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Investment efficiency of supplementary pension schemes vs macroeconomic factors*

Efektywność inwestycyjna dodatkowych planów emerytalnych a czynniki makroekonomiczne

Abstract
The adequacy of old-age pension systems depends on the efficiency of retirement plans offered to individuals. The purpose of this study was to identify which macroeconomic factors influence the investment efficiency of voluntary pension funds and employee pension funds in Poland. We verified whether there is any relationship between the rates of return of voluntary and employee pension funds and selected macroeconomic factors. We found that nominal and real rates of return of employee pension funds depend on the WIG rate of return. In case of voluntary pension funds higher nominal rates of return resulted from both more aggressive investment policy and better competencies of asset managers. The research findings are relevant for social policy as they provide useful information how to tailor investment policy of supplementary pension plans to better achieve the social and economic goals of the old-age pension system.

Keywords
investment efficiency, supplementary pension schemes, rate of return, macroeconomic factors, pension funds

Streszczenie
Adekwatność systemu emerytalnego zależy od efektywności planów emerytalnych, w których uczestniczą osoby indywidualne. W artykule zbadano, które czynniki makroekonomiczne miały wpływ na efektywność inwestycyjną dobrowolnych funduszy emerytalnych oraz pracowniczych funduszy emerytalnych w Polsce. Sprawdzono, czy istnieją zależności pomiędzy stopą zwrotu wymienionych planów a wybranymi wskaźnikami makroekonomicznymi. Ustalono, że nominalne i realne stopy zwrotu pracowniczych funduszy emerytalnych są dodatnio skorelowane z wartością indeksu WIG, a najwyższe nominalne stopy zwrotu osiągnęły dobrowolne fundusze emerytalne charakteryzujące się zarówno bardziej agresywnym portfelem inwestycyjnym, jak i lepszymi kompetencjami zarządzających. Wyniki analizy dostarczają cennych wniosków dla polityki społecznej w obszarze definiowania polityki inwestycyjnej planów emerytalnych, tak aby skuteczniej osiągać cele społeczne i ekonomiczne stawiane przed systemem emerytalnym.

Słowa kluczowe
efektywność inwestycyjna, dodatkowe plany emerytalne, stopa zwrotu, czynniki makroekonomiczne, fundusze emerytalne

JEL: E22, E60, J32, 016

Introduction

Adequacy of pension benefits and financial wellbeing in old age is the key aim of every old-age pension system (Szumlicz, 2010). Due to lowering replacement rates from the public pension systems, adequate income in old age depends increasingly on participation in supplementary pension schemes (Blake, 2000; Knoef, 2014; Rutecka-Góra, 2016; Ganapathy, 2021). Supplementary schemes take the form of individual or group plans, often supported by costly tax incentives (Banterle, 2002; Antón, 2007, OECD, 2018). Increasingly, there is also an obligation or quasi--obligation to participate and to accumulate capital for old age in such schemes, especially in countries where benefits from public pension systems are relatively low (Chen & Beetsma, 2015; Meerten & Schmidt, 2017).

The adequacy of benefits from supplementary pension schemes is determined by various factors. It does not depends solely, as it is most often perceived, on the level of participation and the amount of contributions made, or the length of the capital accumulation period. Equally important aspect is appropriate profitability of the solutions applied with investment efficiency being the key factor (Tapia, 2008; Rutecka-Góra, 2019; Brzęczek & Szczepankiewicz, 2016). It should be given a highest attention especially when tax incentives to join the schemes are offered or autoenrollment is used. In such a situation an individual has the right to expect that the proposed products are effective tools for raising adequate capital for old age. So the key question is the investment efficiency of such plans from individual savers' point of view. But the answer is rarely provided both by public bodies and financial providers.

The aims of the paper are: 1) to assess the investment efficiency of supplementary pension schemes in Poland and 2) to identify which macroeconomic factors influence the efficiency of voluntary pension funds (DFEs) and employee pension funds (PFEs) in Poland, expressed both in nominal and real rates of return. These are the original aspects of this paper. More broadly and indirectly, it also seeks the relationship between analyzed variables each other.

In this article we verified the following research hypotheses:

H1: There is a correlation between both GDP growth and WIG rate of return and rates of return of employee pension plans and voluntary pension funds in Poland.

H2: High rates of return of voluntary pension funds (DFEs) result from both portfolio structure and quality of asset management.

To achieve our research aims, we used the Pearson correlation coefficient and the Sharpe coefficient. In addition, we analyzed the statistical relationship between macroeconomic and efficiency variables (in nominal and real terms) separately for voluntary and employee pension funds. The scope of the research covers the years 2002–2020 for the employee pension funds and 2013–2020 for the voluntary pension funds.

Literature review

The efficiency of supplementary pension products should be considered at least in several aspects. The most important is the investment efficiency from the point of view of individuals who allocate their funds to supplementary pension products. Its simplest measures are nominal and real rates of return. A more complete dimension of the efficiency is the real rate of return after charges and taxation (Bikker & Dreu, 2009; Mączyńska et al., 2021).

Investment performance of pension funds depends on many factors. At the micro level it is the consequence of investment portfolio selection. At the macro level it depends on macroeconomic situation and as Hu (2005) found, there is also reciprocal positive effect of the performance of the funds on economic growth.

As reported by Hodgson, Breban, Ford, Streatfield and Urwin (2000), investment efficiency is a function of the risk, return and total cost of an investment management structure, subject to the fiduciary and other constraints within which investors must operate. Chorkowy states (2014) that assessment of investment effectiveness can be carried out taking into account the rate of return, the value of risk, the benchmark portfolios, the net asset value of portfolios and their structure and the fundamental analysis indicators. Tapia's (2008) analyses, on the other hand, show that the efficiency of pension funds depends on the type of the pension plan. He found that in the United States better investment results than defined benefit plans were achieved by defined contribution plans, although in the period of the stock market crisis they also registered results that were more negative.

Investment efficiency of funded pension systems depends also on its interaction with the economy. Macroeconomic conditions impact capital market development, namely investment behaviours of individuals and asset allocation of pension funds (Meng & Pfau, 2010). Serrano and Peltonen (2020) write that macroeconomic environment has been raising concern for the sustainability of pension systems and accumulation of savings in their voluntary part. They state that one of these macroeconomic factors is economic growth. When it is low in the longer time, investment returns are reduced.

Nalin (2013) points out that in investment decisions and portfolio choice cannot be omitted inflation, which increases the investments on capital market more than it does in other financial instruments beyond this market. There is also consensus that inflation affects stock market returns, however the direction of the relationship between these two factors in theoretical and empirical

studies is not so obvious. According to two basic concepts, expected asset returns reflect expected inflation (Fisher's theory) (Fisher, 1930; Ioromber et al., 2017), or the relationship between inflation and stock prices is negative (proxy hypothesis of Fama) (Fama, 1981; Grande et al., 1998). The results of Eldomiaty et al. (2020) study indicate that inflation rates are negatively associated with stock prices, but a significant positive relation was found in the study conducted by Titman and Warga (1989). Another research for the Western European countries proves that inflation rate directly affects also saving rates. With the increase of inflation rate increases also gross saving rate of households (Niculescu-Aron & Mihăescu, 2012). Generally, the households savings depend on many factors: economic, political, social, demographic and psychological (Bikas, 2008). The willingness to saving depends on financial performance of investment options. When investing for retirement, the rate of return should at least exceed the rate of inflation (Dash, 2010).

There are many research that focuses also on dependencies between demographic structure and the returns on investment (Poterba, 2001; DellaVigna & Pollet, 2007; Goyal, 2004). Some of them suggest that there is difficult to find strong relationship between asset returns and population age structure (Poterba, 2001). However, an aging population my lead to increase in risk aversion and to lower tendency to investing in equities (Gerber & Weber, 2007), which affects expected returns.

Due to the limited access to data, the analysis of investment efficiency of pension funds focuses usually on the schemes being a part of the public pension system. Supplementary pension vehicles are assessed relatively rarely (Rutecka-Góra, 2019; Rutecka-Góra et al., 2020; Pieńkowska-Kamieniecka et al., 2021). Witkowska (2016) assessed the investment efficiency of open pension funds in Poland and found that their investment portfolios were not adapted to the market situation described by market indices, among other, and pension fund managers had not created effective portfolios. Bikker (2013), in turns, points to administrative and cost issue, writing that the economies of scale achieved by large entities that specialize in asset management makes them relatively more efficient. But although they promise higher rates of return, they incur higher costs of market research in search for information relevant for their business, which increases their operating costs. Moreover, funds that manage large amounts of assets may react more slowly to changes in the market, especially when capital markets are stressed (Bauer, Cremers & Frehen, 2010; Bikker, 2013).

The efficiency of supplementary pension plans in European countries is assessed on regular basis by Better Finance (Šebo et al., 2019, Mączyńska et al., 2020; 2021). The situation of supplementary old-age pension plans in the countries of Central, Eastern, and Southern Europe (CESE) was also analysed in the study by Chłoń-Domińczak et al. (2020) and Rutecka-Góra (2021) who found that supplementary pension funds are usually characterized by a similar investment strategy to that used in mandatory pension funds, but the actual profitability of the former is significantly lower, mainly due to the higher level of costs charged. An exception to this are selected forms of supplementary pension plans in Poland, i.e. employee pension funds (pl. *pracownicze fundusze emerytalne*, PFEs)[1] and voluntary pension funds (pl. *dobrowolne fundusze emerytalne*, DFEs), which achieved average real rates of return that were much higher than those recorded in other selected CESE countries and amounted to 3.84% and 5.42% respectively. The average real rates of return achieved since the schemes inception until the end of 2018 by institutions that manage pension plans did not exceed 2% in most countries (except for Poland and Romania), which seems to be an unsatisfactory result, taking into account the several years of the analysis and the investment profile of the funds. The actual profitability of the pension products is even lower and, in many cases, negative, when the fees charged by the plan providers are taken into account. That poses a key question about the effectiveness of supplementary pension provision in the analysed countries and the adequacy of old-age pension benefits.

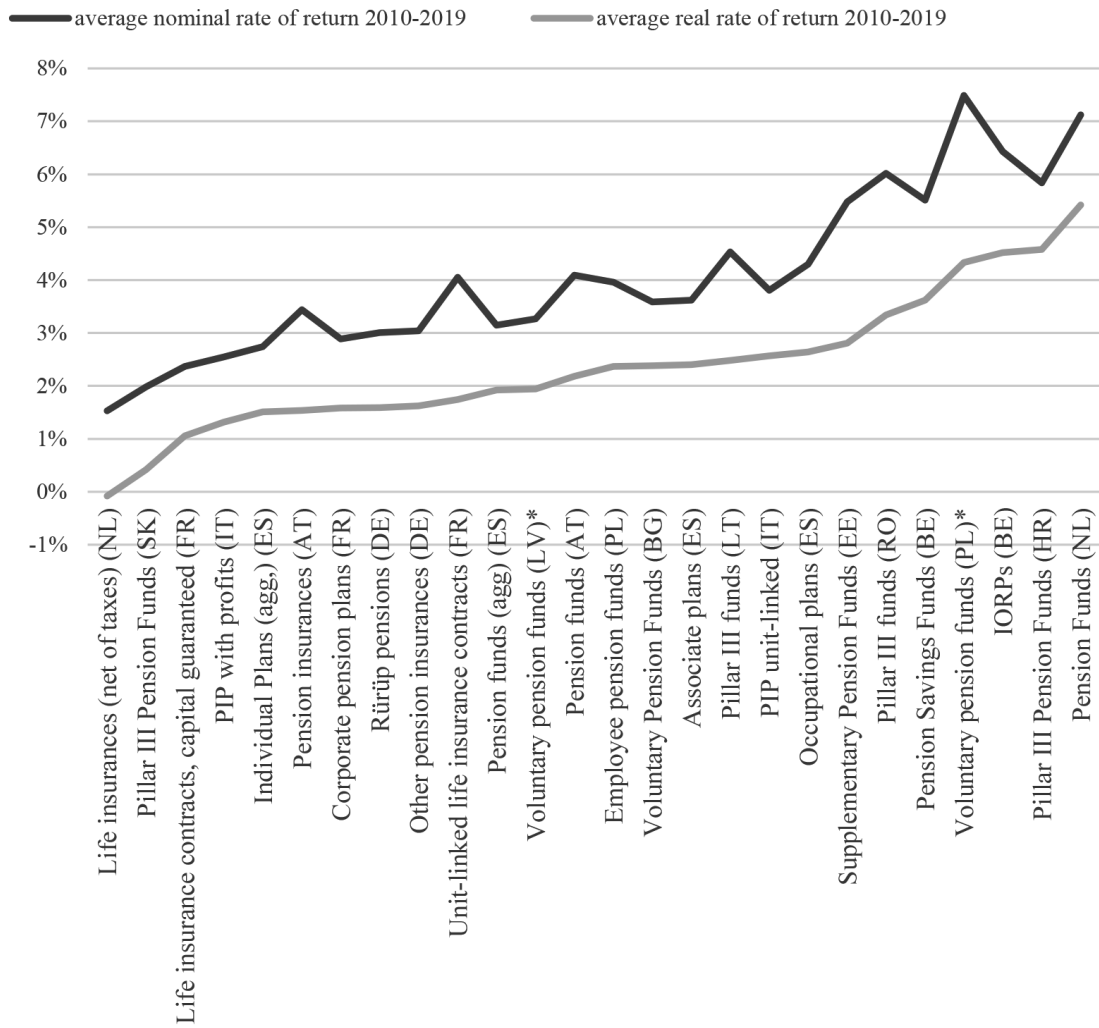
Rates of return of supplementary pension schemes offered in European countries differ a lot due to different investment strategies, portfolio limits, assets under management and macroeconomics conditions (Mączyńska et al., 2020). The average nominal rates of return for the period 2010–2019 ranged from 1.53% for life insurance contracts in the Netherlands to 7.12% for pension funds in the same country (see Figure 1). The highest rate that amounts to 7.49% was observed in Polish voluntary pension funds (DFEs) but the average was calculated in this case for a 7-year period so it is hardly comparable with the rates of other plans.

Average real rates of return for the 10-year period were positive in almost all analyzed supplementary pension plans except life insurance contracts in the Netherlands. On the other hand, Dutch supplementary pension funds recorded the highest real return. Polish employee pension funds and voluntary pension funds achieved relatively moderate and high results amounting to 2.37% and 4.33% in real terms.

Data and methods

In order to verify the first hypothesis assumed in the article, firstly, the Pearson correlation coefficients were calculated. Then, using the correlation coefficient significance test, it was checked which relationships between variables were statistically significant. We analyzed such relationships for employee pension funds

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 funds (PL) — 7 years (2013–2019).
Source: Authors' work based of Mączyńska 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 kapitałowe*, 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, Mączyńska et al., 2021), or
$X_{6\ (real)}$ — real rate of return (after charges and inflation) (Better Finance, Mączyńska 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

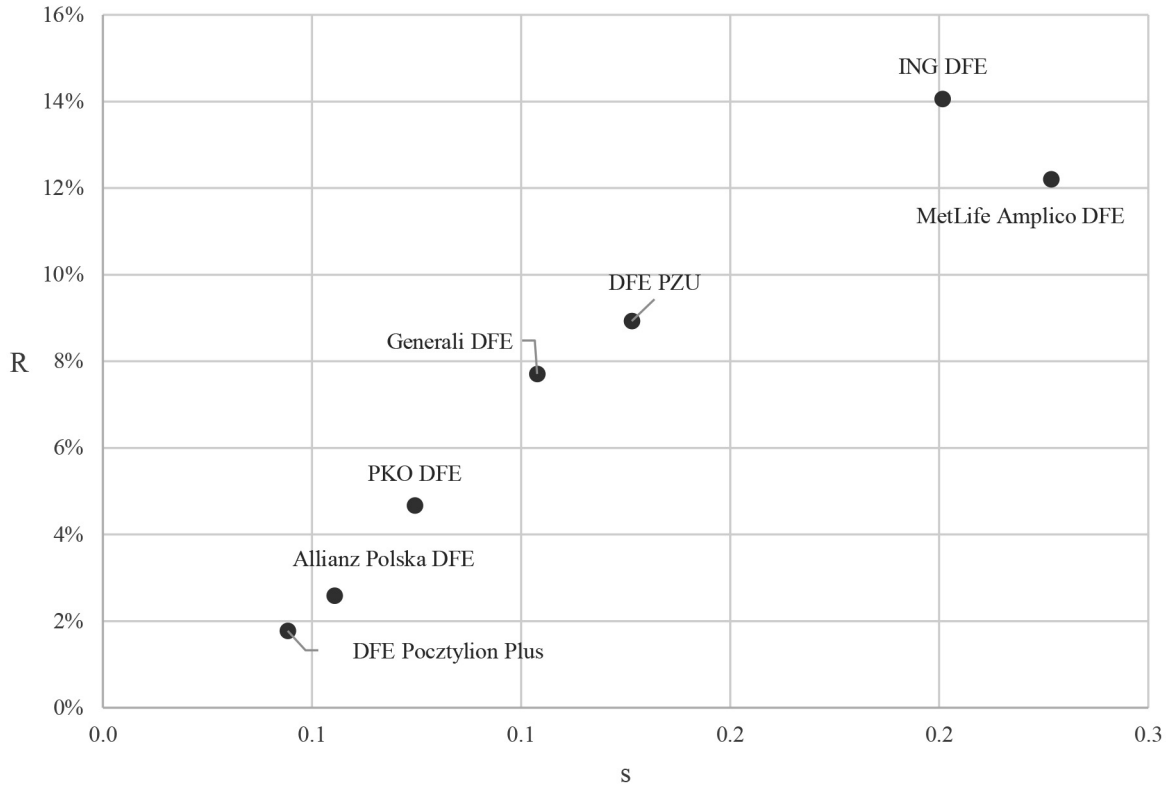
	Average rate of return (2013–2020)	The risk measured by the standard deviations of the rate of return	Sharpe's ratio
Allianz Polska DFE	0.0259	0.0554	–0.0691
DFE Pocztylion Plus	0.0178	0.0442	–0.2704
DFE PZU	0.0893	0.1265	0.4711
Generali DFE	0.0771	0.1038	0.4562
ING DFE	0.1406	0.2008	0.5522
MetLife Amplico 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 Finansowego*, 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 yields 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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