ECONOMICS & Sociology

Witkowska, D., Kompa, K. (2017), Polish Pension Market Performance in Comparison to Selected Benchmarks, *Economics and Sociology*, Vol. 10, No. 1, pp. 35-47. **DOI: 10.14254/2071-789X.2017/10-1/3**

POLISH PENSION MARKET PERFORMANCE IN COMPARISON TO SELECTED BENCHMARKS

Dorota Witkowska,
University of Lodz,
Lodz, Poland,
E-mail:
dorota.witkowska@uni.lodz.pl

Krzysztof Kompa,
Warsaw University of Life Sciences,
Warsaw, Poland,
E-mail:
krzysztof.kompa@gmail.com

Received: July, 2016
1st Revision: October, 2016
Accepted: December, 2016

DOI: 10.14254/2071-789X.2017/10-1/3

ABSTRACT. After the great reform of the pension system in Poland in 1999, the several transformations of the new system were performed. The most essential, which changed the rules for the mandatory fully funded pillar, went implemented in 2011 and 2014. The aim of the study is to answer the question if new regulations better protect the retirement savings. To obtain this goal we compare the performance of the pension funds to the actual and hypothetical benchmarks which are constructed according to the changes of the pension system, introduced by the Polish government. The research is provided applying several measures of the investment efficiency, for instance Sharpe, Sharpe-Israelsen, Sortino, Treynor and Jensen ratios.

JEL Classification: J22

Keywords: pension funds, investment efficiency, Sharpe ratios, Treynor ratio, Sortino ratio, Sharpe-Israelen ratio, Sharpe alpha, Jensen alpha.

Introduction

The pension system in Poland was reformed at the end of the XX century. Due to this original reform, the defined benefit plan was replaced by the defined contribution one. The new pension system consisted of two mandatory pillars: Social Insurance Institution (SII), representing the pay-as-you-go system (PAYG) and open pension funds (OPF), representing fully founded system. The third voluntary founded pillar completed this system.

The reform of the pension system was very profound but it suffered from several shortcomings. The main problem has been the permanent shortage of funds to pay the pension benefits, what causes the increase of the budget deficit. The criticism of the pension system functioning resulted in the essential transformation of the system, concerning: (1) the distribution of the retirement contribution between the SII and the OPF, (2) the retirement age, and (3) the pension funds functioning, among others.

The new law (which went into affect in February 2014) shifted 51.5% of the assets, held by the OPFs (about 150 billion PLN[1]) to the state-run PAYG pension system (i.e. to the SII), including all debt securities issued and guaranteed by the State Treasury. According to the new regulations, the second founded pillar became no longer obligatory. There was an automatic transfer of the retirement contributions to the SII, instead of the OPF, unless an

[1] Approximately it is about 40-45 billion UDS or 35-38 billion EUR.

individual OPF member files a declaration[2] requesting his/her contributions to be transferred to the selected OPF. Now the contribution, which goes to a chosen private fund, is only 2.92 percent of the individual's income. In the original reform it was 7.3%, i.e. the contribution collected by Social Insurance Institution was 1.7 of the contribution collected by pension funds. At present this proportion is 5.7 for the individuals who decided to transfer the part of their pension contribution to the OPF. Also all employees, in the age equals the official retirement age reduced by ten years and higher, must transfer all their pension contribution to the SII.

Overhaul of the pension system also concerns changes in the OPFs' investment portfolio since private pension funds have no longer been allowed to invest in government bonds. That will leave the pension funds with most of their assets held in shares of the companies listed on the Warsaw Stock Exchange and give them an increasingly peripheral role in the future retirement benefits of Poles. However the pension funds operating in Poland became allowed to increase the share of foreign investments in their portfolios, what may cause the capital outflow from the Polish market. Further outflow of funds from OPFs or lack of inflow will result from the gradual transfer of each person's retirement funds managed by OPF to SII, which will start ten years before reaching retirement age[3].

The changes, which took place in the years 2011 and 2014, have been considered (by the government) necessary to lower Poland's budgetary deficit. Many specialists call these changes the "significant step backward"[4], un-privatizing the pension system[5] or even the most drastic nationalization of private assets since Soviet times[6]. However, Polish Prime Minister Donald Tusk claimed "*it is no more than a bookkeeping change in the way to handle the public's retirement money*" (Bilefsky, Zurawik, 2013).

The new regulations, introduced in 2014, will lead to a change in the composition of assets' portfolios managed by OPFs not only due to the forced transfer of assets to SII but also due to new rules applicable to OPF investment activities. According to Polish Financial Supervision Authority[7], shares of Treasury bonds and equity instruments in the OPFs' portfolios in 2013 were the biggest among all instruments and nearly equal i.e. 42% and 43%, respectively. At present pension funds are not allowed to invest in Treasury Bonds thus they will look for other instruments for investments, also abroad.

The aim of our research[8] is to answer the question whether changes introduced by the Polish government improve the functioning of the pension system in Poland, in terms of higher capital for future pensioner. To obtain this goal we analyze the performance of different actual and hypothetical portfolios in the years 2000-2013. We assume that the considered time span, which contains periods of diversified financial and economic situation, is representative and the results of the investigation may be generalized. The hypothetical portfolios are constructed due to the original pension reform and regarding the changes in the

[2] The first time-slot was between 1 April and 31 July 2014, the next will be in 2016, then every 4 years.

[3] The regulations introduced in 2014 also caused the decrease of the maximum fee OPF can charge from contributions from 3.5% to 1.75%. Value of certain categories of assets in OPFs portfolio (i.e. investment certificates issued by closed-end funds, units of open-ended funds or specialized open-ended funds, or units issued by foreign collective investment undertakings of the closed or open-ended type) will not be included in the overall value of total net assets managed by OPF, which means that OPFs may not charge a management fee from these assets.

[4] David McMillan, chief executive of AVIVA Europe in London, which manages a private pension fund in Poland with 17.5 billion euros in assets (Bilefsky, Zurawik, 2013).

[5] See (Hagemejer, 2013).

[6] See (Bilefsky, Zurawik, 2013).

[7] Source: http://www.mpips.gov.pl/ubezpieczenia-spoleczne/ubezpieczenie-emerytalne/skladka -na-bezpieczenie-emerytalne/

[8] Research founded by the grant "*Analysis of Open Pension Funds Market as Compared to the Open Investment Funds Market Functioning in Poland*" 2013/09/B/HS4/00493 financed by National Science Center.

portfolio composition, forced by the regulation that went into affect in 2014. In our investigation we compare the investment performance applying different risk and investment efficiency measures, such as: semi-variance, tracking error, reward-to-variability ratio and information ratio defined by Sharpe, Treynor and Sortino ratios, together with Sharpe alpha, Jensen alpha, Sharpe-Iraelsen and Traynor-Black ratios. These efficiency measures will be evaluated for different assumptions concerning benchmarks, risk free instruments, etc. to investigate the sensitivity of these measures.

1. Data and investment portfolios

Analysis is conducted on the basis of the annual data from the years 2000-2013. In our investigation we provide the comparison of the performance of:

- Open End Pension Funds, represented by the weighted average rates of returns from accounting pension funds units (denoted as OPF);
- Social Insurance Institution, represented by indexation rates of pension contribution collected by these institutions, treated as returns from the retirement savings (- SII);
- Polish capital market, represented by annual returns from the Warsaw Stock Exchange Index WIG, treated as returns from the capital market (- WIG),
- Polish Treasury Bonds, represented by annual returns from Treasury Bonds (- T Bonds),
- Polish money market, represented by the annual Warsaw Interbank Offered Rate (- WIBOR) , treated as risk free instrument and
- constructed benchmarks – portfolios.

In our investigation we select two possible risk-free instruments i.e. T-Bond and WIBOR. We also apply 5 portfolios, which are used as benchmarks for performance analysis:

- m1, describing the capital market in Poland, represented by WIG,
- m2, being the combination of WIG and Treasury Bonds, in such a way that the returns of m2 are always positive, i.e. returns = max {WIG returns, T-Bond returns},
- m3, which replicate the structure of OPF portfolio due to the original reform from 1997, i.e. contains 42% T Bonds, 46% WIG and 12% WIBOR.
- m4, which is a modified portfolio m3 (due to the law from 2014), and combines 67% of WIG and 33% of WIBOR, i.e. the share of T-Bonds from portfolio m3 was equally divided between both instruments WIG and WIBOR;
- m5, which is another modification of portfolio m3 (due to the law from 2014), and includes 88% of WIG and 12% of WIBOR, i.e. the share of T-Bonds was replaced by WIG.

2. Performance measures

Portfolios performance usually is measured by comparing their rates of return and risk measures. The former seems to be the most important for the pension funds members when they decide about the pension funds selection. In the research several hypotheses are verified in order to find out if the expected value of the analyzed rates of return and their variances significantly, generated by the considered portfolio differ, from the ones generated by selected benchmarks. In our investigation we use popular tests statistics (See (Warner, 2007; Witkowska *et al.*, 2012), among others), for the significance level - 0.05. The null hypothesis about the significance of differences between two expected rates of return is as following:

$$H_0 : E(R_e) = E(R_b) \qquad (1)$$

where $E(R_e)$ – expected rates of return from analyzed portfolio, R_b – average return from the benchmark. When R_b=0 we check if rates of returns are positive or negative, if R_b= R*, we check if returns are below or above the accepted by the investor the level of returns R*, when R_b is the defined benchmark we compare returns to the benchmark R_b. The test statistics for small samples (normally distributed) is the Student:

$$t = \frac{R_e - R_b}{S_e}\sqrt{T-1} \tag{2}$$

The null hypothesis about the equality of two expected values of returns from two portfolios is formulated as following:

$$H_0 : E(R_{e1}) = E(R_{e2}) \tag{3}$$

and it is testified using the t-Student statistics:

$$t = \frac{R_{e1} - R_{e2}}{\sqrt{\frac{T_1 S_{e1}^2 + T_2 S_{e2}^2}{T_1 + T_2 - 2}\left(\frac{1}{T_1} + \frac{1}{T_2}\right)}} \tag{4}$$

To compare the risk, we use two tests that let us inference if the analyzed portfolio is characterized by smaller or bigger risk than the benchmark or another portfolio. In the former the null hypothesis:

$$H_0 : D^2(R_e) = S_b \tag{5}$$

is testified using the Chi-squared statistics with (T-1) degrees of freedom:

$$\chi^2 = \frac{TS_e^2}{S_b^2} \tag{6}$$

while the latter consists in testifying the hypothesis:

$$H_0 : D^2(R_{e1}) = D^2(R_{e2}) \tag{7}$$

using the Fisher test statistics with (T_1-1) & (T_2-1) degrees of freedom:

$$F = \frac{\max\{S_{e1}; S_{e2}\}}{\min\{S_{e1}; S_{e2}\}} \tag{8}$$

where $E(R_e)$, $E(R_{e1})$, $E(R_{e2})$ - the expected values of rates of return from the compared portfolios, $D^2(R_e)$, D^2 (R_{e1}), D^2 (R_{e2}) – variance of the portfolios, R_e, R_b – average rates of return from the analyzed portfolio and the benchmark, respectively, S_e, S_{e1}, S_{e2}, S_b – standard deviation of the portfolios and the benchmark, respectively, T – the count of periods (observations) under investigation.

Various researchers have highlighted numerous factors influencing the portfolio performance, therefore there is great variety of the efficiency measures in the literature. They usually differ by the defined benchmarks, which are used to evaluate the surplus return, and the risk measures. There are also problems of defining the market index, the risk free instrument, or acceptable by the investors the level of returns, and some technical questions. All these aspects influence the conclusion about the considered portfolio. It also happens that the value of the same measure is different for selected (two or more) benchmarks, and even for the same benchmark the value of the ratio may differ if it is evaluated by different researchers or analysts because of technical questions that essentially affect the values of these measures (see Otto, Wiśniewski, 2013).

The surplus return is measured by comparing the rates of return from the considered portfolio to: the selected benchmarks – R_b, the market portfolio, – R_m, the risk free instrument – R_f, and the investor's return target or minimal acceptable return – R^*. There are several measures of risk used in the investment efficiency ratios such as: standard deviation of: the portfolios – S_e, the market index – S_m and the benchmark – S_b, beta coefficient – $\hat{\beta}_e$ estimated from the single-index model[9] or the Capital Asset Pricing Model (CAMP), tracking error S_{eb}, which is the standard deviation of differential returns – S_{eb}:

$$S_{eb} = \sqrt{\frac{1}{T-1}\sum_{t-1}^{T}\left(R_{et} - R_{bt} - \left(R_{et} - R_{bt}\right)\right)} \tag{9}$$

and the semi-deviation of differential returns – SS_e:

$$SS_e = \sqrt{\frac{1}{T}\sum_{t-1}^{T} d_t^2} \tag{10}$$

$$d_t = \begin{cases} R_{et} - R^* \ \ gdy\ R_{et} - R^* < 0 \\ 0 \qquad\ gdy\ R_{et} - R^* \geq 0 \end{cases} \tag{11}$$

In our investigation we apply several well-known investment efficiency measures, which are described in (Tarczyński, 1997; Białek, 2009; Perez, 2012; Antolin, 2008; Domański (ed.), 2011; Witkowska *et al.*, 2012; Zamojska, 2012, among others. The Sharpe (reward-to-variability) ratio (Sharpe, 1966) measures an investment's excess return per unit of risk is defined as following:

$$WS_e = \frac{R_e - R_f}{S_e} \tag{12}$$

The excess return information ratio or the differentia return information ratio (Sharpe 1994) is defined as:

$$WGS_e = \frac{R_e - R_b}{S_{eb}} \tag{13}$$

[9] To evaluate Traynor ratio (Domański (ed.), 2011, p. 62) and (Perez, 2012, p. 155) use beta from the single-index model.

The modification of the Sharpe ratios is the Sortino measure (Sortino, Price, 1994):

$$WSP_e = \frac{R_e - R^*}{SS_e} \tag{14}$$

Another traditional measure of the portfolio performance is the reward-to-volatility index proposed by (Treynor, 1965):

$$WT_e = \frac{R_e - R_f}{\hat{\beta}_e} \tag{15}$$

In the research the Jensen's performance index (Jensen's alpha) (Jensen, 1968) is used to determine the abnormal return of the portfolio over the theoretical expected return. The index is estimated from the Capital Asset Pricing Model (CAPM):

$$\left(R_{et}\text{-}R_{ft}\right) = \alpha_e + \beta_e \left(R_{mt}\text{-}R_{ft}\right) + \varepsilon_t \tag{16}$$

due to the formula:

$$\hat{\alpha}_e = \left(R_e\text{-}R_f\right) + \hat{\beta}_e \left(R_m\text{-}R_f\right) \tag{17}$$

If Jensen's alpha is positive the analyzed portfolio is superefficient, if it is negative the portfolio is inefficient i.e. the obtained results are worse than buy and hold strategy. To compare the performance of the portfolios, characterized by different risk, the Black-Treynor ratio (Treynor, Black, 1973) is used:

$$WBT_e = \frac{\hat{\alpha}_e}{\hat{\beta}_e} \tag{18}$$

where $\hat{\alpha}_e$, $\hat{\beta}_e$ – parameter estimates of CAPM (16).

Not only the management of the fund determines the performance of the investment portfolio but also the situation on the market. Therefore, the efficiency measures that take into account the market trend are also used. The examples of such measures are two following ratios (see Salamaga, 2013):

$$WSA_e^1 = R_e - R_m \frac{S_e}{S_m} \tag{19}$$

see (Jamróz, 2013):

$$WSA_e^2 = (R_e - R_f) - (R_m - R_f) \cdot \frac{S_e}{S_m} \tag{20}$$

Similar to the information ratio (13) is the Sharpe-Israelsen measure (Israelsen, 2005):

$$WSI_e = \frac{R_e - R_b}{S_{eb}} \tag{21}$$

where the exponent for the tracking error equals (+1) when the average portfolio returns are bigger than the benchmark returns, and (-1) when the situation is opposite.

Presented above measures (except Jensen's alpha, which is interpreted) are used to compare the different portfolios however here the question arises if the differences between the evaluated values of the measures are statistically significant. To testify such hypothesis for the Sharpe ratios the Jobson-Korkie test (Jobson, Korkie, 1981) with the Memmel correction (Memmel, 2003) may be used. The test statistics is as following (Blitz, van Vliet, 2007):

$$z = \frac{WS_{e1} - WS_{e2}}{\sqrt{\frac{1}{T}\left[2\left(1-\rho_{1,2}\right)+\frac{1}{2}\left(WS_{e1}^2 + WS_{e2}^2 - WS_{e1}\cdot WS_{e2}\left(1-\rho_{1,2}^2\right)\right)\right]}} \tag{22}$$

where WS_{ei} – the Sharpe ratio evaluated for the i-th portfolio (i=1, 2), $\rho_{1,2}$ – the correlation coefficient evaluated for the rates of return obtained by both portfolios. Discussion about this test and its application for the Polish pension market can be found in (Kurach, Papla, 2014).

3. Empirical results

The period 2000-2013 was characterized by different economic and financial situation in Poland, and we may distinguish bull and bear markets at the Warsaw Stock Exchange that affected returns from the investments. Therefore, we assume that the situation observed in the considered period is representative for any time span, and conclusions concerning the performance of analyzed portfolios may be generalized.

Table 1a. Analysis of the returns in years 2000-2013 actual portfolios

Evaluated measures	Actual portfolios				
	OPF	SII	Benchmarks		
			WIG	T-Bonds	WIBOR
Cumulated returns	3.512	2.460	2.497	2.433	1.500
Geometric average for returns	1.094	1.066	1.067	1.066	1.029
Arithmetic average for rates of return	0.098	0.067	0.110	0.066	0.030
Standard deviation for rates of return	0.093	0.043	0.289	0.045	0.025
Max for rates of return	0.202	0.163	0.468	0.175	0.086
Min for rates of return	-0.141	0.019	-0.511	0.035	0.001
Coefficient of variation for rates of return	0.952	0.639	2.639	0.681	0.839
Sharpe Index WS_e (1) R_f=WIBOR	0.732	0.874	0.274	0.814	

Source: Own elaboration.

Table 1a,b contains the general information about the performance of the actual and the hypothetical portfolios. Among all actual portfolios the returns from the OPF seems to be

the biggest what means that this portfolio better protects the pensioners' savings than the SII, and investments on money, bond or capital markets. The smallest risk is observed for WIBOR (if it is measured by the standard deviation) and the SII (for the coefficient of variation), which seems to be the most effective in terms of the Sharpe ratio, evaluated for WIBOR representing the risk-free instrument. Among all hypothetical portfolios, the one denoted as m2 is the most effective. It is worth mentioning that the portfolios m4 and m5 (which are divested of T-Bonds) are characterized by bigger risk and smaller cumulative return than the portfolio m3. It means that the changes of the OPFs' portfolio structure (as it has been affected since 2014) do not improve performance of the pension funds

Table 1b. Analysis of the returns in years 2000-2013 market portfolios

Evaluated measures	Market portfolios				
	WIG	Hypothetical portfolios			
	m1	m2	m3	m4	m5
Cumulated returns	2.497	13.686	2.728	2.429	2.519
Geometric average	1.067	1.205	1.074	1.071	1.074
Arithmetic average	0.110	0.215	0.082	0.083	0.100
Standard deviation	0.289	0.157	0.128	0.193	0.254
Max	0.468	0.468	0.236	0.316	0.412
Min	-0.511	0.032	-0.209	-0.338	-0.448
Coefficient of variation	2.639	0.730	1.561	2.320	2.542
Sharpe Index WS_e (1) R_f=WIBOR	0.274	1.223	0.421	0.276	0.275

Source: Own elaboration.

Value of the tracking error depends on the benchmark. Indexation coefficient of the pension contribution collecting by the SII follows the inflation and the percentage rates thus the tracking errors for WIBOR and T-Bonds being benchmarks are the smallest among all analyzed portfolios in *Table 2*. While the tracking error of the OPF is the smallest when it is evaluated for the portfolio m3 being the benchmark, since this portfolio represents the pension funds' portfolio structure due to the original reform.

Table 2. Tracking errors

Benchmarks	OPF	SII	WIG	T-Bonds	WIBOR	m2	m3	m4	m5
WIBOR	0.087	0.047	0.293	0.026		0.160	0.123	0.197	0.258
T-Bonds	0.094	0.054	0.308		0.026	0.171	0.143	0.211	0.273
m1 (WIG)	0.229	0.313		0.308	0.293	0.179	0.164	0.097	0.035
m2	0.136	0.172	0.179	0.171	0.160		0.084	0.105	0.149
m3	0.075	0.153	0.164	0.143	0.129	0.084		0.068	0.129

Source: Own elaboration.

Table 3 contains the test statistics (2), (4), (6) and (8). The expected rates of returns are positive for all portfolios, and significantly bigger than WIBOR for all of them except capital market. When T-Bonds become the benchmark, the OPF, the SII and the WIG returns are insignificantly bigger, and for the benchmark selected as WIG, returns generated by the SII, T-Bonds and WIBOR are significantly smaller than the one generated by the capital

market. Returns from the OPF are not significantly bigger than the SII indexation but the risk is significantly higher. The portfolio m2 is characterized by the significantly bigger returns and variances for all benchmarks what is connected with its construction.

Table 3. Test statistics

H_0		OPF	SII	WIG	T-Bonds	WIBOR	m2	m3	m4	m5
(1)	R_b=0	**3.79**	**5.64**	**1.37**	**5.30**	**4.30**	**4.94**	**2.31**	1.55	1.42
	R_b=WIBOR	**2.64**	**3.15**	1.00	**2.93**		**4.26**	**1.47**	1.00	1.00
	R_b=T-Bonds	1.22	0.07	0.54		**-5.33**	**3.41**	0.44	0.31	0.48
	R_b=WIG	-0.45	**-3.56**		**-3.44**	**-11.60**	**2.42**	-0.78	-0.49	-0.14
	R_b=SII	1.19		0.53	-0.06	**-5.45**	**3.39**	0.41	0.30	0.47
(3)	E(R_e)=E(R_{SII})	0.33		0.15	-0.02	**-1.51**	0.94	0.11	0.30	0.48
(5)	S_b=WIBOR	**52.47**	**24.20**	**162.94**	**25.46**		**88.22**	**72.00**	**841.97**	**1460.23**
	S_b = T-Bonds	**28.85**	13.31	**89.60**		7.70	**48.52**	**39.59**	**255.52**	**443.14**
	S_b =SII	**30.36**		**94.26**	14.73	8.10	**51.04**	**41.65**	**282.33**	**489.65**
(7)	$D^2(R_e)$= $D^2(R_{SII})$	**4.70**		**45.34**	1.11	**2.99***	**13.29**	**8.85**	**20.17**	**34.98**

Source: Own elaboration.

Table 4. Efficiency ratios

		OPF	SII	WIG	T-Bonds	m2	m3	m4	m5
Sharpe ratios (12) and (13) for different benchmarks									
R_f=WIBOR	WS_e (12)	0.732	0.874	**0.276**	0.814	**1.181**	**0.409**	0.278	0.277
R_b =WIBOR	WGS_e (13)	0.784	0.800	0.273	1.423	0.946	0.121	0.087	0.132
R_b =WIG	WGS_e (13)	-0.051	-0.135		-0.147	0.586	-0.169	-0.273	-0.273
R_b =m2	WGS_e (13)	-0.856	-0.855	-0.586	-0.869		-1.588	-1.255	-0.768
R_b =m3	WGS_e (13)	0.213	-0.096	0.169	-0.108	1.588		0.020	0.140
Sharpe-Israelsen ratios (21) for different benchmarks									
R_b =WIBOR		0.784	0.800	0.273	1.423	1.155	0.403	0.273	0.273
R_b =WIG		-0.001	-0.003		-0.003	0.586	-0.002	-0.002	-0.001
R_b =m2		-0.011	-0.010	-0.012	-0.010		-0.011	-0.011	-0.012
R_b =m3		0.213	-0.001	0.169	-0.001	1.588		0.020	0.140
Treynor ratio (15) for β from single-index model WT_e									
R_f= WIBOR	R_m = WIG	0.285	-0.502	**0.080**	-0.682	0.407	0.120	0.080	0.080
	R_m =m2	0.229	-0.547			**0.185**			
	R_m =m3	0.115	-0.230				**0.052**		

Value of test statistics (22)						
for pairs od Sharpe ratios		OPF÷SII	OPF÷WIG	OPF÷T-Bonds	SII÷WIG	SII÷T-Bonds
R_f=WIBOR	WS_e (12)	-0.29	**1.94**	-0.22	1.22	0.16
R_b =WIBOR	WGS_e (13)	-0.03	**2.12**	-1.56	1.09	-1.53
R_b =WIG	WGS_e (13)	0.18	-0.27	0.29	-0.29	0.04
R_b =m2	WGS_e (13)	0.00	-1.04	0.03	-0.55	0.04
R_b =m3	WGS_e (13)	0.67	0.23	0.95	-0.57	0.04

Note bold letters denote Sharpe and Treynor indexes evaluated for different market indexes.
Source: Own elaboration.

The efficiency ratios defined by Sharpe, Sharpe-Israelsen and Treynor are presented in *Table 4*. The SII indexation is more effective than the OPF investments if Sharp ratios are taken into account, although these differences seem not to be significant. Also the hypothetical portfolio m3 (containing T-Bonds) performs better than the portfolios m4 and m5 (without T-Bonds). While the Treynor ratio (evaluated for the beta coefficient from the single-index model) shows much better performance of the pension funds than the Social Insurance Institution. However the significant differences between Shape measures evaluated for the returns from the compared pairs of the instruments are visible only for the pension funds and the capital market when WIBOR is treated as a benchmark (*Table 4*).

Table 5. Comparison of the Treynor and the Jensen measures

	Treynor ratios (15) for β from CAMP		Jensen α (17)		*WBT* (18)	
Indeks rynku	OPF	SII	OPF	SII	OPF	SII
R_m = m1 (WIG)	-0.069	-0.017	**0.105**	**0.164**	-0.107	-0.073
R_m =m2	0.240	-0.487	0.016	**0.044**	0.055	-1.195
R_m =m3	0.209	-0.566	**0.039**	**0.045**	0.070	-0.329

Note: bold letters denote statistical significant parameters α.
Source: Own elaboration.

The similar conclusions may be derived if the Treynor ratio is evaluated for beta coefficient estimated for the CAPM, except the model for WIG as the market index. The same situation is when Jensen alphas are compared (*Table 5*). The alpha values are positive and significantly bigger than zero in all models, except the one estimated for the returns from the pension and the market index represented by the hypothetical portfolio m2. However the Black-Treynor ratio shows that the OPF investments are more effective than the SII indexation in two comparisons.

Table 6. Sortino ratio

Sortino	OPF	SII	WIG	T-Bonds	WIBOR	m2	m3	m4	m5
R^* =WIBOR	1.555	3.498	0.464	*		38.621	0.764	0.464	0.464
R^*=WIG	-0.074	-0.194		-0.196	-0.336	*	-0.229	-0.336	-0.336
R^*=m2	-0.680	-0.669	-0.520	-0.671	-0.768		-0.856		
R^*=m3	0.361	-0.149	0.262	-0.155	-0.448	19.332			

Note: *denotes that for selected instruments Sortino measure could not be evaluated because of the zero value of the semivariance.
Source: Own elaboration.

The Sortino performance measure (*Table 6*) gives the SII indexation the best position (after m2) if WIBOR is the minimal expected by the investor return. While if the accepted return is on the level of WIG or m3, the OPF (and the hypothetical portfolio m2) investments perform better than others. Also for both selected actual benchmarks WIBOR and WIG, portfolios constructed due to new regulations (i.e. m4 and m5) perform worse than the one following the original pension system reform (i.e. m3).

Table 7 contains values of the measures (19)-(20) evaluated for the different market indexes, and risk free instruments. If the general situation of the market is taken into account, we notice that the OPF investments usually better performs than the SII indexation, and the portfolio m3 is more effective than the portfolios m4 and m5, except the situation when T-Bonds is risk-free instrument.

Table 7. Efficiency measures (19) and (20)

Measure parameters	OPF	SII	WIG	T-Bonds	WIBOR
(19) R_m =m1=WIG	0.0626	0.0509		0.0493	0.0202
(19) R_m =m2	-0.0298	0.0083	-0.2869	0.0045	-0.0044
(19) R_m =m3	0.0382	0.0397	-0.0757	0.0375	0.0137
(20) R_m =m1=WIG, R_f = T-Bonds	0.0176	-0.0056		-0.0067	-0.0405
(20) R_m =m2, R_f = T-Bonds	-0.0567	-0.0399	-0.2306	-0.0428	-0.0603
(20) R_m =m3, R_f = T-Bonds	0.0202	-0.0044	0.0082	-0.0055	-0.0398
(20) R_m =m1=WIG, R_f =WIBOR	0.0425	0.0257		0.0243	-0.0069
(20) R_m =m2, R_f =WIBOR	-0.0418	-0.0132	-0.2617	-0.0166	-0.0294
(20) R_m=m3, R_f=WIBOR	0.0302	0.0200	-0.0382	0.0183	-0.0102
Measure parameters		m2	m3	m4	m5
(19) R_m =m1=WIG		0.1553	0.0334	0.0101	0.0037
(19) R_m =m2			-0.0933	-0.1813	-0.2484
(19) R_m =m3		0.1143		-0.0404	-0.0628
(20) R_m =m1=WIG, R_f = T-Bonds		0.1249	-0.0036	-0.0120	-0.0044
(20) R_m =m2, R_f = T-Bonds			-0.1055	-0.1659	-0.2070
(20) R_m =m3, R_f = T-Bonds		0.1293		-0.0898	-0.0972
(20) R_m =m1=WIG, R_f =WIBOR		0.1417	0.0169	0.0002	0.0001
(20) R_m =m2, R_f =WIBOR			-0.0988	-0.1744	-0.2299
(20) R_m=m3, R_f=WIBOR		0.121		-0.0253	-0.0335

Source: Own elaboration.

Conclusion

In our investigation we use 34 performance measures constructed for the different representatives of the benchmarks, the market indexes and the risk-free instruments. All these measures are calculated for both institutions active at the Polish pension market i.e. the private pension funds representing the founded mandatory pillar, and the state PAYG institution. During analyzed period the retirement contribution from each employee was obligatory transferred to the OPF and the SII, however the part obtained by the pension funds was declining.

It is worth mentioning that all contribution collected by PAYG system has been at once paid as the pension benefits thus there is no retirement savings in the SII accounts which can be invested anywhere. The government provides the indexation of the pension contribution to keep the book value of the individual pension accounts on the same real level. But the indexation rate is the political decision, and it is usually close to the inflation rate. Therefore now nobody knows what level of the replacement rate can be expected in future, even the close one.

The private pension funds invest retirement savings constructing their portfolios according the obligatory regulations. Therefore the analysis is provided not only for the pension funds (OPF) but also for the hypothetical portfolios m3, m4 and m5. To make our research more complete we considered also portfolios representing the capital (WIG), money

(WIBOR) and bonds markets together with the hypothetical portfolio m2, which represents the best performance, being a combination of the capital and bond markets.

The analysis shows that the OPF investment performance in the considered time span is usually better than the SII indexation. Therefore, assuming that it is reasonable to generalize the results obtained for the sample 2000-2013, the future pensioners' savings will be higher if retirement contribution is invested by the OPF than if collected by the SII. Although the management of the OPF should try to obtain better results, especially that they charge their services high.

Applying different measures of the investment efficiency, it is visible that the diversified portfolio m3 is usually more effective than portfolios m4 and m5, constructed due to new regulations that became affective in 2014. Therefore, in our opinion, the limitation of the investment instruments, introduced by the government in 2014, declines the performance of the pension funds and also reduces the security of the retirement savings. In other words, the pension system in Poland had to be modified but not in the way as it was done.

Acknowledgement

This research is made possible by a grant for the "*Analysis of Open Pension Funds Market as Compared to the Open Investment Funds Market Functioning in Poland*" 2013/09/B/HS4/ 00493 financed by National Science Center.

References

Antolin P. (2008), Pension Fund Performance, *OECD Working Papers on Insurance and Private Pensions*, No. 20, OECD publishing, © OECD. doi:10.1787/240401404057.

Białek, J. (2009), *Konstrukcja miar efektywności Otwartych Funduszy Emerytalnych*, Wydawnictwo UŁ, Łódź.

Bilefsky, D., Zurawik, M. (2013), Polish Plan on Pensions Arouses Sharp Criticism, The New York Times, October, 9, 2013, (on-line:) http://www.nytimes.com/2013/10/10/business/international/polish-plan-on-pensions-arouses-sharp-criticism.html?_r=0.

Blitz, D. C., van Vliet, P. (2007), The Volatility Effect: Lower Risk without Lower Return, *Journal of Portfolio Management*, Fall, pp. 102-113, ERIM Report Series Research in Management, ERS-2007-044-F&A, Erasmus Research Institute of Management (ERIM), Erasmus Universiteit, Rotterdam.

Domański, C. (red.) (2011), *Nieklasyczne metody oceny efektywności i ryzyka. Otwarte fundusze emerytalne*, PWE, Warszawa.

Hagemejer, J., Makarski, K., Tyrowicz, J. (2013), Unprivatizing the Pension System: The Case of Poland, University of Warsaw, Faculty of Economic Sciences, *Working Papers* No. 26/2013(111), Warsaw.

Jamróz, P. (2013), Efektywność wybranych FIO rynku akcji w latach 2003-2011, Rynek kapitałowy. Skuteczne inwestowanie, *Zeszyty Naukowe Uniwersytetu Szczecińskiego* Nr 768, Finanse, Rynki Finansowe, Ubezpieczenia Nr 63, Wydawnictwo Uniwersytetu Szczecińskiego, Szczecin, pp. 193-206.

Jensen, M. C. (1968), The performance of Mutual Funds in the period 1945-1964, *Journal of Finance*, 23, No. 2, pp. 389-416.

Jobson, J. D., Korkie, B. M. (1981), Performance hypothesis testing with the Sharpe and Treynor measures, *Journal of Finance*, Vol. 36, pp. 889-908.

Kurach, R., Papla, D. (2014), Inwestycje alternatywne w portfelach otwartych funduszy emerytalnych, *Optimum Studia Ekonomiczne*, No. 1 (67), pp. 71-81.

Memmel, C. (2003), Performance hypothesis testing with the Sharpe ratio, *Finance Letters*, Vol. 1, pp. 21-23.

Otto, W., Wiśniewski, M. (2013), *Stopy zwrotu: OFE i ZUS*, http://kob e.org.pl/wp-content/uploads/2013/06/Stopy-zwrotu-w-OFE-a-indek sacja-sk%C5%82a dek-w-ZUS.pdf.

Perez, K. (2012), *Efektywność funduszy inwestycyjnych*, Difin, Warszawa.

Salamaga, M. (2013), Ocena Efektywności wybranych strategii inwestowania cyklicznego na polskim rynku kapitałowym w świetle mierników opartych na modelu CAPM, In: Trzaskalik T. (red.), *Modelowanie preferencji a ryzyko'13*, Seria Zeszyty Naukowe Wydziałowe Uniwersytetu Ekonomicznego w Katowicach Nr 163, „Studia Ekonomiczne", Wydawnictwo Uniwersytetu Ekonomicznego w Katowicach, Katowice, pp. 113-130.

Sharpe, W. F. (1966), Mutual Fund Performance, *Journal of Business*, 39, No. 1, pp. 119-138.

Sharpe, W. F. (1994), The Sharpe Ratio, *Journal of Portfolio Management*, 21, No. 1, pp. 49-58.

Sortino, F., Price, L. (1994), Performance Measurement in a Downside Risk Framework, *Journal of Investing*, 3, No. 3, pp. 59-65.

Tarczyński, W. (1997), *Rynki kapitałowe – Metody ilościowe. Tom 2*, Agencja Wydawnicza Placet, Warszawa.

Treynor, J. L. (1965), How to Rate Management of Investment Funds, *Harvard Business Review*, 43, No. 1, pp. 63-75.

Treynor, J. L., Black, F. (1973), How to use security analysis to improve portfolio selection, *Journal of Business*, 461, pp. 66-88.

Warner, R. C. (2007), *Applied Statistics*, SAGE Publications, Los Angeles.

Witkowska, D., Matuszewska, A., Kompa, K. (2012), *Wprowadzenie do ekonometrii dynamicznej i finansowe*j, Wydawnictwa SGGW, Warszawa.

Witkowska, D., Kompa, K., Grabska, M. (2009), Badanie informacyjnej efektywności rynku w formie silnej na przykładzie wybranych funduszy inwestycyjnych, *Metody ilościowe w Badaniach Ekonomicznych*, Warszawa, t. X, pp. 265-286.

Zamojska, A. (2012), *Efektywność funduszy inwestycyjnych w Polsce. Studium teoretyczno-empiryczne*, C. H. Beck, Warszawa.