	−31.8%	−23.7%	−11.7%	−3.0%	11.8%	72.3%
Pioneer Akcji Polskich	−66.6%	−52.2%	−35.0%	−26.7%	−13.3%	−5.9%	38.3%
PZU Akcji KRAKOWIAK	−49.1%	−31.5%	−17.7%	−8.3%	2.7%	20.9%	68.8%
Skarbiec Akcja	−41.0%	−25.1%	−8.4%	0.8%	11.1%	22.5%	69.8%
UniKorona Akcje	−34.4%	**−13.1%**	**3.2%**	**12.1%**	22.6%	45.5%	109.9%
Total of funds							
mean	−46.4%	−29.7%	−14.1%	−2.2%	9.6%	24.3%	77.8%
min	−66.6%	−52.2%	−35.0%	−26.7%	−13.3%	−5.9%	38.3%
max	−34.1%	−13.1%	3.2%	12.1%	26.0%	55.7%	121.8%
range	32.4%	39.1%	38.1%	38.7%	39.3%	61.6%	83.6%
SD	8.7%	10.1%	9.9%	10.2%	11.0%	14.6%	19.0%
RSD	18.8%	34.1%	70.5%	465.3%	114.9%	59.9%	24.5%

Source: Own calculations.

Table 6. The values of return distribution parameters (for 5-year horizon)

Funds	Distribution parameters						
	MIN	10%	Q1	Q2	Q3	90%	MAX
Allianz Akcji	**−35.1%**	−28.4%	−22.1%	−9.8%	4.8%	23.0%	81.2%
Arka BZ WBK Akcji Polskich	−51.2%	−39.6%	−26.6%	−12.7%	2.1%	30.3%	74.6%
Aviva Investors Polskich Akcji	−42.6%	−29.3%	−8.5%	14.2%	**34.7%**	**76.3%**	**152.9%**
BNP Paribas Akcji	−63.7%	−49.8%	−30.0%	−5.3%	10.3%	32.2%	98.7%
BPH Akcji	−52.5%	−39.1%	−20.8%	−4.1%	10.2%	35.9%	84.8%
Investor Akcji Dużych Spółek Dywidendowych	−44.7%	−33.4%	−22.6%	−4.8%	12.3%	41.4%	100.8%
Legg Mason Akcji	−38.5%	−22.6%	−10.6%	9.4%	**34.7%**	61.0%	112.5%
MetLife Akcji	−59.7%	−47.8%	−31.2%	−12.3%	7.7%	32.7%	85.3%
Millennium Akcji	−52.3%	−38.7%	−19.4%	−0.9%	14.0%	37.4%	87.7%
NN Akcji	−52.8%	−39.7%	−19.9%	3.7%	21.0%	45.0%	92.4%
Novo Akcji	−50.8%	−42.2%	−34.7%	−17.6%	4.0%	24.8%	78.3%
Pioneer Akcji Polskich	**−70.9%**	**−62.9%**	**−51.3%**	**−37.4%**	**−20.7%**	**−4.0%**	50.4%
PZU Akcji KRAKOWIAK	−52.4%	−41.3%	−28.7%	−10.3%	6.0%	32.2%	85.5%
Skarbiec Akcja	−44.9%	−30.2%	−19.3%	−1.6%	12.0%	33.5%	87.3%
UniKorona Akcje	−35.7%	**−19.5%**	**−6.2%**	**15.2%**	31.8%	68.1%	126.6%
Total of funds							
mean	−49.9%	−37.6%	−23.5%	−4.9%	12.3%	38.0%	93.3%
min	−70.9%	−62.9%	−51.3%	−37.4%	−20.7%	−4.0%	50.4%
max	−35.1%	−19.5%	−6.2%	15.2%	34.7%	76.3%	152.9%
range	35.8%	43.5%	45.1%	52.6%	55.5%	80.3%	102.5%
SD	10.0%	11.1%	11.3%	13.3%	14.3%	19.5%	23.8%
RSD	20.1%	29.5%	48.2%	268.1%	115.8%	51.2%	25.5%

Source: Own calculations.

Table 7. The values of return distribution parameters (for 6-year horizon)

Funds	Distribution parameters						
	MIN	10%	Q1	Q2	Q3	90%	MAX
Allianz Akcji	−32.4%	−23.4%	−20.1%	−12.7%	0.0%	31.0%	71.5%
Arka BZ WBK Akcji Polskich	−44.6%	−36.5%	−24.8%	−17.6%	−7.1%	37.9%	80.5%
Aviva Investors Polskich Akcji	−33.5%	−18.2%	−5.2%	**12.2%**	**30.2%**	**85.7%**	**151.7%**
BNP Paribas Akcji	−58.9%	−44.8%	−32.6%	−14.1%	6.0%	50.4%	104.1%
BPH Akcji	−45.0%	−32.4%	−23.5%	−9.9%	4.0%	41.4%	82.0%
Investor Akcji Dużych Spółek Dywidendowych	−37.6%	−29.2%	−21.8%	−9.9%	4.7%	47.0%	99.2%
Legg Mason Akcji	−29.7%	−12.3%	**0.7%**	9.6%	28.8%	63.4%	103.3%
MetLife Akcji	−55.7%	−44.5%	−32.8%	−16.8%	−5.4%	34.2%	81.3%
Millennium Akcji	−45.2%	−31.7%	−22.7%	−6.7%	8.5%	44.6%	84.1%
NN Akcji	−42.8%	−30.6%	−24.3%	−7.6%	18.2%	56.1%	101.7%
Novo Akcji	−49.5%	−39.7%	−34.1%	−22.0%	−8.3%	36.6%	82.8%
Pioneer Akcji Polskich	**−68.0%**	**−60.0%**	**−54.7%**	**−45.2%**	**−34.2%**	**−1.4%**	43.8%
PZU Akcji KRAKOWIAK	−47.7%	−34.0%	−26.4%	−16.2%	−4.9%	29.8%	67.3%
Skarbiec Akcja	−33.9%	−20.8%	−14.8%	−7.3%	2.6%	37.0%	77.8%
UniKorona Akcje	**−26.8%**	**−10.9%**	−0.1%	**12.2%**	27.5%	80.9%	138.3%
Total of funds							
mean	−43.4%	−31.3%	−22.5%	−10.1%	4.7%	45.0%	91.3%
min	−68.0%	−60.0%	−54.7%	−45.2%	−34.2%	−1.4%	43.8%
max	−26.8%	−10.9%	0.7%	12.2%	30.2%	85.7%	151.7%
range	41.2%	49.1%	55.4%	57.3%	64.4%	87.1%	108.0%
SD	11.5%	13.1%	14.2%	14.5%	16.9%	21.3%	27.0%
RSD	26.6%	42.0%	63.0%	142.9%	358.6%	47.3%	29.5%

Source: Own calculations.

Table 8. The values of return distribution parameters (for 7-year horizon)

Funds	Distribution parameters						
	MIN	10%	Q1	Q2	Q3	90%	MAX
Allianz Akcji	−32.5%	−26.2%	−18.1%	−10.0%	−0.2%	15.4%	42.7%
Arka BZ WBK Akcji Polskich	−44.6%	−37.3%	−28.7%	−12.7%	0.5%	26.4%	55.1%
Aviva Investors Polskich Akcji	−29.1%	−18.5%	−0.4%	19.3%	**37.1%**	**73.2%**	**123.0%**
BNP Paribas Akcji	−53.4%	−44.4%	−31.3%	−14.0%	10.6%	41.2%	80.2%
BPH Akcji	−40.5%	−32.2%	−20.3%	−7.2%	7.3%	27.6%	61.2%
Investor Akcji Dużych Spółek Dywidendowych	−35.0%	−27.0%	−19.4%	−8.2%	4.7%	31.8%	66.3%
Legg Mason Akcji	−23.0%	−11.9%	**6.3%**	17.7%	35.2%	49.0%	75.7%
MetLife Akcji	−52.0%	−45.4%	−35.9%	−20.5%	−1.4%	14.7%	49.3%
Millennium Akcji	−40.4%	−31.5%	−20.0%	−4.6%	8.9%	33.0%	58.7%
NN Akcji	−36.3%	−28.8%	−21.1%	−2.8%	20.7%	47.0%	83.3%
Novo Akcji	−45.6%	−37.4%	−31.3%	−19.2%	−12.0%	0.1%	35.9%
Pioneer Akcji Polskich	−65.3%	−60.7%	−55.0%	−46.0%	−36.1%	−16.3%	15.4%
PZU Akcji KRAKOWIAK	−45.1%	−37.4%	−26.2%	−13.4%	−0.9%	12.3%	40.4%
Skarbiec Akcja	−32.8%	−24.2%	−10.5%	0.5%	10.4%	23.5%	53.3%
UniKorona Akcje	**−18.2%**	**−7.3%**	3.7%	**22.4%**	35.4%	61.8%	103.2%
Total of funds							
mean	−39.6%	−31.3%	−20.6%	−6.6%	8.0%	29.4%	62.9%
min	−65.3%	−60.7%	−55.0%	−46.0%	−36.1%	−16.3%	15.4%
max	−18.2%	−7.3%	6.3%	22.4%	37.1%	73.2%	123.0%
range	47.1%	53.5%	61.3%	68.5%	73.2%	89.5%	107.6%
SD	12.2%	13.5%	16.0%	17.4%	19.2%	23.2%	27.2%
RSD	30.7%	43.2%	77.7%	264.0%	239.6%	78.9%	43.3%

Source: Own calculations.

Table 9. The values of return distribution parameters (for 8-year horizon)

Funds	Distribution parameters						
	MIN	10%	Q1	Q2	Q3	90%	MAX
Allianz Akcji	−40.6%	−33.0%	−30.3%	−22.0%	−8.5%	1.6%	16.4%
Arka BZ WBK Akcji Polskich	−45.8%	−40.3%	−35.0%	−26.2%	−11.9%	−1.6%	18.1%
Aviva Investors Polskich Akcji	−27.0%	−21.1%	−11.5%	3.2%	23.6%	40.3%	58.3%
BNP Paribas Akcji	−50.5%	−44.2%	−37.0%	−23.6%	−8.3%	1.9%	11.7%
BPH Akcji	−40.8%	−35.9%	−27.0%	−17.7%	−4.7%	3.2%	14.3%
Investor Akcji Dużych Spółek Dywidendowych	−38.3%	−31.9%	−26.0%	−18.7%	−9.4%	−1.1%	13.1%
Legg Mason Akcji	−27.9%	−21.9%	−12.9%	2.6%	**35.4%**	**59.9%**	**81.3%**
MetLife Akcji	−53.2%	−49.5%	−44.3%	−35.2%	−18.3%	−5.6%	5.1%
Millennium Akcji	−39.8%	−34.2%	−26.6%	−17.2%	−5.2%	5.2%	15.6%
NN Akcji	−32.2%	−28.6%	−23.1%	−12.7%	−1.0%	8.3%	20.5%
Novo Akcji	−56.3%	−48.1%	−45.3%	−34.0%	−14.9%	−7.6%	5.4%
Pioneer Akcji Polskich	−67.4%	−65.3%	−60.9%	−55.4%	−46.3%	−41.2%	−35.5%
PZU Akcji KRAKOWIAK	−48.2%	−43.8%	−38.1%	−31.0%	−14.7%	−0.7%	15.7%
Skarbiec Akcja	−34.6%	−28.5%	−24.0%	−14.5%	0.1%	18.0%	35.7%
UniKorona Akcje	**−20.2%**	**−13.7%**	**−2.0%**	**9.4%**	27.3%	37.3%	54.6%
Total of funds							
mean	−41.5%	−36.0%	−29.6%	−19.5%	−3.8%	7.9%	22.0%
min	−67.4%	−65.3%	−60.9%	−55.4%	−46.3%	−41.2%	−35.5%
max	−20.2%	−13.7%	−2.0%	9.4%	35.4%	59.9%	81.3%
range	47.2%	51.6%	58.9%	64.8%	81.7%	101.0%	116.8%
SD	12.5%	13.1%	14.8%	16.6%	20.1%	23.7%	27.2%
RSD	30.0%	36.3%	50.1%	85.1%	531.4%	301.9%	123.3%

Source: Own calculations.

Table 10. The values of return distribution parameters (for 9-year horizon)

Funds	Distribution parameters						
	MIN	10%	Q1	Q2	Q3	90%	MAX
Allianz Akcji	−45.7%	−40.8%	−37.3%	−24.0%	−3.3%	1.3%	6.8%
Arka BZ WBK Akcji Polskich	−49.9%	−46.2%	−41.1%	−23.7%	−1.0%	4.5%	15.5%
Aviva Investors Polskich Akcji	−33.6%	−25.8%	−17.9%	7.5%	34.5%	44.4%	52.3%
BNP Paribas Akcji	−58.2%	−53.5%	−44.1%	−26.8%	−0.2%	6.2%	13.7%
BPH Akcji	−48.4%	−40.9%	−34.7%	−17.8%	1.0%	5.7%	11.5%
Investor Akcji Dużych Spółek Dywidendowych	−45.8%	−39.7%	−34.6%	−19.4%	−3.2%	1.9%	14.5%
Legg Mason Akcji	−35.3%	−27.8%	−17.5%	7.8%	**47.2%**	**59.3%**	**75.9%**
MetLife Akcji	−61.3%	−57.0%	−51.9%	−34.1%	−10.1%	−3.8%	3.6%
Millennium Akcji	−48.8%	−41.6%	−36.0%	−19.9%	3.2%	7.5%	15.5%
NN Akcji	−41.3%	−36.6%	−30.2%	−13.5%	8.7%	13.7%	22.8%
Novo Akcji	−63.7%	−60.2%	−55.9%	−35.2%	−8.4%	−3.1%	4.3%
Pioneer Akcji Polskich	−73.1%	−69.9%	−67.2%	−58.5%	−44.7%	−41.7%	−38.0%
PZU Akcji KRAKOWIAK	−55.9%	−49.4%	−45.5%	−29.6%	−11.0%	−4.6%	1.8%
Skarbiec Akcja	−42.8%	−35.7%	−30.2%	−10.8%	11.4%	18.3%	26.4%
UniKorona Akcje	**−28.4%**	**−20.2%**	**−12.5%**	**8.8%**	37.1%	47.2%	57.9%
Total of funds							
mean	−48.8%	−43.0%	−37.1%	−19.3%	4.1%	10.5%	19.0%
min	−73.1%	−69.9%	−67.2%	−58.5%	−44.7%	−41.7%	−38.0%
max	−28.4%	−20.2%	−12.5%	8.8%	47.2%	59.3%	75.9%
range	44.7%	49.6%	54.7%	67.3%	91.9%	101.1%	114.0%
SD	12.1%	13.5%	14.8%	18.1%	22.5%	24.7%	27.0%
RSD	24.8%	31.3%	40.0%	93.6%	550.3%	236.3%	142.4%

Source: Own calculations.

Table 11. The values of return distribution parameters (for 10-year horizon)

Funds	Distribution parameters						
	MIN	10%	Q1	Q2	Q3	90%	MAX
Allianz Akcji	−27.0%	−24.5%	−23.2%	−20.8%	−17.0%	−13.5%	−7.8%
Arka BZ WBK Akcji Polskich	−25.4%	−21.0%	−19.3%	−15.7%	−12.3%	−8.5%	3.3%
Aviva Investors Polskich Akcji	**10.8%**	**15.7%**	**19.1%**	22.2%	27.6%	32.9%	41.3%
BNP Paribas Akcji	−24.0%	−21.6%	−19.5%	−13.5%	−6.6%	−3.6%	4.9%
BPH Akcji	−19.9%	−16.8%	−14.1%	−11.7%	−7.8%	−4.2%	1.3%
Investor Akcji Dużych Spółek Dywidendowych	−28.1%	−25.3%	−21.6%	−18.7%	−16.0%	−11.5%	−4.4%
Legg Mason Akcji	10.6%	13.8%	17.5%	**27.6%**	**34.0%**	**39.4%**	**50.9%**
MetLife Akcji	−33.7%	−32.1%	−29.6%	−26.3%	−22.2%	−18.3%	−13.4%
Millennium Akcji	−20.6%	−17.2%	−14.7%	−11.7%	−8.1%	−4.0%	3.1%
NN Akcji	−14.0%	−10.5%	−8.8%	−4.1%	0.8%	5.2%	11.9%
Novo Akcji	−45.4%	−42.9%	−41.3%	−38.5%	−34.1%	−30.8%	−25.9%
Pioneer Akcji Polskich	−59.8%	−58.0%	−57.1%	−55.8%	−53.8%	−51.5%	−49.0%
PZU Akcji KRAKOWIAK	−31.0%	−28.7%	−27.1%	−24.5%	−21.2%	−17.3%	−11.1%
Skarbiec Akcja	−16.2%	−12.7%	−9.6%	−6.8%	−2.3%	2.5%	13.9%
UniKorona Akcje	8.9%	13.2%	16.6%	19.7%	24.8%	30.7%	37.9%
Total of funds							
mean	−21.0%	−17.9%	−15.5%	−11.9%	−7.6%	−3.5%	3.8%
min	−59.8%	−58.0%	−57.1%	−55.8%	−53.8%	−51.5%	−49.0%
max	10.8%	15.7%	19.1%	27.6%	34.0%	39.4%	50.9%
range	70.6%	73.7%	76.2%	83.4%	87.7%	90.9%	99.9%
SD	19.7%	20.5%	21.1%	22.3%	23.2%	24.0%	25.9%
RSD	94.1%	114.3%	136.3%	187.2%	304.4%	684.8%	682.7%

Source: Own calculations.

The values of the ranges calculated for the minimum values ranged from 16.6 to 70.6 p.p., depending on the investment horizon. The values of the ranges calculated for the 10th percentiles ranged from 19.9 to 73.7 p.p., depending on the investment horizon. The values of the ranges calculated for the first quartiles ranged from 10.2 to 76.2 p.p., depending on the investment horizon. The values of the ranges calculated for the median values ranged from 7.8 to 83.4 p.p., depending on the investment horizon. The values of the range calculated for the third quartiles ranged from 12 to 87.7 p.p., depending on the investment horizon. The values of the ranges calculated for the 90th percentiles ranged from 21.1 to 90.9 p.p., depending on the investment horizon. The values of the ranges calculated for the maximum values ranged from 51.2 to 99.9 p.p., depending on the investment horizon. The differences between the best and worst funds can therefore be regarded as either large or very large.

The standard deviation calculated for the minimum values ranged from 4.5 to 19.7 p.p., depending on the investment horizon. The standard deviation calculated for the 10th percentiles ranged from 5.5 to 20.5 p.p., depending on the investment horizon. The standard deviation calculated for the first quartiles ranged from 3 to 21.1 p.p., depending on the investment horizon. The standard deviation calculated for the medians ranged from 2.5 to 22.3 p.p., depending on the investment horizon. The standard deviation calculated for the third quartiles ranged from 3.2 to 23.2 p.p., depending on the investment horizon. The standard deviation calculated for the 90th percentiles ranged from 6.6 to 24 p.p., depending on the investment horizon. The standard deviation calculated for the maximum values ranged from 14.6 to 25.9 p.p., depending on the investment horizon. The average differences between the values of the parameters for individual funds and the average value can be regarded as significant in the case of longer investment horizons.

The values of the relative standard deviation calculated for the minimum values exceeded 20% for investment horizons ≥5 years. The values of the relative standard deviation calculated for the 10th percentiles exceeded 20% for investment horizons of ≥3 years. The values of the relative standard deviation calculated for the first quartiles did not exceed 20% only in the case of a 1-year investment horizon. The values of the relative standard deviation calculated for the medians ranged from 76% to 465.3%, depending on the investment horizon. The values of the relative standard deviation calculated for Q3 ranged from 20.3% to 550.3%, depending on the investment horizon. The values of the relative standard deviation calculated for the 90th percentiles did not exceed 20% only in the case of 1-year and 2-year investment horizon. The values of the rela-

tive standard deviation calculated for the maximum values were lower than 20% only in the case of the 1-year and 2-year investment horizon. On this basis, it can be concluded that the diversity of values of individual investment funds was variable, and largely depended on the length of the investment horizon (ranging from low diversity for the shortest horizons to an extremely high level of diversity for the longest horizons).

In order to obtain the answers to questions 2-5, funds with the best individual parameters of their distributions of returns and funds with the worst individual parameters of their distributions of returns were identified (see the selected values in Tables 2-11). It was determined that: 1) It is not possible to identify a single fund which is the best in terms of all parameters of its distribution; 2) It is possible to specify a group of funds which are the best in terms of all parameters. These were: UniKorona Akcje (for almost all investment horizons) and Legg Mason Akcji and Aviva Investors Polskich Akcji (for some horizons); 3) there were funds which were the best in terms of some of the parameters of the distribution of returns, while the worst in terms of other parameters e.g. Allianz Akcji (for hi = = 1, 2, 3), Aviva Investors Polskich Akcji (for hi = 1), or Skarbiec Akcja (for hi = = 1 2). This was not, however, a rule (cf. the previous conclusion); 4) it is possible to indicate the worst fund in respect of all or nearly all of the parameters of the distribution. For investment horizons longer than two years, this was found to be Pioneer Akcji Polskich.

Conclusions and discussion

Based on these results, it can be stated that due to the significant variability which can occur in the values of the parameters of the distributions of the rates of return, when choosing an equity mutual fund the investor should assess the individual funds and not rely exclusively on the average values of the parameters of the distributions of the rates of return for the group of equity funds. It was also found that when choosing an equity mutual fund, the investor should first determine which parameters of the distribution of the rates of return are the most important for the investor, and which are less important, as there was no fund with the highest values for all parameters of the distribution of returns. It should be noted, however, that if the investor looks for the fund where the values of the parameters of the distribution of the rates of return are among the highest, then finding such a fund is possible. It was determined that the choice of equity fund can be narrowed down to a group of 2 to 4 of the best based on all or most of the

parameters of the distribution of returns. It was also found that the investor does not always have to choose between equity funds with the lowest risk and equity funds giving the possibility of the highest above-average returns. Furthermore, it was established that there was equity funds, which should not be the object of an investor's interest, regardless of the adopted hierarchy of importance of the parameters of the distribution of the rates of return.

When summarizing these considerations, two issues should be addressed. The first is the use of the method of historical simulation to construct distributions of rates of return. The disadvantage of this method is the sensitivity of the results obtained to the selected test period. The trading periods adopted in this study enabled the calculation of multiple returns for the assumed investment horizons. It should, however, be kept in mind that the period of potential acquisition and resale of the units by the investor was shortened along with an increase in the investment horizon. For the longest time horizons it was relatively short. This means that the studies take into account the volatility of shares in quite a limited period of time. This may affect the values of the parameters of the distributions of the rates of return. Another disadvantage of the method of historical simulation is the limited ability to use the results for predictions. It should be emphasized that the values calculated for the different parameters take into account the potential changes in the investment portfolio in the studied period (following a reconstruction of the portfolio by the fund manager) [cf. Butler, 2001, p. 51].

A second critical issue is the method of selecting the best funds, taking into account a comparison of several parameters of the distributions of the rates or return simultaneously. The theory of decision-making points to different strategies of multi-criteria decision-making, e.g. lexicographic strategy, semi-lexicographic strategy, elimination by aspects, and others. A practical solution may be to determine the weights (hierarchy) of individual parameters or to limit their number to, e.g. two. In particular, when comparing funds in terms of a specific criterion, it is worth noting the importance of the order of magnitude of the difference between the values. As recognized by Tversky [1969], alternative A is better than the alternative B when the assessment of alternative A (according to the criterion adopted) is higher than the assessment of alternative B by a predetermined threshold. If the difference in ratings does not exceed the predetermined threshold, the decision maker will treat both alternatives as equivalent[5]. For example, a difference of 5 p.p. in the minimum values of the distributions of the

[5] Some researchers proposed models of preference based on the application of quantitative criteria where small differences in the values of criteria were treated as 'similarity' and ignored [Tversky, 1969; Rubinstein, 1988; Leland, 1994; Manzini, Mariotti, 2012].

rates of return may be irrelevant for the investor. In this case, the investor would go into a further analysis of the funds in terms of the subsequent criteria, e.g. the 10^{th} percentiles or the medians. It can be noticed that this issue will be important in determining the group of funds included amongst the best, i.e. characterized by the highest values of all parameters of the distribution of returns. The issue of the use of different methods of multi-criteria comparative analysis in order to evaluate the suitability of an investment fund for individual investors requires further research. The role of decision making theory in research in the field of personal finance is emphasized among others by Jajuga et al. [2015, p. 13].

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OCENA ODPOWIEDNIOŚCI FUNDUSZU AKCYJNEGO DLA INWESTORA. WYKORZYSTANIE PARAMETRÓW ROZKŁADU STÓP ZWROTU

Streszczenie: Celem badania było ukazanie możliwości i metod użycia parametrów rozkładu stóp zwrotu w ocenie odpowiedniości funduszu akcyjnego dla inwestora. Badanie zostało przeprowadzone dla 15 polskich funduszy akcyjnych. Empiryczne rozkłady stóp zwrotu dla 10 horyzontów inwestycyjnych skonstruowano na podstawie notowań dziennych z lat 2005-2016. Stwierdzono m.in., iż: 1) wybierając fundusz akcyjny nie powinno się opierać wyłącznie na wartościach średnich parametrów rozkładu stóp zwrotu dla grupy funduszy akcyjnych, 2) wybór funduszu akcyjnego można zawęzić do grupy 2-4 najlepszych ze względu na wszystkie lub większość parametrów rozkładu stóp zwrotu; 3) inwestor nie zawsze musi wybierać między funduszami akcyjnymi o najmniejszym ryzyku a funduszami akcyjnymi dającymi szansę na najwyższe ponadprzeciętne stopy zwrotu; 4) istnieją fundusze akcyjne, które nie powinny być przedmiotem inwestycji inwestora ze względu na najniższe wartości wszystkich parametrów rozkładów stóp zwrotu.

Słowa kluczowe: finanse osobiste, ocena odpowiedniości, fundusze akcyjne, rozkład stóp zwrotu, analiza porównawcza.