DOI:10.17951/h.2022.56.4.63-82

ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN – POLONIA

VOL. LVI, 4 SECTIO H 2022

FILIP LISAK

fl67696@doktorant.sgh.waw.pl
SGH Warsaw School of Economics
162 Niepodległości Av., 02-554 Warsaw, Poland
ORCID ID: https://orcid.org/0000-0001-8309-1654

Evaluation of Performance and Efficiency of Polish Open-End Mutual Funds under High Volatility Environment in Financial Markets

Keywords: investment funds; performance analysis; funds' performance indicators; investment; volatility

JEL: G11; G23; G51

How to quote this paper: Lisak, F. (2022). Evaluation of Performance and Efficiency of Polish Open-End Mutual Funds under High Volatility Environment in Financial Markets. *Annales Universitatis Mariae Curie-Skłodowska, sectio H – Oeconomia*, Vol. 56, No. 4.

Abstract

Theoretical background: Retail investors in the financial market have nowadays access to a wide range of investment products. One of the types of such products are open-end investment funds, which by design are asset masses managed by professional entities. Open-end investment funds became one of the more popular financial instruments that retail customers purchase.
Purpose of the article: This article aims at determining the efficiency of mutual funds as measured by the rate of return. An important point of the study is to determine whether funds with lower total risk as measured by standard deviation achieved lower losses.
Research methods: The research method is an analysis of performance of twenty Polish open-ended mutual funds in three different time horizons, by using classic mutual fund performance measures adjusted for negative returns, i.e. Sharpe, Treynor and Jensen alpha indicators as well as the Israelsen and Treynor ratios adjusted for negative return.

Main findings: It has been observed that the high volatility in the financial market had a direct negative impact on the returns of these funds. When comparing the Treynor ratio adjusted for negative returns values it appears that some of the analysed equity funds performed better than, for example, stable growth funds. In case of high volatility in the stock market, both in the long and short term, the analysed stable growth funds did not bring more value to investors in relation to the total risk incurred than balanced or even equity funds, which is particularly noticeable in the case of three-year and annual results. This is because asset diversification did not fully work in the high market volatility seen since the beginning of 2022 mostly due to falling prices of debt securities caused by interest rate increases. The article also contributes to the interpretation of Sharpe and Israelsen ratios in case of similar negative rates of return and different volatility measured, because the Israelsen ratio may not be the best to compare such funds as it prioritizes the funds with lower risk and does not consider relation of risk to return.

Introduction

Retail investors in the financial market have nowadays access to a wide range of investment products. One of the types of such products are mutual funds, which by design are asset masses managed by professional entities (investment fund companies [*towarzystwa funduszy inwestycyjnych*]). These entities, in exchange for payments made by investors, allocate the funds in assets specified by the investment funds' statutes and objectives of these funds, with the main aim of increasing the value of the funds' assets and thereby obtaining a positive rate of return for the investor who purchases the funds' units or certificates. From the regulatory point of view, investment funds are legal entities (legal persons) established under the Law of 27 May 2004 on investment funds and management of alternative investment funds, whose sole object is to invest money collected from investors in exchange for participation units or investment certificates. The money is then allocated in the financial instruments or other products (i.e. other property rights) specified in the provisions of law.

Open-end investment funds that issue units [*jednostki uczestnictwa*] are one of the types of investment funds. The investment objective of such legal entity may only be the protection of the real value of the investment fund's assets, the generation of income from the investment fund's net deposits, or an increase in the value of the investment fund's assets because of an increase in the value of the deposits. An investor making an investment in an open-ended investment fund may demand a repurchase of his units at a price equal to the ratio of the fund's net asset value and the number of units held by all fund participants on the valuation date. The units are then redeemed. The mutual fund company managing a fund charges, among other things, management fees or purchase and redemption fees for its activities, while distribution entities charge distribution fees.

Mutual funds are one of the more popular financial instruments that retail customers purchase – shares in mutual funds accounted in 2021 for 5.27% of household assets (NBP, 2022). This is due, among other things, to high accessibility through distribution of units by commercial banks or other authorized entities, and relatively simple investment rules. Mutual funds allow investors to gain exposure to broad,

diversified portfolios of assets, including foreign assets, the acquisition of which would normally require an investor to establish a separate brokerage account with a foreign institution and incur the costs imposed by such firm. Open-ended investment funds had the largest share of the market of the investment funds in Poland. In the first half of 2021, their assets increased by 30%, and their share in the total value of investment fund assets in Poland increased from 36 to 40.1% (stat.gov, 2021).

The performance of the investment funds is influenced by the current situation in the financial markets which is characterized by a high level of volatility and consecutive declines in the value of indices. Figure 1 shows index values for three foreign stock exchanges – the German (DAX index), British (FTSE 250 index), American (S&P 500 index) – and the Polish WIG20 index.

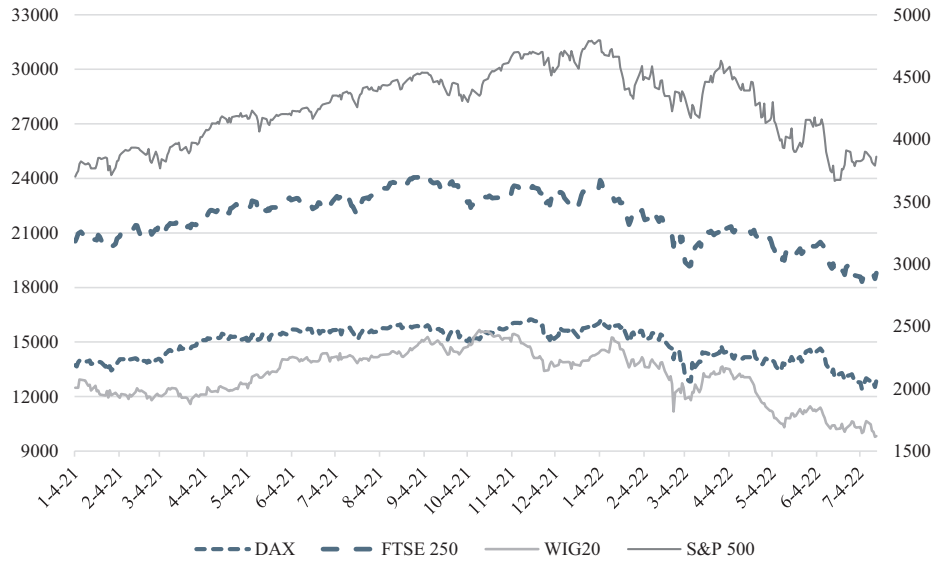


Figure 1. Returns of the four stock market indices DAX, FTSE 250, WIG20 and S&P 500 from 1 January 2021 to 14 July 2022

Source: Author's own study based on stooq.pl data as of July 14, 2022.

From the values of the indices shown in Figure 1, it can be seen that despite successive increases as late as 2021, the indices recorded declines in value from the beginning of 2022, mainly due to rising inflationary pressure and investors' concerns about possible recession. For the WIG20 index from 1 January 2022 to 14 July 2022, there was a change of -29.14% observed, for the S&P 500 index over the same period a decline of -19.46%, the DAX -19.70% and the FTSE 250 -21.19%. It is worth pointing out that these declines were correlated – the correlation of world indices, measured by the correlation coefficient, was high or even very high. As an example, the correlation coefficient of the WIG20 to the US S&P 500 index was

78.3%, and when measuring the correlation between the Polish and European indices, the coefficient was 86.45% (DAX) and 89.95% (FTSE 250). Thus, the mood on foreign stock exchanges had a direct impact on the Polish market, however, due to greater volatility in the Polish market as a developing economy, the declines in the Polish index were higher.

The above factors affect the performance of investment funds, which are among the largest institutional investors in the Polish financial market. Thus, declines in global and Polish stock markets have a direct impact on the performance of these funds. Table 1 depicts the averaged results that the respective open-ended investment funds have achieved by the various groups of open-ended mutual funds, depending on the investment strategy adopted.

Table 1. Average results of open-ended investment funds distributed on the Polish market in the period up to 14 July 2022

Fund type	3M	6M	$> r_f$ (6M)	YTD	12M	$> r_f$ (12M)	24M	$> r_f$ (24M)
Polish equity ($N = 93$)	-14.13%	-23.06%	5	-20.78%	-20.46%	7	3.25%	53
Bonds ($N = 150$)	-2.97%	-8.15%	9	-6.16%	-9.82%	9	-8.44%	10
Balanced ($N = 89$)	-9.39%	-13.94%	3	-13.60%	-15.14%	3	-5.39%	17
Stable growth ($N = 52$)	-7.3%	-14.35%	0	-13.71%	-16.81%	0	-8.53%	5

Risk-free rate (r_f) determined based on Treasury bond rates for individual periods with maturity on June 30, 2022.

Source: Author's own study based on data from biznesradar.pl and obligacjeskarbowe.pl as of July 14, 2022.

Table 1 shows that mutual funds have been significantly affected by increased uncertainty in financial markets. What is noticeable, since the beginning of 2022, the high declines in stock markets have also resulted in losses in the value of these funds over a two-year horizon (24M column), and only a few Polish equity funds have achieved positive returns over this time horizon. Table 1 also illustrates the numbers of mutual funds that obtained higher returns than investments in risk-free assets – government bonds. In the 6-month and 12-month periods, none of the stable growth funds obtained a higher rate of return than the risk-free rate of return. During such periods, investors who invested assets in riskier Polish equity funds were more likely to obtain a positive rate of return.

Literature review

As Kuciński (2010) points out, economic stability was a good predictor for the mutual fund market. Crisis periods, on the other hand, multiply the investment risk of mutual funds. A study by Kompa and Witkowska (2010) found that mutual fund managers did not succeed in adjusting their portfolio composition to the market situation, especially when an increased volatility in financial markets was observed. Thanou (2008) points out that although the performance of funds is linked to the market in

which the funds hold assets (similarly, in the case of stock funds, Witkowska [2009]), only some of these funds achieved returns higher than the market. Mościbrodzka's (2018) research showed a negative correlation between risk and returns achieved by these funds, especially over the long term. Similarly, Jurek-Wasilewska (2014), based on an assessment of investment funds' efficiency, found that in the case of volatility in market conditions, their performance, regardless of the investment policy they pursued, did not differ significantly or was significantly worse than the performance of the market portfolio. Filip (2016) estimated that funds generally obtained worse returns than the market portfolio, but these results were not statistically significant. The reason for this may be a lack of market intuition on the part of managers, as described, for example, by Żelazowska (2017). Test results by Gusni and Hamdani (2018) showed that only stock selection skill and inflation have a positive impact on equity fund performance, while, for example, market timing skill has no impact on equity fund performance. On the other hand, however, e.g. Wegrzyn (2015) indicated that high volatility may have been an advantage for investors over passive investment strategies at high levels of volatility.

Thus, while there is a consensus in the literature that investment risk under high volatility environment increases even more significantly for mutual funds, it is important in the case of different, heterogeneous groups of funds to present these results jointly, taking into account the investment strategies they use and the risk they undertake so that investors are aware of the possible advantages and disadvantages of specific groups of funds.

Although market volatility affects the negative performance of funds, it can have a varying impact, depending on different categories of funds. Moskal and Zawadzka (2015), analysing small and medium-sized company stock funds, point to their high-risk profile. Dittmann (2018), conducting research for stable growth, balanced and equity funds between 2005 and 2017 indicated that funds are characterized by high diversity in excess returns and that the chances of a positive risk premium in the past varied for individual funds. According to Nicolescu et al. (2020), statistical analyses show that in the CEE countries studied, equity funds were the category with the highest risk across all fund categories. At the same time, low-risk funds performed better in periods of economic recession than in periods of economic expansion.

Qureshi et al. (2017) argue that market volatility and instability in emerging economies are driving potential investors to accept more secure and safer options, such as a balanced fund. According to their research, balanced funds negatively follow market volatility. Similarly, an analysis by Mirza et al. (2022) indicates that there is an investment drift from riskier investment styles to more cautious options in response to uncertainty in the financial market. Karpio and Żebrowska-Suchodolska (2014) point out that there is a need for investors to take a proactive approach to fund selection, as ranking positions are constantly changing in different market periods. Analyses under consideration did not, however, indicate the ranking positions of these funds in the context of the selection of different groups of funds, such as in the case

of switching from a riskier fund to more secure one, and whether such a strategy in the case of continuous stock market declines could be successful. It is, therefore, necessary to make comparisons also for "intermediate" fund classes and their ranking in periods of high volatility to show investors how performance, considering risk, is shaping up for individual investment strategies.

The available research does also not address unequivocally the issue of using classic performance measures such as the Sharpe ratio or Treynor ratio when funds earned negative returns. For example, Susilo and Najah (2018), analysing 19 stocks from the Jakarta Islamic Index used classic measures of volatility without using their modified versions. Similarly, Claransia and Sugiharto (2021), Verma and Hirpara (2016) or Anwar and Arif (2017) used these tools in a similar way for negative returns.

On the other hand, in a study of Venugopal and Sophia (2020), the researchers found that the Sharpe ratio is not a realistic tool for assessing fund performance under high volatility conditions, as funds with a better ratio actually performed worse. Similar objections to this indicator were pointed out by Chuang et al. (2008) and Scholz (2006), for example. Thus, this article also intends to indicate whether classic measures of volatility without modification for negative returns are an appropriate tool for assessing the performance of these funds.

Research methods

The purpose of this article is to assess the effectiveness of open-ended investment funds measured by the rate of return, considering the situation in financial markets since the beginning of 2022, including the situation in the Polish market. This is because the cited research shows that the performance of investment funds is sensitive to the economic situation and volatility in the financial market, but also depends in large part on the investment strategies used and the ability of investment fund companies to manage them. At the same time, starting in March 2020, financial markets are characterized by a high level of uncertainty due to inflationary pressures and the expected economic slowdown (i.e. the possible occurrence of stagflation).

The main research objective of this article is to determine what performance the analysed funds achieved during a period of high uncertainty in financial markets. The research hypothesis of this article is to determine whether the analysed funds, by definition "safer" for investors, i.e. using less aggressive investment strategies, were actually less efficient than funds using aggressive strategies (characterized by higher volatility).

In order to analyse the above hypotheses, classical methods of evaluating the efficiency of investment funds will be applied to the rates of return calculated for twenty open-ended investment funds presented below. The funds under study are among the largest in terms of asset value in the Polish market and have been grouped into four types which are the most common on the Polish investment fund market, i.e.

Polish equity funds, debt securities funds, stable growth funds and balanced funds. Types and names of the analysed funds as well as general description of the investment strategies of such funds have been provided for each group of funds in Table 2.

Table 2. Types and names of the analysed open-ended investment funds

Fund type	Fund name	Abbreviation	Investment strategy description
Polish equity	NN Indeks Odpowiedzialnego Inwestowania (NN Parasol FIO)	NNIO	Funds that acquire equities and financial instruments of a similar nature, seeking to achieve returns through exposure to domestic equities and relating returns to Polish equity indices, including WIG20 and WIG.
	NN Subfundusz Akcji (NN Parasol FIO)	NNSA	
	PZU Akcji KRAKOWIAK (PZU FIO Parasolowy)	PZUK	
	Santander Akcji Polskich (Santander FIO)	SANA	
	PKO Akcji Plus (PKO Parasolowy FIO)	PKOA	
Stable growth	PZU Stabilnego Wzrostu Mazurek (PZU FIO Parasolowy)	PZUM	Mixed funds, realizing a rate of return through a combination of debt and equity securities to achieve a positive rate of return with a predominance of financial instruments with lower volatility.
	NN Stabilnego Wzrostu (NN Parasol FIO)	NNSW	
	Investor Zabezpieczenia Emerytalnego (Investor FIO)	INZE	
	Esaliens Senior FIO (PKO Parasolowy FIO)	ESAS	
	PKO Stabilnego Wzrostu (PKO Parasolowy FIO)	PKOS	
Balanced	NN Zrównoważony (NN Parasol FIO)	NNZR	Mixed funds, realizing returns through a combination of equities, financial instruments of a similar nature, debt securities and money market instruments, with a predominance of financial instruments with higher volatility.
	Investor Zrównoważony (Investor FIO)	INVZ	
	Santander Zrównoważony (Santander FIO)	SANZ	
	PKO Zrównoważony (PKO Parasolowy FIO)	PKOZ	
	Pekao Zrównoważony (Pekao FIO)	PEKZ	
Debt securities	PKO Obligacji Skarbowych (PKO Parasolowy FIO)	PKOO	Funds that purchase low-volatility assets, particularly bonds, treasury bills, non-Polish debt securities, bank deposits and corporate bonds.
	NN Krótkoterminowych Obligacji (NN Parasol FIO)	NNKO	
	Generali Korona Dochodowy (Generali Fundusze FIO)	GEKD	
	Santander Dłużny Krótkoterminowy (Santander FIO)	SAND	
	PZU Polonez (PZU FIO Parasolowy)	PZUP	

Source: Author's own study based on prospectuses of the surveyed investment funds.

First, for the above mutual funds, the fund's rate of return over the period under review (r_t), was calculated, as measured by the formula:

$$r_t = \frac{I_t}{I_0} - 1$$

where: t is the investment period under study, I_0 is the net asset value per unit (unit price) of the fund at the beginning of the period under study, I_t is the value of that unit at the end of the period under study.

The returns obtained were then adjusted on an annual basis by calculating the fund's average annual return $\bar{r}_t$, measured by the formula:

$$\bar{r}_t = (r_t)^{1/t}$$

In order to assess efficiency as measured by mutual fund returns, Sharpe, Treynor and Jensen ratios have been calculated as basic measures of mutual fund performance. The Sharpe ratio is defined by the formula (Sharpe, 1994):

$$S = \frac{\bar{r}_t - \bar{r}_f}{\bar{\sigma}_t}$$

where: $\bar{r}_f$ is the average annual risk-free rate of return over the period studied and $\bar{\sigma}_t$ is the average annual standard deviation of the instrument's return. The Sharpe ratio allows to determine what average annual excess return (over the risk-free rate), given the differences in the risk of these financial instruments, could have been achieved by investing in each fund.

Before calculating the subsequent ratios, it is necessary to calculate the portfolio's beta coefficient, which determines the degree of dependence of the portfolio's return on the return of the "benchmark" portfolio or the "benchmark" index (denoted r_i), depending on the methodology adopted. The beta coefficient is calculated as the ratio of the covariance of the returns of the portfolio under study and the market portfolio that is the benchmark of the instrument under study, and the variance of the market portfolio, and its formula is as follows (with returns being daily returns in this case).

$$\beta_t = \frac{Cov\ (r_t, r_i)}{Var(r_i)}$$

The beta coefficient is a measure of risk used in the capital assets pricing model (CAPM) and is the slope of the best-fit line obtained by applying a linear regression of the portfolio return over the free rate to the index return (Hull, 2021). The beta coefficient is a tool used to determine how an asset's return behaves compared to the return of a benchmark index, hence it measures the sensitivity of an asset's return to a change in the market portfolio return and is a measure of systematic risk.

After calculating the beta of the mutual fund portfolios under study, the next indicator is the Treynor (1965) ratio, calculated as follows:

$$T = \frac{\bar{r}_t - \bar{r}_f}{\beta_t}$$

As Treynor points out, given a certain level of market return, the combination of expected return and portfolio risk can be determined. The Treynor ratio measures

the extent to which an individual investor increases the expected excess return of a portfolio as the portfolio's risk load increases. Comparing this ratio allows the performance of funds to be evaluated regardless of any differences in their risk aversion (Treynor, 1965).

The last indicator used is Jensen's alpha (denoted α), the formula of which is shown below (Jensen, 1968):

$$\alpha = \bar{r}_i - (\bar{r}_f + \beta_t(\bar{r}_i - \bar{r}_t))$$

Jensen's alpha is calculated based on the assumptions of the CAPM model and indicates how much the return on the asset under study differed from the expected value of the return on that asset calculated based on the CAPM model.

It is also of a huge importance to point out the different interpretations of the Sharpe and Treynor ratios in the literature when negative returns are obtained by the investment funds analysed. Jakšić et al. (2015) indicate that the principle of interpretation of these indicators, according to which the higher the value of the Sharpe ratio, the better the fund should be evaluated. On the other hand, such an interpretation without the application of restrictions on the funds' investment strategies results in an exemplary conclusion that funds obtaining the same or higher losses with much higher volatility turn out to be better than funds that achieved lower losses during the same period, while incurring lower investment risk (see McLeod & van Vuuren, 2004).

For this reason, Israelsen (2005) proposed a modification of the Sharpe ratio used in this analysis, allowing for a more reliable comparison of funds, the formula of which is as follows:

$$I = \frac{\bar{r}_t - \bar{r}_f}{\bar{\sigma}_t^{\overline{|r_t - r_f|}}}$$

The Treynor ratio has the same disadvantages, and, therefore, an analogous modification as proposed by Bayraktar (2018) will be calculated for this ratio according to the formula:

$$MT = \frac{\bar{r}_t - \bar{r}_f}{\beta_t^{\overline{|r_t - r_f|}}}$$

The benchmark indices for the funds were determined based on the individual funds' prospectuses and standardized for the entire group. In the case of Polish equity funds, the WIG index of the Warsaw Stock Exchange was taken as the reference index, for debt funds – TBSP.Index (Treasury BondSpot Poland Index), and for

balanced and stable growth funds, the index return was calculated as a weighted rate of return determined by the formula:

$$r_i = w_1 r_1 + w_2 r_2 + \cdots + w_n r_n$$

where, in the case of balanced funds, 50% of the weight in the portfolio was the return on the WIG index, 35% of the weight was the return on the TBSP.Index, and 15% was the return on the MSCI World index. For stable growth funds, 70% of the weight in the portfolio was the return on the TBSP.Index, and 30% was the return on the WIG index. The risk-free rate in the study was taken as the yield on bonds redeemed in June 2022 in the respective periods based on profitability tables available at obligacjeskarbowe.pl. It is necessary to mention that Beta and Treynor ratios are not analysed in the literature for debt securities funds, due to the low values of the beta coefficient and thus the lack of comparability of their performance to other groups of funds (Mościbrodzka & Żukowska, 2013). For this reason, calculations on these indicators will not be analysed.

Results

Having applied the methodology described in the previous section, the standard deviation $\bar{\sigma}_t$, the rates of return and ratios presented in the previous section were calculated. The analysis of the rates of return was carried out over three period horizons – a three-year horizon, an annual horizon, and a six-month horizon. The time horizons analysed in the study are interesting for the purposes of this article because of the indicated large increase in fund assets in 2021, and the possibility of comparing what results could have been obtained by investors who invested in a long-term perspective or started investing in mid-2021 or early 2022, that is, during the period of very large increases in global stock market indices. Moreover, the last, six-month horizon will be useful to assess how the perturbations in the 2022 financial market affected the assets value of mutual funds. The results of the analysis are presented in Tables 3–5.

Table 3. Results of the open-end investment funds' return analysis for the three-year period of investment until June 30, 2022

Fund	$\bar{\sigma}$	$\bar{r}$	*r*	*S*	β	*T*	α	*I*	*MT*
NNIO	24.50%	-7.56%	-21.02%	-0.3573	1.03	-0.0853	0.0020	-0.0214	-0.0899
NNSA	21.49%	-0.24%	-0.72%	-0.0665	0.89	-0.0160	-0.0082	-0.0031	-0.0128
PZUK	19.67%	-8.53%	-23.48%	-0.4944	0.81	-0.1200	-0.0145	-0.0191	-0.0788
SANA	21.90%	-2.58%	-7.55%	-0.1722	0.92	-0.0411	-0.0062	-0.0083	-0.0346
PKOA	21.47%	-4.82%	-13.77%	-0.2798	0.90	-0.0666	-0.0058	-0.0129	-0.0542
PZUM	8.37%	-6.44%	-18.10%	-0.9112	1.05	-0.0729	0.0027	-0.0064	-0.0798
NNSW	7.07%	-1.64%	-4.83%	-0.4000	0.89	-0.0318	-0.0065	-0.0020	-0.0251
INZE	9.89%	-2.41%	-7.07%	-0.3645	0.92	-0.0392	-0.0047	-0.0036	-0.0331

Fund	$\overline{\sigma}$	$\overline{r}$	r	S	β	T	α	I	MT
ESAS	6.94%	-3.36%	-9.76%	-0.6562	0.84	-0.0543	-0.0095	-0.0032	-0.0382
PKOS	8.18%	-4.59%	-13.16%	-0.7066	1.04	-0.0555	0.0024	-0.0047	-0.0602
NNZR	11.98%	0.36%	1.09%	-0.0689	1.09	-0.0076	0.0037	-0.0010	-0.0090
INVZ	16.41%	0.10%	0.30%	-0.0664	1.23	-0.0089	0.0095	-0.0018	-0.0134
SANZ	12.80%	-3.45%	-9.99%	-0.3624	1.16	-0.0401	0.0065	-0.0059	-0.0537
PKOZ	12.80%	-4.77%	-13.63%	-0.4654	1.12	-0.0534	0.0048	-0.0076	-0.0665
PEKZ	12.09%	-2.04%	-6.01%	-0.2676	1.17	-0.0277	0.0070	-0.0039	-0.0378
PKOO	1.77%	-1.99%	-5.86%	-1.7972	0.21	-0.1503	-0.0404	-0.0006	-0.0067
NNKO	1.38%	1.59%	4.84%	0.2908	0.10	0.0412	-0.0462	0.2908	0.0412
GEKD	2.40%	-1.90%	-5.59%	-1.2866	0.17	-0.1862	-0.0427	-0.0007	-0.0051
SAND	1.39%	-0.81%	-2.40%	-1.4325	0.16	-0.1219	-0.0428	-0.0003	-0.0033
PZUP	5.40%	-4.77%	-13.65%	-1.1042	0.77	-0.0774	-0.0118	-0.0032	-0.0459

Source: Author's own study based on data from stooq.pl, prospectuses of the surveyed investment funds. analyses.pl and obligacjeskarbowe.pl as of July 14, 2022.

Investors who decided to purchase assets in mid-2019 were able to obtain positive returns at the end of June 2022 after three years investment from only a certain number of balanced funds and debt securities funds. At the same time, analysing the Sharpe ratio results obtained, only one debt instruments fund – NNKO – allowed to obtain a return higher than the risk-free rate. Thus, investors who chose to invest over a three-year horizon in most cases earned a return lower than the risk-free rate, even despite the stable interest rate environment until early 2022 and relatively stable increases in the value of stock market indices. One stock fund (NNSA) achieved lower loss than majority of stock funds and debt funds under consideration as well as part of the balanced and equity funds suffered smaller losses over the three-year period than the less aggressive and more diversified stable growth funds (NNSA, SANA, NNZR, INVZZ, EPKZ outperformed PZUM, ESAS and PKOZ funds).

Table 4. Results of the return analysis for the one-year holding period of the funds in the investor's portfolio until June 30, 2022

Fund	$\overline{\sigma}$	r	S	β	T	J	I	MT
NNIO	24.97%	-21.19%	-0.8887	1.02	-0.2167	0.0053	-0.0554	-0.2272
NNSA	22.07%	-16.52%	-0.7936	0.92	-0.1914	-0.0190	-0.0387	-0.1603
PZUK	21.00%	-23.08%	-1.1466	0.86	-0.2787	-0.0304	-0.0506	-0.2080
SANA	22.13%	-19.41%	-0.9224	0.92	-0.2213	-0.0173	-0.0452	-0.1883
PKOA	21.75%	-17.47%	-0.8492	0.91	-0.2039	-0.0211	-0.0402	-0.1673
PZUM	9.05%	-21.34%	-2.4669	1.00	-0.2236	-0.0002	-0.0202	-0.2231
NNSW	8.28%	-14.20%	-1.8352	0.90	-0.1681	-0.0184	-0.0126	-0.1374
INZE	9.96%	-23.66%	-2.4753	0.89	-0.2775	-0.0213	-0.0246	-0.2192
ESAS	7.93%	-17.81%	-2.3734	0.84	-0.2251	-0.0315	-0.0149	-0.1572
PKOS	8.89%	-16.58%	-1.9766	0.98	-0.1789	-0.0033	-0.0156	-0.1727
NNZR	12.29%	-14.74%	-1.2805	1.11	-0.1417	0.0210	-0.0193	-0.1747
INVZ	14.65%	-26.60%	-1.8841	1.15	-0.2391	0.0293	-0.0404	-0.3185
SANZ	11.79%	-18.65%	-1.6662	1.02	-0.1934	0.0030	-0.0232	-0.1995
PKOZ	11.79%	-16.95%	-1.5220	1.05	-0.1715	0.0089	-0.0212	-0.1878

Fund	$\overline{\sigma}$	r	S	β	T	J	I	MT
PEKZ	11.34%	-14.51%	-1.3675	1.10	-0.1412	0.0187	-0.0176	-0.1704
PKOO	2.41%	-6.36%	-3.1339	0.29	-0.2588	-0.1274	-0.0018	-0.0220
NNKO	1.61%	-2.10%	-2.0459	0.16	-0.2011	-0.1504	-0.0005	-0.0054
GEKD	3.73%	-10.55%	-3.1487	0.18	-0.6526	-0.1474	-0.0044	-0.0211
SAND	1.93%	-4.38%	-2.8925	0.19	-0.2963	-0.1460	-0.0011	-0.0105
PZUP	6.31%	-19.39%	-3.2638	0.86	-0.2404	-0.0259	-0.0130	-0.1762

Source: Author's own study based on data from stooq.pl, prospectuses of the surveyed investment funds. analyses.pl and obligacjeskarbowe.pl as of July 14, 2022.

In a one-year perspective, none of the mutual funds surveyed achieved a positive rate of return. As in the three-year perspective, the largest losses were observed in stock funds and the lowest in four out of five analysed debt securities funds (the only exception is PZUP fund). Surprisingly, the results of balanced funds were comparable to the rates of return of stable growth funds, whilst the share of riskier assets of stable growth funds is about 20 p.p. less weight in the portfolio (PZUM, INZE, ESAS and PKOS obtained lower results than the two balanced funds NNZR, PEKZ, and PZUM and INZE – lower than SANZ).

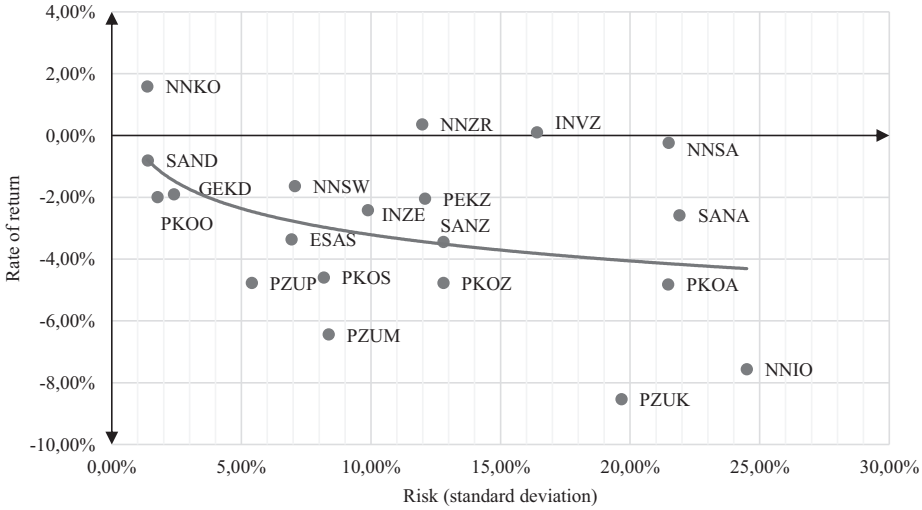
Table 5. Results of return analysis for the period of holding funds in the investor's portfolio from the beginning of 2022 to June 30, 2022

Fund	$\overline{\sigma}$	$\overline{r}$	r	S	β	T	J	I	MT
NNIO	32.11%	-46.71%	-27.00%	-1.4856	1.04	-0.4566	0.0135	-0.1532	-0.4984
NNSA	28.26%	-39.56%	-22.26%	-1.4355	0.92	-0.4429	-0.0253	-0.1146	-0.3715
PZUK	26.80%	-40.37%	-22.78%	-1.5436	0.86	-0.4807	-0.0419	-0.1109	-0.3561
SANA	28.30%	-39.46%	-22.20%	-1.4296	0.92	-0.4400	-0.0242	-0.1145	-0.3721
PKOA	27.86%	-39.49%	-22.21%	-1.4534	0.90	-0.4480	-0.0290	-0.1128	-0.3659
PZUM	11.82%	-29.10%	-15.80%	-2.5466	1.00	-0.3004	0.0004	-0.0356	-0.3016
NNSW	10.75%	-23.43%	-12.49%	-2.2714	0.90	-0.2701	-0.0203	-0.0263	-0.2209
INZE	12.86%	-37.04%	-20.65%	-2.9579	0.94	-0.4032	-0.0120	-0.0489	-0.3589
ESAS	10.42%	-26.08%	-14.02%	-2.5991	0.85	-0.3167	-0.0308	-0.0282	-0.2315
PKOS	11.67%	-28.41%	-15.39%	-2.5209	0.99	-0.2970	-0.0021	-0.0343	-0.2911
NNZR	15.78%	-28.61%	-15.51%	-1.8757	1.10	-0.2701	0.0246	-0.0467	-0.3246
INVZ	18.45%	-45.76%	-26.35%	-2.5339	1.18	-0.3955	0.0467	-0.0863	-0.5529
SANZ	15.08%	-33.27%	-18.31%	-2.2733	0.99	-0.3466	-0.0029	-0.0517	-0.3389
PKOZ	15.08%	-31.18%	-17.04%	-2.1344	1.02	-0.3140	0.0064	-0.0485	-0.3298
PEKZ	14.46%	-28.00%	-15.15%	-2.0057	1.05	-0.2765	0.0125	-0.0419	-0.3042
PKOO	3.24%	-8.18%	-4.18%	-2.8902	0.33	-0.2869	-0.1247	-0.0030	-0.0306
NNKO	2.10%	-2.59%	-1.30%	-1.8000	0.19	-0.1959	-0.1494	-0.0008	-0.0073
GEKD	5.22%	-16.56%	-8.66%	-3.4004	0.20	-0.9027	-0.1487	-0.0093	-0.0349
SAND	2.50%	-3.93%	-1.99%	-2.0525	0.19	-0.2649	-0.1493	-0.0013	-0.0099
PZUP	8.27%	-21.96%	-11.66%	-2.7987	0.91	-0.2533	-0.0159	-0.0191	-0.2115

Source: Author's own study based on data from stooq.pl, prospectuses of the surveyed investment funds. analyses.pl and obligacjeskarbowe.pl as of July 14, 2022.

Analysis of Polish open-end investment funds' performance from the beginning to the end of June 2022 showed very high losses obtained by each category of funds, whereas the returns were mostly dependent on the share of risky assets in the portfolio of a fund under consideration. Observations on returns for the six-month period are comparable to those for the one-year period.

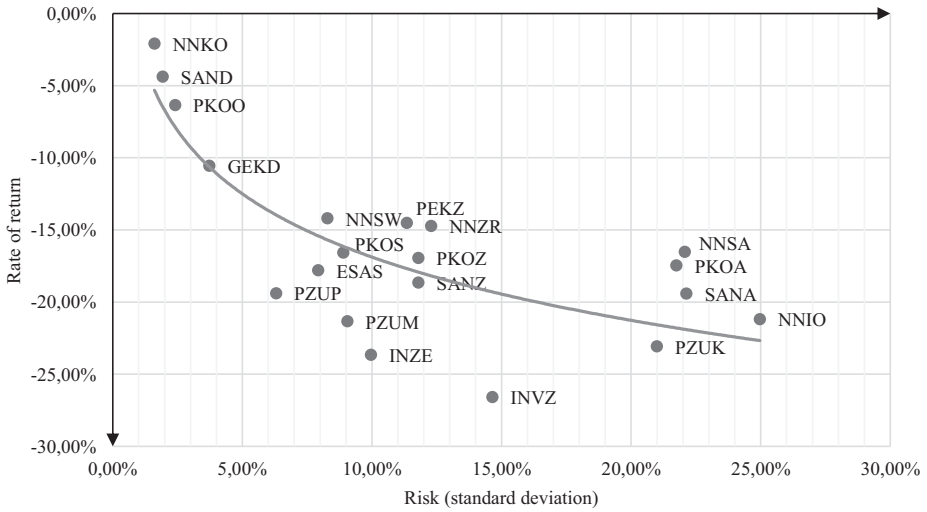
To illustrate the dependence of risk measured by standard deviation on the rate of return, in Figures 2 to 4, point charts have been drawn, along with the logarithmic trend curve of the dependence between risk measured by deviation and the rate of return, as most useful in the case of a rapidly increasing rate of change in the dependence, followed by its stabilization. The equations of these curves and the R^2 coefficient of this line are shown under the figures.



Equation of the trend line $y = -0.012\ln(x) - 0.0603;\ R^2 = 0.1807$

Figure 2. Dependence of average return on risk measured by annual standard deviation over a three-year investment period for the funds studied

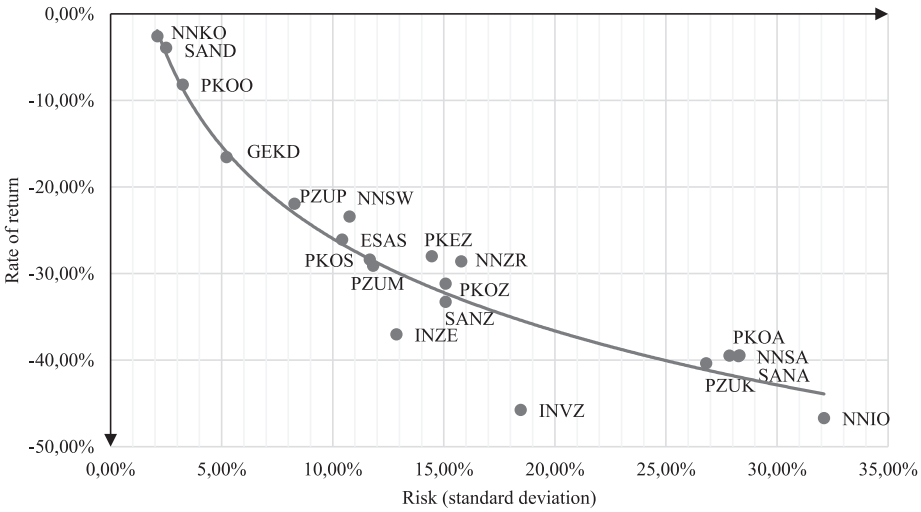
Source: Author's own study based on data from stooq.pl, prospectuses of the surveyed investment funds. analyses.pl and obligacjeskarbowe.pl as of July 14, 2022.



Equation of the trend line $y = -0.056\ln(x) - 0.3012;\ R^2 = 0.6601$

Figure 3. Relationship of returns to risk as measured by standard deviation over the annual investment period for the funds studied

Source: Author's own study based on data from stooq.pl, prospectuses of the surveyed investment funds. analyses.pl and obligacjeskarbowe.pl as of July 14, 2022.



Equation of the trend line $y = -0.154ln(x) - 0.6139;\ R^2 = 0.9249$

Figure 4. Relationship of returns to risk as measured by standard deviation over the six-month investment period for the funds studied

Source: Author's own study based on data from stooq.pl, prospectuses of the surveyed investment funds. analyses.pl and obligacjeskarbowe.pl as of July 14, 2022.

The shape of the logarithmic trend line in the one-year period shows that the risk-return relationship grew faster for low-risk assets, and then flattened out as the risk increased (however, in the case of the three-year period, the small R^2 coefficient does not allow conclusions to be made), while the position of the individual results of the analysed funds shows that for all the investment horizons studied, the balanced funds performed similarly in terms of return in relation to the risk incurred compared to stable growth funds. In the six-month period, the returns of the analysed stock funds were characterized by very high volatility, and, therefore, the shape of this curve is regular, i.e. losses increased in proportion to the total risk incurred.

Discussion

From the analysis of returns, it can be observed that over the long term, the NNKO debt instruments fund and two balanced funds – NNZR and INVZ – yielded the highest returns. At the same time, only the NNKO (a short-term bond fund) yielded a return higher than the assumed risk-return rate and was the most efficient fund in terms of the total and systematic risk incurred ($S = 0.2908$ and $T = 0.0412$). The worst performing funds in terms of rate of return over the same period were the equity funds – NNIO and PZUK, which also had the worst performance measured by Israelsen and Modified Treynor ratios (except for the outcome of MT for PZUM, which was worse than PZUK). For both analysed short-term investment periods, the worst fund in terms of the ratio of excess return to systematic risk incurred was the INVZ fund (balanced fund) and to the total risk – NNIO (stock fund). Interestingly, these funds achieved positive Jensen alpha values.

The dispersion of observed returns over a three-year period does not allow to rank the different groups of funds in terms of efficiency and, therefore, to make conclusions about those groups of analysed funds. The calculated ratios differ independently both within and between groups of analysed funds. Analysis of the calculated Israelsen coefficients shows that, in the long term, the most effective group in terms of the rate of return obtained in relation to total risk were the debt securities funds, of which the NNKO fund was the best. In contrast, the lowest performance of this ratio was achieved by equity funds. However, in the case of the Modified Treynor measure in relation to systematic risk (i.e. uncontrollable risk), in the long term the worst results, apart from the NNSA and PZUK stock funds, were achieved by the PZUM stable growth fund and the SANZ (balanced) fund. The premise of the Treynor ratio (as well as the calculated MT) is to assess investors' compensation for portfolio risks that cannot be eliminated by means of portfolio diversification. The Treynor ratio enables an assessment of the performance of a fund after taking into consideration the diversification of portfolios, so in the case of the calculations obtained, it appears that some equity funds performed better than, for example, stable growth funds.

For the one-year and six-month periods, stock funds were the least efficient funds, while bond funds were the most efficient funds. As presented in the charts of the relationship between the total risk (measured by the standard deviation) and return – during the analysed short-term period there was a high relationship between the two indicators. However, as indicated when describing rates of return in Tables 2–4, the returns for the stable growth funds analysed were comparable in all periods studied to the balanced funds (except INVZ in short-term). Moreover, the results of the Modified Treynor ratio do not indicate that the funds under analysis were performing much better thanks to portfolio diversification in the case of stable growth and balanced funds compared to equity portfolios.

Thus, in case of high volatility in the stock market, both in the long and short term, the analysed stable growth funds did not bring more value to investors in relation to the total risk incurred than balanced or even equity funds, and, therefore, did not mitigate losses well enough, what is particularly noticeable in the case of three-year and annual results. This is because asset diversification did not fully work in the high market volatility seen since the beginning of 2022. The prices of investment funds' assets were influenced mostly by falling prices of debt securities caused by interest rate increases in Poland since October 2021. The very large increases, up to 6.5%, accompanied by an environment of record low interest rates prior to that date, meant that portfolio diversification in the form of holding debt securities did not have the intended effect. The performance of the short-term bond fund (NNKO) and the long-term bond fund (PZUP) supports the thesis that when interest rates rise, a better strategy is to reduce long-dated bonds in favour of short-term bonds, although the short-term bond fund also brought losses in both the long and short term.

Through the analysis of Jensen's alpha ratio, in each of the analysed periods, balanced funds achieved the highest positive values of this ratio. This means that the managers of the balanced funds under study performed best among the managers of the other analysed funds than the benchmark would suggest, and this is a red flag for investors of these funds in the event of possible index increases in the future and may have influenced the overall rate of return of those funds.

What is worth mentioning during the analysis is that negative values of the Sharpe ratio do not always allow a correct assessment of the funds because including the standard deviation in the divisor in such cases favours funds with higher volatility. Therefore, Israelsen and Modified Treynor ratios were calculated. However, in case of similar negative returns, which were obtained by the analysed stable growth and balanced funds, while at the same time observed higher volatility measured by the standard deviation, the Sharpe ratio is higher, where the results are opposite or similar for the Israelsen ratio. This should be analysed in terms of investors' expectations. It does not seem, for example, that investors who have taken less risk would be satisfied with achieving similar losses as funds with much higher volatility. Secondly, in the case of differences in fund volatility while achieving similar losses, this means that balanced funds were characterized by more random increases and decreases in

value, while stable growth funds were characterized by less varied, but in an overall perspective, continuous declines. Thus, within similar groups of funds with similar performance, analysing the Sharp ratio makes it possible to clearly determine whether an investor expecting higher returns due to higher risk suffered a higher loss at the same time, when in case of Israelsen ratio – it ranks funds with lower risk higher. This is particularly noticeable in case of three-year results of PZUM and PKOZ, where the result of I for PZUM is -0.0064 where $\bar{r}$ = -6.44% and $\bar{\sigma}$ = 8.37%, and the result of I for PKOZ is -0.0074, where $\bar{r}$ = -4.77% and $\bar{\sigma}$ = 12.8%. While the results of the Israelsen ratio in the case of rates of return and standard deviation results differing to a greater extent are reliable, in case of small differences between those, the results seem challenging to be properly described. In the author's view, in such cases Sharpe ratio seems more reliable since it still describes the risk premium gained by the investor even when the rates of return are negative. The results of the calculations shown in Tables 2 through 4 indicate that most of the balanced funds analysed were better than stable growth funds in the sense that, despite incurring similar losses as stable growth funds, the result was achieved with much higher volatility, and, therefore, these funds performed better considering the overall risk borne during this period. The hierarchy of these funds in each period is shown in Table 6 (balanced funds have been marked in grey).

Table 6. Hierarchy of stable growth and balanced funds in terms of Sharpe ratio

3 years		1 year		YTD	
Fund name	S	Fund name	S	Fund name	S
NNZR	-0.07	NNZR	-1.28	NNZR	-1.88
INVZ	-0.07	PEKZ	-1.37	PEKZ	-2.01
PEKZ	-0.27	PKOZ	-1.52	PKOZ	-2.13
INZE	-0.36	SANZ	-1.67	NNSW	-2.27
SANZ	-0.36	NNSW	-1.84	SANZ	-2.27
NNSW	-0.40	INVZ	-1.88	PKOS	-2.52
PKOZ	-0.47	PKOS	-1.98	INVZ	-2.53
ESAS	-0.66	ESAS	-2.37	PZUM	-2.55
PKOS	-0.71	PZUM	-2.47	ESAS	-2.60
PZUM	-0.91	INZE	-2.48	INZE	-2.96

Source: Author's own study based on data from stooq.pl, prospectuses of the surveyed investment funds. analyses.pl and obligacjeskarbowe.pl as of July 14, 2022.

Conclusions

The purpose of this article was to determine the performance and ranking of mutual funds under conditions of high volatility. The research conducted shows that the hypothesis that investment (mutual) funds by definition "safer" for investors, i.e. employing less aggressive investment strategies sufficiently limited investors' losses, especially in three-year and one-year period, should be rejected regarding stable

growth and balanced funds. This is because some of the analysed funds belonging to these groups did not outperform part of the analysed equity funds in relation to both systematic and overall risk incurred. However, the high volatility observed on the market had a negative impact on the performance of mutual funds, particularly the performance of stock funds which incurred huge losses, greater than the benchmark indices.

As pointed out, for comparable negative returns obtained under higher volatility measured by the standard deviation, the calculated Sharpe ratio was higher, where the results were opposite or similar when calculating the Israelsen ratio. Correct interpretation of these ratios should be made with appropriate assumptions, bearing in mind investors' expectations. The Israelsen ratio, in bearish market, rank less risky funds higher but this does not mean that these funds had an overall better performance for investors. In fact, their formulas rank higher not necessarily the funds with the least loss, but with the least risk. Hence, this should be done with caution because when comparing similar results and different risk levels. Investors may be eager to invest in funds which achieve similar losses with higher volatility since these less risky funds may in fact not manage the risk properly and the promises of returns may be higher in the future for the riskier funds. This may be the case for the balanced and stable-growth funds. Non-modified Sharp ratio makes it possible to clearly determine whether an investor expecting higher returns due to higher risk suffered a higher loss at the same time when the negative rates of return are similar.

Investors making asset selections, for diversified investment strategies, should, therefore, keep in mind not only market conditions, but the way assets are diversified and the possible impact of the fund's portfolio assets prices on the entire fund net asset value. As Nicolescu et al. (2020) pointed out, funds with lower riskiness performed better during periods of volatility. This is true given the rates of return alone, but conditioning it further on the risk incurred, it can be considered that part of the balanced funds under analysis did perform better. The reason for this may be the skills of managers, as indicated by Jensen's positive alpha values in case of those funds. However, falling prices of debt instruments could also have been the significant factor. In addition, managers in a period of mutual fund declines should consider whether the strategy adopted, even though it is less risky as measured by standard deviation, results in changes that also apply riskier investment strategies.

Implications for the future include conducting further research on the effectiveness of adjusting the investment strategies of mixed strategy funds, which must reckon with the current difficult economic situation. It is also worth taking a closer look at Sharpe and Treynor ratios in the case of a bear market, as their interpretation may be troublesome in certain circumstances.

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