Figure 1. Average nominal and real rates of return of supplementary pension plans in selected European countries (2010…2019)

* Rates of return calculated for less than 10 years: Voluntary pension funds (LV) „ 9 years (2011…2019), Voluntary pension fund s (PL) „ 7 years (2013…2019).
Source: Authors' work based of M czy ska et al., 2020.

(pl. pracownicze fundusze emerytalne PFEs) and for voluntary pension funds (pl. dobrowolne fundusze emerytalne DFEs) taking into account nominal and real rates of return. Other types of retirement plans existing in Poland were excluded from the analysis due to the lack of data on investment efficiency (individual retirement plans) or too short period of operation (employee capital plans, pl. pracownicze plany kapita›owe PPKs).

The nominal rates of return, that we used in analyses, where the simple rates of return obtained from the website analizy.pl.

For the analyzes of dependence for PFEs and DFEs we used the same variables. The variable sets differ only in terms of the values of nominal and real rates of return for PFEs and DFEs respectively. The variables were as follows (the source of data is provided in brackets at the end of each variable):

X_1 „ GDP growth (annual, in %) (World Bank),
X_2 „ household savings [2] (total amount of net saving as % of net household disposable income) (OECD),
X_3 „ old-age dependency ratio (% of working-age population) [3] (World Bank),
X_4 „ inflation (HICP) (Eurostat),
X_5 „ unemployment, total (% of total labor force) (modeled ILO estimate) [4] (World Bank),
$X_{6\ (nom)}$ „ nominal rate of return after charges, before inflation (Better Finance, M czy ska et al., 2021), or
$X_{6\ (real)}$ „ real rate of return (after charges and inflation) (Better Finance, M czy ska et al., 2021),
X_7 „ EMU convergence criterion series (annual data)[5] (Eurostat),

X_8 „ The Warsaw Stock Exchange General Index (WIG) rate of return, y/y (own calculations based on www.stooq.pl).

For PFEs, which are a form of employee pension programs (pl. pracownicze program emerytalne, PPEs), we collected and analyzed the data for the period 2002…2020. In the case of DFEs the period for the analyzes was shorter, i.e. 2013…2020 as 2013 was the first full year for operating of these funds. For the variable X_2 (household savings) the last available and analyzed year, both for PFEs and DFEs, was 2019 due to the lack of data for 2020.

In order to measure portfolio management performance for DFEs we used Sharpe's ratio (SR). The performance was calculated as the excess rates of return relative to the risk free rate, where risk adjustment was provided by the return's standard deviation as a denominator (σ_p) (Sharpe, 1964):

$$SR = \frac{R_p - R_f}{\sigma_p}$$

As Jajuga and Jajuga (2007) points out, the Sharpe ratio is used to assess portfolio management performance. The higher the value of the ratio, the higher the quality of portfolio management. The returns (R_p) from all (seven) voluntary pension funds functioning at the end of 2020 were their average nominal rates of return in the analysed period, i.e. years 2013…2020. The risk-free rate (R_f) were returns from EMU convergence criterion series bond yields. We excluded PFEs from this part of analysis due to the lack of data on investment portfolios of each PFE in the analysed period.

Results and discussion

According to the presented methodology, the results of Pearson's correlation for the first hypothesis are presented below. Firstly, with nominal and real rates of return with the other variables remaining constant for the employee pension funds (PFEs) (Table 1), and secondly, analogously for voluntary pension funds (DFEs) (Table 2).

We presented in one table results both for nominal and real rates of return as the results of Pearson's correlation between the remaining variables were exactly the same. This means, that the other macroeconomic variables depend (or not) on each other in the same way, regardless of which rate of return we analyze for PFEs and DFEs respectively.

Table 1. Correlation coefficient matrix with nominal and real rates of return of PFEs (2002…2020)

	X_1	X_2	X_3	X_4	X_5	$X_{6\ (nom)}$	$X_{6\ (real)}$	X_7	X_8
X_1	1.00	…0.20	…0.31	0.11	0.09	…0.14	…0.16	0.29	0.01
X_2	…0.20	1.00	…0.44	…0.02	0.71	0.40	0.40	0.53	0.42
X_3	…0.31	…0.44	1.00	…0.16	…0.75	…0.22	…0.19	…0.91	…0.27
X_4	0.11	…0.02	…0.16	1.00	…0.06	0.03	…0.19	0.36	…0.03
X_5	0.09	0.71	…0.75	…0.06	1.00	0.44	0.45	0.74	0.46
$X_{6\ (nom)}$	…0.14	0.40	…0.22	0.03	0.44	1.00	0,98	0.21	0.94
$X_{6\ (real)}$	…0.16	0.40	…0.19	…0.19	0.45	0,98	1.00	0.13	0.93
X_7	0.29	0.53	…0.91	0.36	0.74	0.21	0.13	1.00	0.21
X_8	0.01	0.42	…0.27	…0.03	0.46	0.94	0.93	0.21	1.00

Source: Own calculations (Statistica 13.3).

Table 2. Correlation coefficient matrix with nominal and real rates of return of DFEs (2013…2020)

	X_1	X_2	X_3	X_4	X_5	$X_{6\ (nom)}$	$X_{6\ (real)}$	X_7	X_8
X_1	1.00	…0.38	…0.21	…0.41	…0.05	…0.45	…0.40	0.46	0.02
X_2	…0.38	1.00	0.03	0.40	0.01	0.33	0.33	…0.26	0.47
X_3	…0.21	0.03	1.00	0.87	…0.96	…0.49	…0.58	…0.81	…0.15
X_4	…0.41	0.40	0.87	1.00	…0.77	…0.02	…0.13	…0.68	0.17
X_5	…0.05	0.01	…0.96	…0.77	1.00	0.62	0.70	0.70	0.09
$X_{6\ (nom)}$	…0.45	0.33	…0.49	…0.02	0.62	1.00	0,99	0.38	0.44
$X_{6\ (real)}$	…0.45	0.33	…0.58	…0.13	0.70	0,99	1.00	0.46	0.43
X_7	0.46	…0.26	…0.81	…0.68	0.70	0.38	0.46	1.00	0.37
X_8	0.02	0.47	…0.15	0.17	0.09	0.44	0.43	0.37	1.00

Source: Own calculations (Statistica 13.3).

The results of the correlation analyses conducted for PFEs showed, that in the analyzed years the nominal rates of return (X_6) were positively correlated only with the WIG rate of return (X_8). This correlation is very strong and indicates that, when annual average WIG rate of return increases, the higher is also efficiency of PFEs. This finding is partly consistent with another studies, that the investment policy of pension funds are under the influence of the performance of the stock market (Bikker et al., 2007).

Moreover, for the period 2002…2020 we observed statistically significant and positive correlations between the household savings (X_2) and unemployment rate (X_5). The higher is unemployment in the economy, the more savings the households have. It can be explained, that the increase in unemployment reduces the present consumption in order to accumulate precautionary savings (Mody et al., 2012). Besides, the higher EMU criteria (X_7) are, the higher are also households savings (X2). It is due to the fact, that implementation of this criteria is an important factor for the economic growth, when saving rates have a significant impact on this growth (Alper, 2018). But for the shorter period (2013…2020) the household savings were not correlated with other variables.

The analysis also showed that when the old age dependency ratio (X_3) increases, the unemployment rate (X_5) declines. This supports the findings of other studies that an aging population is an important factor influencing labour market conditions and resulting in shrinking labour force (Akanni & Èepar, 2015). Increase in old age dependency ratio is also negatively correlated with EMU convergence criterion series (X_7). With the aging of the population these criteria tend to be lower. Additionally, in the period 2013…2020 there is a positive correlation between the old-age dependency ratio and inflation (X_4). For the same years inflation tend to be higher with the higher interest rates for long-term government bonds (under the EMU convergence criteria) (X_7).

Unexpectedly, we did not find any dependency between GDP and neither nominal nor real rates of return.

In the next part of analysis we assessed the DFEs' portfolio management performance and calculated the Sharp's ratios. We found that they differ significantly between funds (Table 3).

The obtained results indicate that ING DFE managed the investment portfolio the best in the analyzed period. The Sharpe's ratios were at a similar level for Generali DFE and DFE PZU. Allianz Polska and DFE Pocztylion Plus were the worst funds with negative results, that proved rather weak competencies in asset management.

We also observed the general, almost linear, dependency between risk and rate of return, namely the higher the risk is, the higher the rate of return is (Figure 2). Thus, the second research hypothesis was verified positively.

The lowest risk was observed in DFE Pocztylion Plus and Allianz Polska DFE that had a high share of bonds in their investment portfolios. The highest investment risk characterized MetLife Amplico DFE, which had more than 45% share of stocks in its portfolio in almost all analysed period and achieved the second best investment result. The highest rate of return (above 14% annually) was recorded for ING DFE. The investment portfolio of this fund included a high share of stocks „ over 50% over the entire period analysed „ and a relatively low share of government bonds (particularly in 2016…2018).

Table 3. Rates of return, risk and Sharpe ratios for DFEs

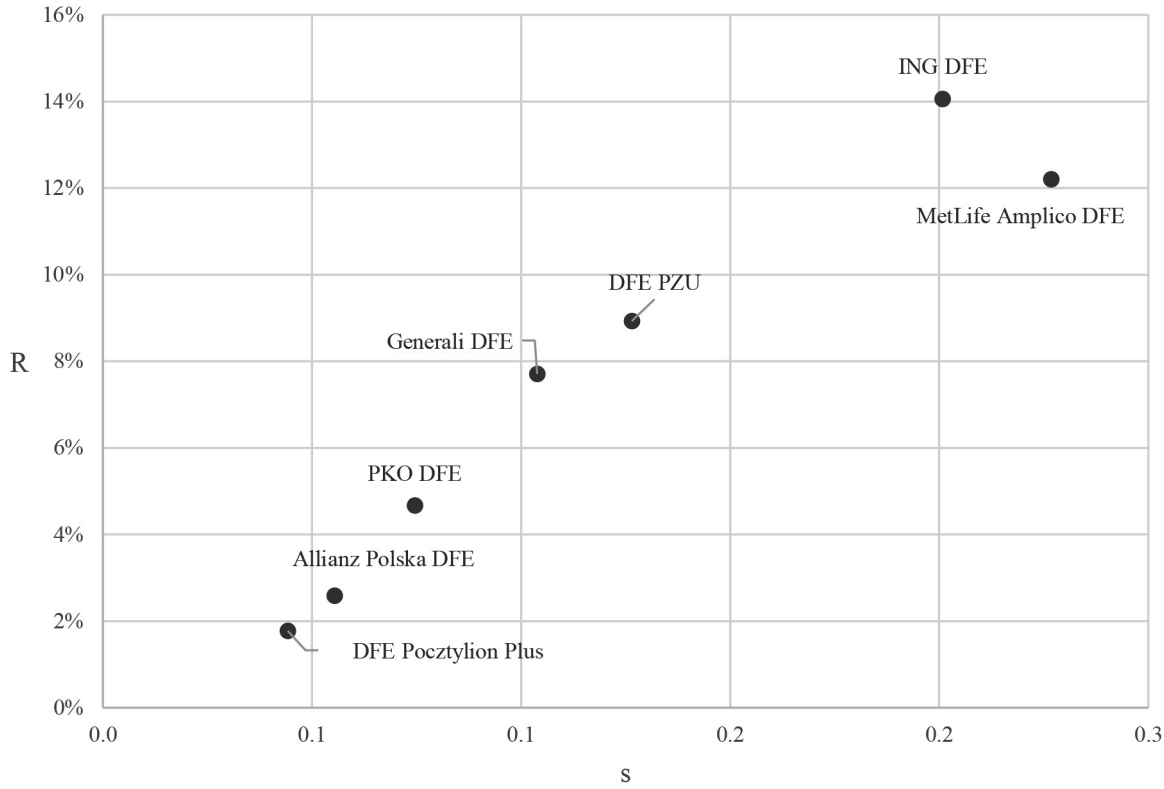
	Average rate of return (2013…2020)	The risk measured by the standard deviations of the rate of return	Sharpe's ratio
Allianz Polska DFE	0.0259	0.0554	…0.0691
DFE Pocztylion Plus	0.0178	0.0442	…0.2704
DFE PZU	0.0893	0.1265	0.4711
Generali DFE	0.0771	0.1038	0.4562
ING DFE	0.1406	0.2008	0.5522
MetLife Amplico DFE	0.1220	0.2267	0.4072
PKO DFE	0.0467	0.0746	0.2277

Source: Own calculations.

Conclusions

The effectiveness of old-age pension systems depends on its ability to provide adequate income in old age. The level of old-age benefits from supplementary pension schemes depends on a contributing period, amount of money paid, rates of return and fees charged by financial provider. Although the investment efficiency is a key factor of supplementary pensions adequacy, it is not assessed on a regular basis due to few problems. The first is the lack of access to data as a result of flawed

Figure 2. Risk*-return map of DFEs



* Risk is measured by the standard deviations of the rate of return.
Source: Authors' own study.

information policy (cf. Rutecka-Góra, 2021). Providers of supplementary pension plans do not inform individual savers about the rates of return achieved by funds as they are usually obliged to provide only regular information about the amount of contributions paid and the balance of the pension accounts. As a result, individuals face significant problems when they want to assess whether their supplementary pension plan is an effective tool for providing them with adequate income in old age. This is the key failure of information policy on the supplementary pension market.

There is also a huge deficit of information on efficiency of supplementary pension schemes provided by public institutions, including the Polish Financial Supervision Authority (pl. Komisja Nadzoru Finansowegǫ KNF). Public bodies generally disseminate data on the number of supplementary pension schemes, coverage and assets under management but deliver no complex report on efficiency and effectiveness of supplementary pension provision. This applies to both simply information on rates of return and the analysis of micro- and macroeconomic factors of supplementary pensions development.

Our study partially closes this gap. The results prove that employee pension funds and voluntary pension funds in Poland reported positive and relatively high rates of return in the analyzed periods. We found that there is a correlation between selected macroeconomic factors and both nominal and real rates of return of supplementary pension schemes in Poland. The investment efficiency of pension funds depends on the WIG rate of return for employee pension funds (PFEs) but not for voluntary pension funds (DFEs). Hence, the first research hypothesis was only partially confirmed. The more thorough analysis of investment portfolios of DFEs allowed us to verify positively the second research hypothesis. We found that the best investment outcomes resulted from both more aggressive investment policy and good competencies of asset managers. The voluntary pension fund that reported the highest investment profit achieved the highest risk-adjusted rate of return at the same time.

Our research results provide financial and public institutions and individual investors with the information how selected macroeconomic factors influence the performance of the supplementary pension schemes and how to assess the investment efficiency of these schemes given the macroeconomic situation and their portfolio selection. Moreover, the research findings are useful for social policy makers planning to modify investment regulations of pension funds to make the old-age security in Poland more adequate and effective.

Notes /Przypisy

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[1] An employee pension fund is a form of employee pension plans (pl. pracownicze programy emerytalne PPE).

[2] Net household saving is defined as the household net disposable income plus the adjustment for the change in pension entitlements less household final consumption expenditure (OECD, 2021).

[3] Age dependency ratio, old, is the ratio of older dependents (people older than 64) to the working-age population (aged 15…64). https://data.worldbank.org/indicator/SP.POP.DPND.OL

[4] Unemployment refers to the share of the labor force that is without work but available for and seeking employment. https://data.worldbank.org/indicator/SL.UEM.TOTL.ZS

[5] Relates to interest rates for long-term government bonds denominated in national currencies based on central government bond yi elds on the secondary market, gross of tax, with a residual maturity of around 10 years. https://ec.europa.eu/eurostat/cache/metadata/en/irt_lt_mcby_esms.htm

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Dr hab. Patrycja Kowalczyk-Rólczy ska prof. UEW, profesor Uniwersytetu Ekonomicznego we Wroc›awiu, pracuj ca w Katedrze Ubezpiecze . Jej badania naukowe koncentruj si na finansach gospodarstw domowych, systemie emerytalnym oraz equity release. Pe›ni funkcj redaktora w czasopismach: ŒFinancial ScienceŽ i ŒApplied Economics and FinanceŽ. Ponadto jest cz›onkiem Sekcji Klasyfikacji i Analizy Danych Polskiego Towarzystwa Statystycznego oraz European Network for Research on Supplementary Pensions.

Dr Sylwia Pie kowska-Kamieniecka, adiunkt w Katedrze Finansów na Uniwersytecie Warmi sko-Mazurskim w Olsztynie. W swoich badaniach koncentruje si w szczególno ci na systemach zabezpieczenia emerytalnego, dodatkowych programach emerytalnych, wp›ywie p›ci na zachowania finansowe, edukacji finansowej i wiadomo ci emerytalnej. Jest cz›onkiem European Network for Research on Supplementary Pensions, Stowarzyszenia Finansów i Rachunkowo ci na rzecz Zrównowa onego Rozwoju oraz Przewodnicz c Oddzia›u Pó›nocno-Wschodniego Polskiego Stowarzyszenia Ubezpieczenia Spo›ecznego. Wspó›pracuje naukowo równie z Netspar, Network for Studies on Pensions, Aging and Retirement.