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OPEN-END DEBT INVESTMENT FUNDS AND BANK DEPOSITS IN POLAND 1995–2015. A COMPARISON OF THE A POSTERIORI PROBABILITY (CHANCE) OF FAILURE TO ACHIEVE THE LEVEL OF ASPIRATION[1]

DŁUŻNE OTWARTE FUNDUSZE INWESTYCYJNE ORAZ DEPOZYTY BANKOWE W POLSCE W LATACH 1995-2015. PORÓWNANIE *A POSTERIORI* PRAWDOPODOBIEŃSTWA (SZANS) NIEOSIĄGNIĘCIA POZIOMU ASPIRACJI

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Summary: The aim of the study was to compare, a posteriori, the probabilities (chances) of failure to achieve the level of aspiration (expressed in expected rates of return) on open-end debt investment funds (debt OEF), as well as the rates of return on bank deposits in Poland in light of different investment horizons. The data covered the periods of operation of each individual fund. The values for the probability of not achieving the level of aspiration (PNAL) have been calculated on the basis of empirical probability distributions of the rates of return on funds and bank deposits, obtained through the use of a rolling window of observation. Studies have shown the existence of a lower limit for the level of aspiration, the achievement of which is required in order for investment in a fund to be chosen over investment in a bank deposit. Based on research on the investment horizons which had, in the past, guaranteed the achievement of a given rate of return on a fund, both good and bad funds were identified. The results were largely influenced by the very high interest rate on bank deposits in Poland in the period 1995 – 2001 (in the case of the oldest funds) and by the boom on the Treasury bond market in 2011 – 2012 (for the youngest funds).

Keywords: personal finance, investment fund, bank deposit, comparative analysis.

Streszczenie: Celem pracy było porównanie *a posteriori* prawdopodobieństw (szans) nieosiągnięcia poziomu aspiracji (wyrażonych oczekiwanymi stopami zwrotu) z dłużnych otwartych funduszy inwestycyjnych oraz stóp zwrotu z depozytów bankowych w Polsce w różnych

[1] The paper was presented at *The 22nd International Forecasting Financial Markets Conference*, Rennes, France, May 20th–22nd, 2015.

horyzontach inwestycyjnych. Dane obejmowały okresy funkcjonowania poszczególnych funduszy. Wartości prawdopodobieństwa nieosiągnięcia poziomu aspiracji (PNAL) zostały obliczone na podstawie empirycznych rozkładów prawdopodobieństwa stóp zwrotu z funduszy i depozytów bankowych uzyskanych za pomocą ruchomego okna obserwacji. Badania wykazały istnienie granicznego poziomu aspiracji, którego osiągnięcie wymagało inwestycji w fundusz zamiast wyboru depozytu. Na podstawie badania horyzontów inwestycyjnych gwarantujących w przeszłości osiągnięcie danej stopy zwrotu z funduszu zidentyfikowano dobre i złe fundusze. Na uzyskane wyniki w dużym stopniu wpłynęło bardzo wysokie oprocentowanie depozytów bankowych w Polsce w latach 1995–2001 (w przypadku najstarszych funduszy) oraz hossa na rynku obligacji skarbowych w latach 2011–2012 (w przypadku najmłodszych funduszy).

Słowa kluczowe: finanse osobiste, fundusze inwestycyjne, depozyty bankowe, analiza porównawcza.

1. Introduction

As a result of the political changes taking place in the 1990s in Poland, Polish people gained access to various forms of investment on the financial market. Due to the pension reforms in Poland (see e.g. [Jędrasik-Jankowska 2001; Kowalczyk-Rólczyńska, Rólczyński 2014]), and to very low projected pension benefits, for the last ten years Poles have been encouraged to save and invest independently. A popular form of saving is in the form of bank deposits, while one of the ways to invest is investing in investment funds. The low financial barrier to entry and ease of transactions characterized by open-end investment funds were decisive in their selection in this article as an alternative to saving in the form of bank deposits. Debt OEF were chosen due to their relatively low investment risk. On the other hand, investors can expect investment risk premiums. The research presented in the paper refers to the Polish financial market.

The comparison between rates of return on different types of investments (mutual funds, stocks, bonds, real estate etc.) and the profitability of saving in the form of deposits is a frequent subject for articles published on financial portals (e.g. analizy.pl, bankier.pl, mojaprzyszlaemerytura.pl) and in economic newspapers (e.g. "Rzeczpospolita"). Comparative analyses on the rates of return on deposits and investment funds, however, are usually simplified. For example, the capitalization of interest in the case of the renewal of bank deposits with longer investment horizons is not taken into account, and account handling fees for funds are also not included. Research rarely involves longer-term horizons. The subject of funds rentability or funds' performance is often touched upon in scientific research (see e.g. [Zamojska 2015; Perez 2014; Jurek-Wasilewska 2014; Karkowska, Niewińska 2013; Karpio, Żebrowska-Suchodolska 2013; Jamróz 2013; Perez 2012a; Dawidowicz 2012; Zamojska 2012; Perez 2011; Kompa, Witkowska 2010; [Dawidowicz 2009; Zamojska 2008]). However, research is carried out usually in terms of the efficiency of fund management than from the point of view of the investor. In this paper the point of

view of the investor was adopted. Assumptions have been made which correspond more accurately to reality. To the author's best knowledge, thus far in scientific literature there have been no comparisons conducted utilizing the methodology which has been adopted in this paper.

The aim of the study was to obtain answers to the following three questions:

1) At what level of aspiration (expressed as an annual net rate of return) was the probability of not achieving this level greater for investments in debt OEFs than for savings held in an annual renewable bank deposit?

2) Were there differences in the values of the probabilities of failure to achieve the assigned level of aspiration in view of the different individual funds as well as the varied investment horizons?

3) For what time horizons for investment in a fund was the attainment of the desired level of aspiration found to be certain?

In the first section (point 2), saving in the form of bank deposits and investing in debt OEFs are compared in terms of the barriers to entry and the predictability of the rates of return, as well as the possibility of selecting, ex ante, the best offers on the market. In the second section (point 3), statistical data is described and a research methodology is selected. The third section (point 4) contains the results of the analysis conducted. The conclusions are presented in point 5.

2. Saving in deposits and investing in OEF

Saving in the form of bank deposits and investing in OEF should be compared in terms of barriers to entry and exit[2] (Table 1).

The first three barriers can be assessed as low. This is due to: 1) the relatively low minimum amounts required for both deposits and purchasing shares of investment; 2) the ease of purchase (shares) or opening (deposits); 3) the high availability of data which is necessary in order to analyze the profitability and risk of both options. One can consider higher barriers for entry for the OEFs to be both a lack of adequate knowledge of the OEF or about investing in general, as well as mental barriers such as: an aversion to novelty, the force of habit of saving in the form of deposits, the fear of loss, general laziness. The loss on equity, in the case of the funds, can be considered a high barrier to exit. In the case of deposits the "loss" is limited to the accrued interest.

It is worth noting the differences between the calculation and prediction of rates of return for saving in the form of bank deposits and investing in OEF (Table 2). Deposits are established for a specified length of time, and at their renewal there is the possibility of interest capitalization, there is no such possibility in the case of

[2] A description of the advantages and disadvantages of saving in deposits, investing in funds as well as a comparison between investing in funds and other forms of allocation of capital can also be found in Perez [2012b].

Table 1. Barriers to entry and exit

Barrier		Open-Ended Funds	Bank Deposit
To entry	Minimum payment	• initial minimum payment of PLN 100-200 • subsequent minimum payments of PLN 50	• Minimum payment of PLN 500 – 1000
	Channels of distribution	Possibility of purchase of shares: • via an intermediary, e.g. at a bank, • via Internet, telephone	Possibility of opening a deposit: • at a bank, • via Internet, telephone
	Availability of data for analysis of profitability and risk	Free, available on the Internet: • historical data concerning the rate of return in any given period, • independent rankings and ratings	Free, available on the Internet: • rankings (comparison websites)
	Necessary knowledge	Average (inter alia, on the functioning of open-ended investment funds, risks associated with the investment policies of open-ended investment funds)	Low (inter alia, on deposit guarantees, capitalization)
	Psychological	Aversion to novelty, passivity, fear of loss, laziness	Lack
To exit	The ability to exit at any time	Yes (however funds have seven days to redeem units)	Yes
	The possibility of incurring a nominal loss	Even a big loss is possible especially in the case of equity funds	Return on total capital invested, loss of interest in case of premature rupture deposit (usually).

Source: own elaboration.

Table 2. Differences between the calculations and forecasting of rate of return.

Criterium	Bank deposit	Open-ended funds
Capitalization of interest (compound interest)	**Yes**, e.g. annual. Very significant in the case of long term investments.	**Lack** of capitalization of interest.
Rate of return known a priori	**Yes**, in the case of fixed interest rate, no in the case of floating interest rates.	**No.** The rate of return is only known a posteriori.
Possibility of choice of the best, in terms of expected (future) rate of return of bank deposit or open-ended fund	**Yes** (comparison tools) in the case of deposits with fixed interest rates; partially, in the case of deposits with floating interest rates.	**No.** The choice of the best open-ended fund is made on the basis of historical data (and rankings created on its basis) and ratings taking into account qualitative features (e.g. management's experience).
Distribution fees (as lowering the rate of return)	**No** (possibly small monthly fees for account management – if having an account is obligatory).	**Yes**, as a percentage of the sum invested (lowers the invested sum). A lack of fees in the case of the purchase of shares via the Internet.

Source: own elaboration.

funds (excluding dividend funds). It should also be noted that when establishing a bank deposit, the rate of return is usually known in advance (i.e. in the case of a fixed interest rate). The rate of return on the investment when investing in a fund, however, is not known. For this reason we can usually choose, ex-ante, the best (in terms of interest rates) bank deposits available in the market, but cannot choose the best (in the sense of the future rate of return) fund.

3. Statistical data and research methodology

Currently in Poland there are 55 investment funds operating which invest in debt securities[3]. The most numerous group among these are the universal Polish funds (25). There are also11 Polish Treasury securities funds, 7 Polish corporate funds, 2 universal European funds, 2 global corporate funds, 2 USA universal funds, 2 other foreign funds, 2 other global funds, 1 universal global fund and 1 other Polish fund[4]. The study was planned to encompass the two most numerous groups – the universal Polish funds and the Polish Treasury securities funds. Among these, funds which had been in existence for less than five years were rejected. The final analysis was conducted for 20 funds: 14 universal Polish funds and 8 Polish Treasury Securities funds.

For each fund, data was collected on their quotations on the 29th day of each month throughout the research period (source: stooq.pl). The research period was different for each individual fund – the analysis included quotations from the month of establishment of the fund until February 2015. On the basis of these quotations, the net annual rate of return for each fund was calculated repeatedly (formula 1) using a rolling window of observation with an offset of one month. This window was equal to the investment horizon. By changing the length of the rolling observation window and repeating the procedure, empirical distributions of the rates of return for different investment horizons were obtained. The study adopted different lengths of investment horizons – from 1 year to 19 years, $h_{years} \in (1,2, ..., 19)$.

$$R_{OEF} = \frac{\left[\frac{Q_S}{Q_B} \times (1-P) - 1\right] \times (1-T)}{n} \times 100\%, \tag{1}$$

where: R_{OEF} – annual net rate of return for a fund, Q_S – quotation on the day of the sale of shares, Q_B – quotation on the day of the buy of shares, P – distribution fee rate (%), T – capital gains tax rate (%), n – investment horizon in years.

[3] State as on March 2015, based on [analizy.pl].

[4] The division made by the company Analizy Online S.A. (funds are divided into these groups according to the criterion of the structure of the asset classes in which the fund invests, which are specified in the information prospectus).

In the calculation of net rates of return, distribution fees were taken into account. The maximum rates were adopted for each fund according to the applicable prospectuses (as of February 2015). The rates calculated were net rates, i.e. taking into account the capital gains tax rate equal to 19% (from the point at which it began to be applicable in Poland). It was acknowledged that distribution fees reduce the amount invested and reduced the taxable base (see [Skrobosz 2014]).

In the case of deposits, the research time periods which were adopted corresponded to the periods of functioning of the individual funds. Among the deposits with different maturities offered by banks, annual deposits were selected. In order to ensure the comparability of the rates of return on funds and deposits, the study took into account the capitalization of interest (in the case of deposits) and the lack of capitalization (in the case of funds) for longer investment horizons. For this purpose, in the case of deposits, the rate of return including annual capitalization (with an assumed 1-year renewal of the deposit) over a given time period was calculated, and subsequently this figure was divided by the number of years to give the simple annual rate of return (formula 2).

$$R_D = \frac{(1+r_1)\times(1+r_2)\times\ldots\times(1+r_n)-1}{n}\times 100\% = \frac{\prod_{i=1}^{n}(1+r_i)-1}{n}\times 100\%, \qquad (2)$$

where: R_D – annual net rate of return for deposit, r_i – net (after tax) interest rate on 1-year deposit in the "i" year, n – investment horizon in years.

To calculate the rates of return on bank deposits for specific periods, monthly data from the National Bank of Poland regarding the average interest rate on 1-year deposits was applied [nbp.pl]. This interest rate was increased by 20%. On the basis of the preliminary analysis conducted, it was found that the establishment of a deposit with an annual interest rate surpassing the average annual interest rate by 20% was, and continues to be, possible. The investor, at the moment of investing, could select a deposit with one of the highest interest rates on the market. These interest rates were significantly higher than the average. Just as in the case of investment funds, the net annual rates of return on bank deposits were calculated repeatedly using a rolling observation window with an offset of one month. The window was, as in the case of funds, between 1 year and 19 years. Empirical distributions of the rates of returns on bank deposits were thus obtained.

The a posteriori probability of not achieving the aspiration level (PNAL) was used as a measure serving to compare the rates of return on a bank deposit and investment in a fund (formula 3). This is a measure of risk based on statistical distribution[5], in this case on the empirical distribution of the annual rates of return.

[5] PNAL is one of the measures of risk assuming the negative concept of risk (more in: [Jajuga (ed.) 2009]).

The comparison was made for different levels of aspiration (expressed as annual net rates of return), $R_{asp} \in$ (1%, 2% ..., 25%).

$$PNAL = P(R < R_{asp}), \tag{3}$$

where: P – probability, R – net annual rate of return (variable), R_{asp} – aspiration level (determined by the analyst).

4. The results of the study

The a posteriori values of the probability of not achieving the target level of aspiration, calculated for both bank deposits and investment funds[6] (presented for selected funds in Tables 3 – 6[7] and Figures 1 – 4[8]), made it possible to answer the research questions which had been formulated earlier.

The study found that in the past there existed a lower limit level of aspiration, expressed as an annual net rate of return, the achievement of which was required in order for investment in a fund to be chosen instead of selecting a bank deposit. This amounted to an annual net rate of return of $R = 5\%$. If the level of aspiration of the investor was at least 5%, the statistically better choice was the acquisition of units in the investment fund. However, if the aspiration level was below 4%, the better choice was the deposit.

In order to deepen the analysis, the funds were divided into four groups. The criteria adopted for the division were the date of creation of the fund as well as the type of fund (universal or Treasury Securities).

The first group included the funds which were set up at the earliest dates. This group includes three universal funds: Pioneer Obligacji Plus (1995[9]), Skarbiec Depozytowy (1998) and Investor Obligacji (1998). For these funds, the time frames for the calculated rates of return were the longest. The analysis conducted was therefore based on the largest number of observations. In the case of Inwestor Obligacji, the better choice was almost always found to be a deposit. In the case of Pioneer Obligacji Plus and Skarbiec Depozytowy, the selection of the funds was a better choice than that of a deposit (i.e. the PNAL calculated for the distribution of the rates of return on the funds was lower than that calculated for the distribution of the rates of return on deposits) only for the level of aspiration $R_{asp} = 5\%$ or 6% and, in the case of longer investment horizons, also for $R_{asp} = 7\%$, 8%. For other levels of aspiration, the choice of bank deposits was the statistically better decision. It should also be noted that the PNAL values calculated for higher levels of aspiration

[6] Due to the large number of funds studied in the article (20), all the tables (i.e. 20) containing PNALs values calculated for each fund are not presented – only four tables for the selected funds are included.

[7] Tables 4–7 are in the Appendix.

[8] Figures 1–4 are in the Appendix.

[9] Years of establishment are in brackets.

was usually very high, especially given the shorter investment horizons which were unlikely to allow for the attainment of high rates of return. Table 3 shows the PNALs for different R_{asp} and for various investment horizons for Pioneer Obligacje Plus (compared to the PNAL values for deposits). The PNAL values for this fund and for deposits at selected levels of aspiration are also shown in Figure 1.

The second group included four universal funds set up in 1999. These were: UniKorona Obligacje, Obligacje, PKO Obligacji, PZU Papierów Dłużnych POLONEZ and BPH Obligacji 1. In the case of this group the selection of a deposit was statistically superior for: 1) an investment horizon of 1 year to 6 – 8 years, with a concurrent low level of aspiration (maximum 4%); 2) high levels of aspiration (PNAL values, however, in this case were very high). Table 4 presents the PNAL values for different levels of aspiration R_{asp} and various investment horizons for PZU Papierów Dłużnych POLONEZ (compared with the PNAL values for deposits). Figure 2 shows the PNAL values for this fund as well as for deposits for the selected levels of aspiration.

The third group consists of three Treasury securities funds founded in 1999: ING Obligacji, Legg Mason Obligacji, and Skarbiec Obligacja Instrumentów Dłużnych. In the case of this group, the choice of a bank deposit was generally better than choosing a fund, however for higher levels of aspiration the likelihood of not achieving that level was high. Table 5 shows the PNAL values for different R_{asp} and for various investment horizons for Legg Mason Obligacji (compared with the PNAL values for deposits). Figure 3 shows the PNAL values for this fund and for deposits for selected levels of aspiration.

The fourth group (the youngest) consists of funds established between 2001 and 2007. These are the funds with the shortest series of rates of return. Their analyses were based on the smallest number of observations. The group includes seven universal funds: KBC Papierów Dłużnych (2001), Novo Papierów Dłużnych (2003), BPH Obligacji 2 (2005), PKO Obligacji Długoterminowych (2005), Opera Avista.pl (2007), PKO Papierów Dłużnych Plus (2007), SKOK Obligacji (2007) and three Treasury securities funds: Arka BZ WBK Obligacji Skarbowych (2002), Aviva Investors Obligacji (2002), MetLife Obligacji Skarbowych (2004). For six funds from this group (Arka BZ WBK Obligacji Skarbowych, SKOK Obligacji, PKO Papierów Dłużnych Plus, PKO Obligacji Długoterminowych, Opera Avista.pl, MetLife Obligacji Skarbowych), the choice of a deposit turned out to be statistically better only for shorter investment horizons (usually 1 – 2 years, exceptionally 3 years) with a simultaneous low level of aspiration (maximum 4%). For other funds, the selection of a deposit was also found to be better for longer investment horizons (from 1 year to 5 – 6 years, in the case of Novo Papierów Dłużnych even up to 11 years) and low levels of aspiration (maximum 4%). Table 6 depicts the PNAL values for different R_{asp} and for various investment horizons for Arka BZ WBK Obligacji Skarbowych (compared with the PNAL values for deposits). Figure 4 shows the PNAL values for this fund and for deposits at selected levels of aspiration.

Table 3. The shortest investment horizons (in years) for which the achievement of different levels of aspiration (net return per annum) was certain

Year of est.	Group*	Fund	Net annual rate of return (%)															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1999	T	ING Obligacji	4	4	7	9	12	13	14	14	16	–	–	–	–	–	–	–
1999	T	Skarbiec Obligacja Instrumentów Dłużnych	4	7	9	11	13	14	14	15	–	–	–	–	–	–	–	–
1999	T	Legg Mason Obligacji	4	4	7	11	13	14	14	15	16	–	–	–	–	–	–	–
2002	T	Arka BZ WBK Obligacji Skarbowych	2	2	3	4	7	10	–	–	–	–	–	–	–	–	–	–
2002	T	Aviva Investors Obligacji	2	4	6	7	9	12	–	–	–	–	–	–	–	–	–	–
2004	T	MetLife Obligacji Skarbowych	2	4	4	5	6	9	10	–	–	–	–	–	–	–	–	–
1995	U	Pioneer Obligacji Plus	2	3	4	7	10	13	14	15	16	17	17	18	18	19	19	19
1998	U	Skarbiec Depozytowy	2	2	4	7	9	12	14	15	–	–	–	–	–	–	–	–
1998	U	Investor Obligacji	3	7	10	13	14	15	16	17	17	–	–	–	–	–	–	–
1999	U	BPH Obligacji 1	2	4	6	7	8	13	14	15	–	–	–	–	–	–	–	–
1999	U	PKO Obligacji	4	6	7	9	13	14	14	15	15	–	–	–	–	–	–	–
1999	U	PZU Papierów Dłużnych POLONEZ	2	4	6	9	9	12	13	14	14	15	–	–	–	–	–	–
1999	U	UniKorona Obligacje	3	4	6	7	7	10	13	13	14	14	15	–	–	–	–	–
2001	U	KBC Papierów Dłużnych	2	4	5	7	10	12	13	–	–	–	–	–	–	–	–	–
2003	U	Novo Papierów Dłużnych	6	8	10	–	–	–	–	–	–	–	–	–	–	–	–	–
2005	U	BPH Obligacji 2	4	4	5	6	6	9	–	–	–	–	–	–	–	–	–	–
2005	U	PKO Obligacji Długoterminowych	2	2	3	3	5	6	7	9	–	–	–	–	–	–	–	–
2007	U	Opera Avista.pl	2	2	3	3	5	7	8	–	–	–	–	–	–	–	–	–
2007	U	PKO Papierów Dłużnych Plus	2	3	3	3	3	5	7	–	–	–	–	–	–	–	–	–
2007	U	SKOK Obligacji	2	2	3	5	5	6	7	–	–	–	–	–	–	–	–	–

* T – Treasury securities fund, U – universal fund.

Source: own elaboration.

Because bank deposit interest rates are usually fixed, when opening a bank deposit we are usually assured of getting a certain specified rate of return. In the case of investing in investment funds, the investor does not know what the outcome of the investment will be. On the basis of the previously determined empirical distributions, in the past the shortest investment horizons (in years) granting certainty (PNAL < 0) of achieving different levels of aspiration (net annual rate of return) were calculated. The results are shown in Table 3.

It is worth noting the existing diversity of the funds. Both in the case of Treasury securities funds and universal funds, the relationship between the date of the establishment of the fund (and thus also the length of time covered by the research) and the horizons which guaranteed a specified rate of return in the past is apparent. Treasury securities funds which had been functioning for a long time were characterized by a longer time horizon which had guaranteed a certain rate of return in the past. For the level of aspiration R_{asp} = 1%, this horizon consisted of two years for the OEFs created between 2002 – 2004, and of four years for the OEFs created earlier. The situation was found to be similar in the case of higher levels of aspiration. In the case of universal funds, the four youngest funds (PKO Obligacji Długoterminowych, Opera Avista.pl, PKO Papierów Dłużnych Plus, and SKOK Obligacji), were characterized by the shortest investment horizons for every level of aspiration (especially for higher R_{asp}). An analysis of the time horizons which guaranteed a certain rate of return in the past can furthermore allow for an identification of the better and worse funds. Novo Papierów Dłużnych and Investor Obligacji belonged to the weaker group. The horizons calculated to guarantee a certain rate of return for these funds are clearly longer than the horizons calculated for the remaining funds. More favorable (excluding the funds with the shortest history of rates of return) were UniKorona Obligacje as well as Skarbiec Depozytowy.

5. Conclusions

This study has enabled obtaining answers to questions about the attractiveness of investing in shares of open-ended debt investment funds, compared to saving in bank deposits, in the past in Poland. The study found that if the level of aspiration of the investor was at least 5% net per year, the statistically better choice was the acquisition of units in a fund. Conversely, if the aspiration level did not exceed 4% net per year, the better choice was the deposit. A deeper analysis allowed for the division of the funds into four groups. The criteria adopted for the division of the funds were the creation date of the fund and the type of fund (universal or Treasury securities). Individual groups were characterized by distinct comparative analysis results. Based on research into the investment horizons which had guaranteed the achievement of a given rate of return on the funds in the past, it was concluded that there were differences between the various funds, and both good and bad funds could be identified.

It is worth recalling that in this study on the rates of return, different research time periods for the individual funds were adopted. Therefore any conclusions obtained from the results should be drawn cautiously, keeping in mind the different lengths of time adopted in the analysis. In particular, it should be emphasized that a portion of the results were largely influenced by the very high interest rates on bank deposits in the period 1995–2001. This was significant in the case of the comparative analysis conducted on the rates of return on funds and deposits for the funds established in the period 1995–1999. These analyses often point to the superiority of deposit over fund. In contrast, the analyses conducted for younger funds were influenced largely by the boom in the Treasury bond market between 2011–2012.

The importance of the structural changes which occur during a series of rates of return on financial instruments on the selection of the appropriate time frame for the research period for the needs of modeling and forecasting was been indicated by M. Doman and R. Doman [Doman, Doman 2009]. A. Zamojska also highlights the lack of theories defining the optimal length of the research period in the case of financial markets, and the attendant implications [Zamojska 2012]. According to J. Marcinkowski, even in the case of very long investment horizons, the rate of return which is realized can greatly differ from the rate of return which had been estimated on the basis of historical data covering decades [Marcinkowski 2009].

APPENDIX

Table 4. PNALs calculated for Pioneer Obligacji Plus and bank deposit (note that dark grey fields mean that PNAL calculated for deposit was lower than PNAL calculated for the fund, grey fields mean the opposite)

Investment horizon (in years)	Number of observation	PNAL	(NET ANNUAL) ASPIRATION LEVEL																										
			0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%
1	225	fund	0.09	0.12	0.21	0.32	0.44	0.51	0.57	0.60	0.63	0.72	0.79	0.81	0.82	0.83	0.83	0.84	0.88	0.92	0.96	0.98	1	1	1	1	1	1
		deposit	0	0	0	0.05	0.29	0.55	0.61	0.64	0.65	0.65	0.65	0.65	0.66	0.68	0.72	0.72	0.75	0.78	0.80	0.82	0.82	0.82	0.83	0.89	0.94	0.96
2	213	fund	0	0	0.02	0.20	0.32	0.49	0.63	0.64	0.64	0.65	0.72	0.79	0.80	0.82	0.83	0.85	0.85	0.86	0.87	0.91	0.98	1	1	1	1	1
		deposit	0	0	0	0	0.22	0.57	0.62	0.63	0.63	0.64	0.65	0.66	0.67	0.68	0.69	0.69	0.71	0.76	0.79	0.82	0.85	0.85	0.85	0.86	0.86	0.88
3	201	fund	0	0	0	0.03	0.23	0.44	0.64	0.67	0.68	0.68	0.72	0.78	0.78	0.80	0.82	0.84	0.86	0.87	0.89	0.92	0.93	0.95	0.96	1	1	1
		deposit	0	0	0	0	0.19	0.56	0.61	0.62	0.63	0.64	0.65	0.67	0.67	0.69	0.70	0.71	0.73	0.76	0.78	0.79	0.80	0.83	0.85	0.86	0.90	0.91
4	189	fund	0	0	0	0	0.13	0.43	0.56	0.65	0.70	0.72	0.74	0.77	0.80	0.83	0.83	0.83	0.83	0.86	0.89	0.92	0.94	0.96	0.97	0.98	0.99	1
		deposit	0	0	0	0	0.09	0.55	0.59	0.59	0.62	0.63	0.65	0.67	0.68	0.70	0.72	0.74	0.76	0.77	0.78	0.78	0.78	0.80	0.81	0.83	0.84	0.88
5	177	fund	0	0	0	0	0.05	0.33	0.55	0.60	0.68	0.76	0.77	0.77	0.79	0.80	0.82	0.87	0.88	0.88	0.88	0.89	0.93	0.95	0.97	0.98	1	1
		deposit	0	0	0	0	0.05	0.51	0.56	0.59	0.60	0.63	0.63	0.66	0.69	0.72	0.74	0.75	0.76	0.76	0.78	0.79	0.80	0.82	0.82	0.83	0.84	0.85
6	165	fund	0	0	0	0	0.04	0.24	0.53	0.59	0.64	0.72	0.78	0.79	0.81	0.82	0.83	0.84	0.88	0.93	0.95	0.95	0.95	0.95	0.95	0.98	1	1
		deposit	0	0	0	0	0	0.49	0.53	0.56	0.59	0.60	0.64	0.66	0.70	0.72	0.74	0.75	0.76	0.77	0.78	0.81	0.81	0.82	0.82	0.84	0.85	0.87
7	153	fund	0	0	0	0	0	0.17	0.52	0.58	0.63	0.70	0.73	0.76	0.82	0.84	0.88	0.89	0.90	0.91	0.93	0.95	0.99	1	1	1	1	1
		deposit	0	0	0	0	0	0.46	0.50	0.54	0.57	0.60	0.62	0.67	0.70	0.71	0.73	0.73	0.76	0.78	0.80	0.80	0.81	0.83	0.84	0.87	0.88	0.88
8	141	fund	0	0	0	0	0	0.13	0.38	0.56	0.63	0.70	0.73	0.75	0.79	0.81	0.88	0.91	0.93	0.96	0.96	0.97	0.99	1	1	1	1	1
		deposit	0	0	0	0	0	0.39	0.45	0.50	0.53	0.58	0.62	0.67	0.69	0.70	0.71	0.74	0.76	0.77	0.79	0.79	0.82	0.84	0.86	0.87	0.88	0.90
9	129	fund	0	0	0	0	0	0.03	0.30	0.45	0.62	0.67	0.71	0.74	0.78	0.81	0.85	0.88	0.92	0.96	0.99	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.27	0.40	0.46	0.49	0.55	0.62	0.65	0.67	0.68	0.71	0.74	0.75	0.77	0.78	0.81	0.83	0.84	0.86	0.86	0.891	0.899
10	117	fund	0	0	0	0	0	0	0.26	0.41	0.50	0.65	0.69	0.74	0.77	0.81	0.85	0.90	0.91	0.95	0.97	0.99	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.15	0.33	0.40	0.44	0.50	0.58	0.62	0.64	0.68	0.70	0.73	0.74	0.75	0.79	0.81	0.83	0.85	0.85	0.88	0.90	0.91

11	105	fund	0	0	0	0	0	0	0.16	0.28	0.47	0.59	0.66	0.72	0.77	0.80	0.86	0.90	0.92	0.96	0.99	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.09	0.26	0.33	0.37	0.45	0.53	0.58	0.60	0.64	0.68	0.70	0.71	0.76	0.79	0.81	0.83	0.84	0.87	0.89	0.90	0.92
12	93	fund	0	0	0	0	0	0	0.09	0.19	0.30	0.53	0.58	0.62	0.70	0.82	0.86	0.89	0.92	0.97	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.01	0.16	0.25	0.29	0.38	0.47	0.53	0.55	0.59	0.63	0.67	0.68	0.73	0.76	0.80	0.82	0.85	0.87	0.89	0.91	0.92
13	81	fund	0	0	0	0	0	0	0	0.09	0.22	0.41	0.51	0.60	0.64	0.70	0.80	0.89	0.94	0.99	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0.04	0.14	0.19	0.28	0.41	0.46	0.48	0.54	0.58	0.62	0.64	0.70	0.75	0.77	0.80	0.84	0.88	0.90	0.91	0.93
14	69	fund	0	0	0	0	0	0	0	0	0.14	0.29	0.39	0.48	0.58	0.68	0.74	0.83	0.90	0.94	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0	0	0.04	0.16	0.29	0.38	0.39	0.46	0.54	0.55	0.61	0.68	0.71	0.72	0.78	0.81	0.86	0.88	0.90	0.91
15	57	fund	0	0	0	0	0	0	0	0	0	0.23	0.30	0.35	0.44	0.56	0.68	0.79	0.86	0.91	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0	0	0	0.02	0.19	0.25	0.26	0.35	0.44	0.47	0.54	0.61	0.67	0.68	0.75	0.77	0.82	0.86	0.88	0.89
16	45	fund	0	0	0	0	0	0	0	0	0	0	0.11	0.27	0.33	0.44	0.53	0.69	0.78	0.89	0.96	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0	0	0	0	0.02	0.07	0.18	0.29	0.31	0.42	0.51	0.58	0.6	0.69	0.73	0.82	0.84	0.84	0.89	0.96
17	33	fund	0	0	0	0	0	0	0	0	0	0	0	0	0.09	0.30	0.45	0.58	0.64	0.76	0.91	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0.09	0.18	0.33	0.42	0.45	0.58	0.70	0.76	0.79	0.82	0.85	0.94
18	21	fund	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.14	0.43	0.62	0.76	0.86	0.95	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.10	0.14	0.33	0.52	0.62	0.67	0.71	0.76	0.90
19	9	fund	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0.78	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.11	0.22	0.33	0.44	0.78

Source: own calculations.

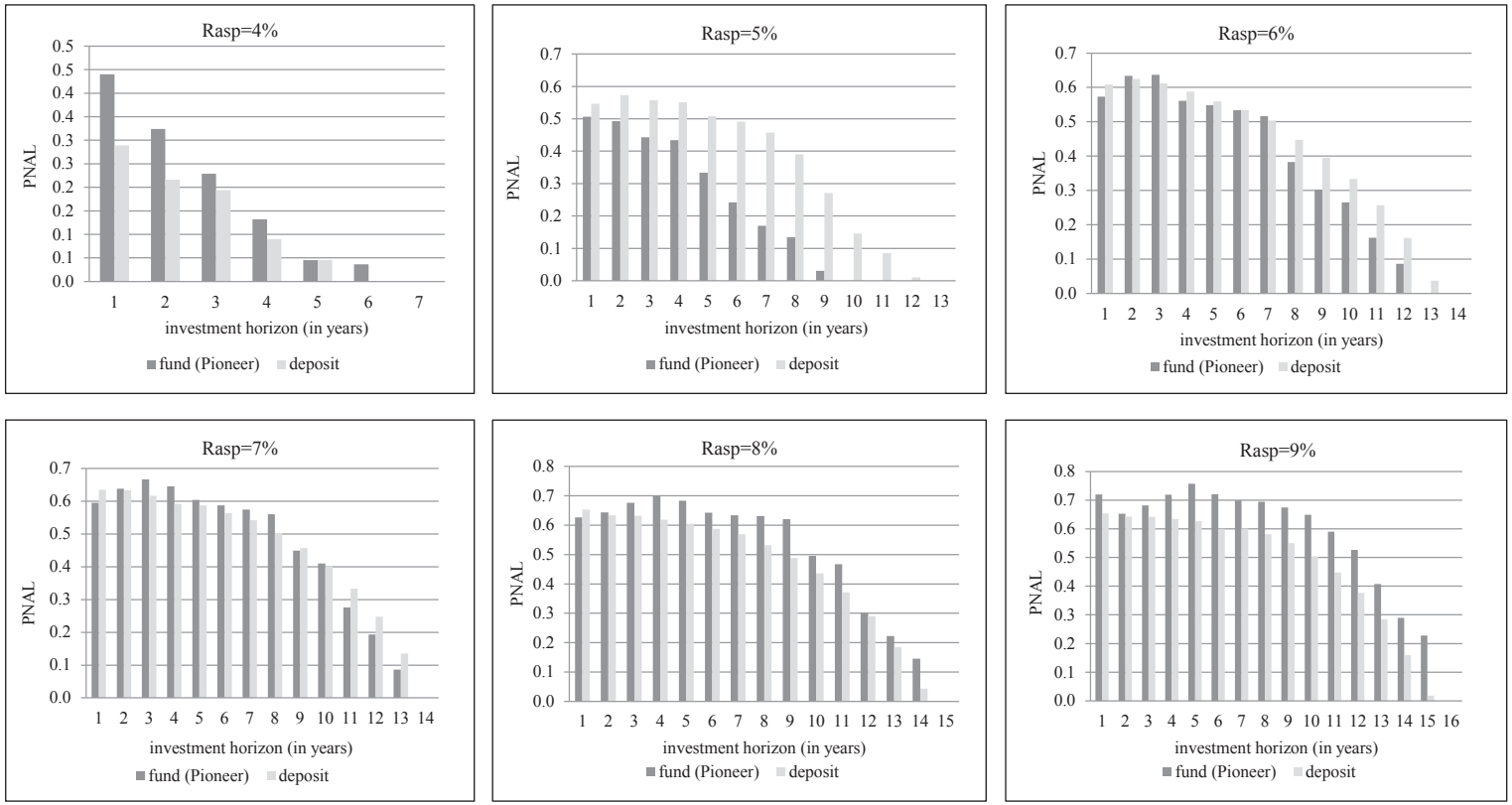

Figure 1. PNALs calculated for selected aspiration levels for Pioneer Obligacji Plus and bank deposit

Source: own elaboration.

Table 5. PNALs calculated for PZU Papierów Dłużnych POLONEZ and bank deposit

Investment horizon (in years)	Number of observation	PNAL	(net annual) ASPIRATION LEVEL																				
			0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	173	fund	0.03	0.13	0.23	0.33	0.40	0.49	0.57	0.62	0.66	0.71	0.77	0.79	0.84	0.90	0.91	0.97	0.99	1	1	1	1
		deposit	0	0	0	0.06	0.38	0.71	0.79	0.83	0.85	0.85	0.85	0.85	0.86	0.87	0.89	0.89	0.92	0.96	0.98	1	1
2	161	fund	0	0	0.09	0.17	0.34	0.45	0.63	0.74	0.78	0.80	0.81	0.84	0.86	0.89	0.97	0.98	0.98	0.99	1	1	1
		deposit	0	0	0	0	0.29	0.76	0.83	0.84	0.84	0.85	0.86	0.87	0.89	0.90	0.91	0.91	0.93	0.95	0.98	1	1
3	149	fund	0	0	0.02	0.11	0.30	0.46	0.51	0.66	0.80	0.87	0.89	0.91	0.92	0.93	0.95	1	1	1	1	1	1
		deposit	0	0	0	0	0.26	0.75	0.83	0.83	0.85	0.87	0.88	0.906	0.91	0.93	0.94	0.96	0.99	1	1	1	1
4	137	fund	0	0	0	0.08	0.30	0.45	0.50	0.67	0.80	0.85	0.93	0.95	0.99	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0.12	0.76	0.81	0.82	0.85	0.88	0.90	0.93	0.94	0.96	0.99	1	1	1	1	1	1
5	125	fund	0	0	0	0.05	0.26	0.45	0.54	0.69	0.83	0.86	0.90	0.99	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0.06	0.72	0.79	0.83	0.86	0.89	0.89	0.94	0.98	1	1	1	1	1	1	1	1
6t	113	fund	0	0	0	0	0.18	0.43	0.55	0.77	0.84	0.90	0.93	0.98	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.72	0.78	0.82	0.86	0.88	0.93	0.96	1	1	1	1	1	1	1	1	1
7	101	fund	0	0	0	0	0.09	0.29	0.62	0.80	0.87	0.91	0.96	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.69	0.76	0.82	0.86	0.91	0.94	1	1	1	1	1	1	1	1	1	1
8	89	fund	0	0	0	0	0.08	0.18	0.53	0.80	0.90	0.96	1	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.62	0.71	0.80	0.84	0.92	0.98	1	1	1	1	1	1	1	1	1	1
9	77	fund	0	0	0	0	0	0	0.43	0.75	0.86	0.95	1	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.45	0.66	0.77	0.82	0.92	1	1	1	1	1	1	1	1	1	1	1
10	65	fund	0	0	0	0	0	0	0.11	0.77	0.83	0.98	1	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.26	0.60	0.72	0.78	0.91	1	1	1	1	1	1	1	1	1	1	1
11	53	fund	0	0	0	0	0	0	0.13	0.36	0.64	1	1	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.17	0.51	0.66	0.74	0.89	1	1	1	1	1	1	1	1	1	1	1
12	41	fund	0	0	0	0	0	0	0	0.17	0.44	0.56	1	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.02	0.37	0.56	0.66	0.85	1	1	1	1	1	1	1	1	1	1	1
13	29	fund	0	0	0	0	0	0	0	0	0.07	0.52	0.69	0.97	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0.10	0.38	0.52	0.79	1	1	1	1	1	1	1	1	1	1	1
14	17	fund	0	0	0	0	0	0	0	0	0	0	0.41	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0	0	0.18	0.65	1	1	1	1	1	1	1	1	1	1	1
15	5	fund	0	0	0	0	0	0	0	0	0	0	0	0.2	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0	0	0	0.20	1	1	1	1	1	1	1	1	1	1	1

Source: own calculations.

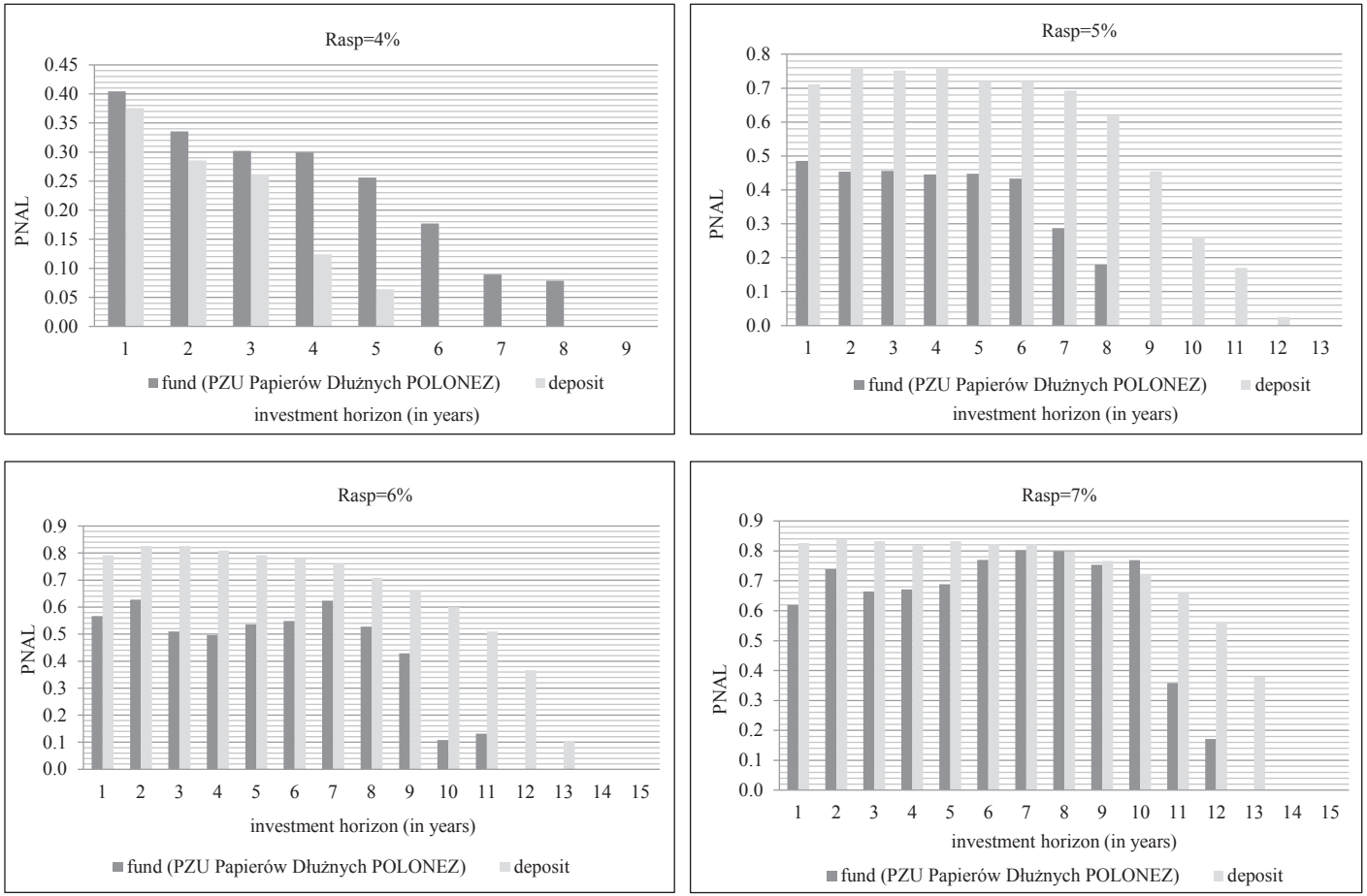

Figure 2. PNALs calculated for selected aspiration levels for PZU Papierów Dłużnych POLONEZ and bank deposit

Source: own elaboration.

Table 6. PNALs calculated for Legg Mason Obligacji and bank deposit

Investment horizon (in years)	Number of observation	PNAL	(annual net) ASPIRATION LEVEL																			
			0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%
1	182	fund	0.13	0.18	0.34	0.41	0.50	0.58	0.65	0.70	0.77	0.813	0.85	0.88	0.91	0.93	0.96	0.99	1	1	1	1
		deposit	0	0	0	0.06	0.36	0.68	0.75	0.79	0.81	0.808	0.81	0.81	0.82	0.84	0.89	0.90	0.93	0.96	1	1
2	170	fund	0	0.04	0.12	0.24	0.54	0.71	0.76	0.79	0.80	0.81	0.82	0.85	0.86	0.96	0.976471	0.976471	0.994118	1		1
		deposit	0	0	0	0	0.27	0.72	0.78	0.79	0.79	0.81	0.82	0.82	0.84	0.85	0.86	0.86	0.89	0.95	0.98	1
3	158	fund	0	0.01	0.07	0.20	0.47	0.65	0.785	0.80	0.83	0.85	0.86	0.87	0.91	0.97	0.987342	1	1	1	1	1
		deposit	0	0	0	0	0.25	0.71	0.778	0.78	0.80	0.82	0.83	0.85	0.85	0.87	0.89	0.91	0.93	0.96	0.99	1
4	146	fund	0	0	0	0.21	0.50	0.66	0.76	0.77	0.83	0.88	0.89	0.93	0.958904	1	1	1	1	1	1	1
		deposit	0	0	0	0	0.12	0.71	0.76	0.77	0.80	0.82	0.84	0.87	0.88	0.90	0.93	0.96	0.98	0.99	1	1
5	134	fund	0	0	0	0.13	0.46	0.65	0.75	0.79	0.83	0.84	0.96	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0.06	0.67	0.74	0.78	0.80	0.83	0.83	0.87	0.92	0.96	0.98	0.99	1	1	1	1
6	122	fund	0	0	0	0.08	0.38	0.69	0.75	0.80	0.84	0.87	0.93	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.66	0.72	0.76	0.80	0.81	0.86	0.89	0.95	0.98	1	1	1	1	1	1
7	110	fund	0	0	0	0	0.43	0.66	0.76	0.80	0.85	0.95	1.00	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.64	0.70	0.75	0.79	0.84	0.86	0.93	0.97	0.99	1	1	1	1	1	1
8	98	fund	0	0	0	0	0.30	0.65	0.73	0.83	0.89	0.97	1.00	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.56	0.64	0.72	0.77	0.84	0.89	0.96	0.99	1	1	1	1	1	1	1
9	86	fund	0	0	0	0	0.22	0.57	0.67	0.78	0.94	1	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.41	0.59	0.69	0.73	0.83	0.93	0.98	1	1	1	1	1	1	1	1
10	74	fund	0	0	0	0	0.01	0.53	0.66	0.70	0.96	1	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.23	0.53	0.64	0.69	0.80	0.92	0.99	1	1	1	1	1	1	1	1
11	62	fund	0	0	0	0	0	0.27	0.55	0.71	0.85	1	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.15	0.44	0.56	0.63	0.76	0.90	0.98	1	1	1	1	1	1	1	1
12	50	fund	0	0	0	0	0	0.20	0.36	0.50	0.98	1	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.02	0.30	0.46	0.54	0.70	0.88	0.98	1	1	1	1	1	1	1	1
13	38	fund	0	0	0	0	0	0	0.08	0.47	0.55	1	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0.08	0.29	0.39	0.61	0.87	0.97	1	1	1	1	1	1	1	1
14	26	fund	0	0	0	0	0	0	0	0	0.65	0.92	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0	0	0.12	0.42	0.77	1	1	1	1	1	1	1	1	1
15	14	fund	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0	0	0	0.07	0.79	1	1	1	1	1	1	1	1	1
16	2	fund	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0	0	0	0	0	0.50	1	1	1	1	1	1	1	1	1

Source: own calculations.

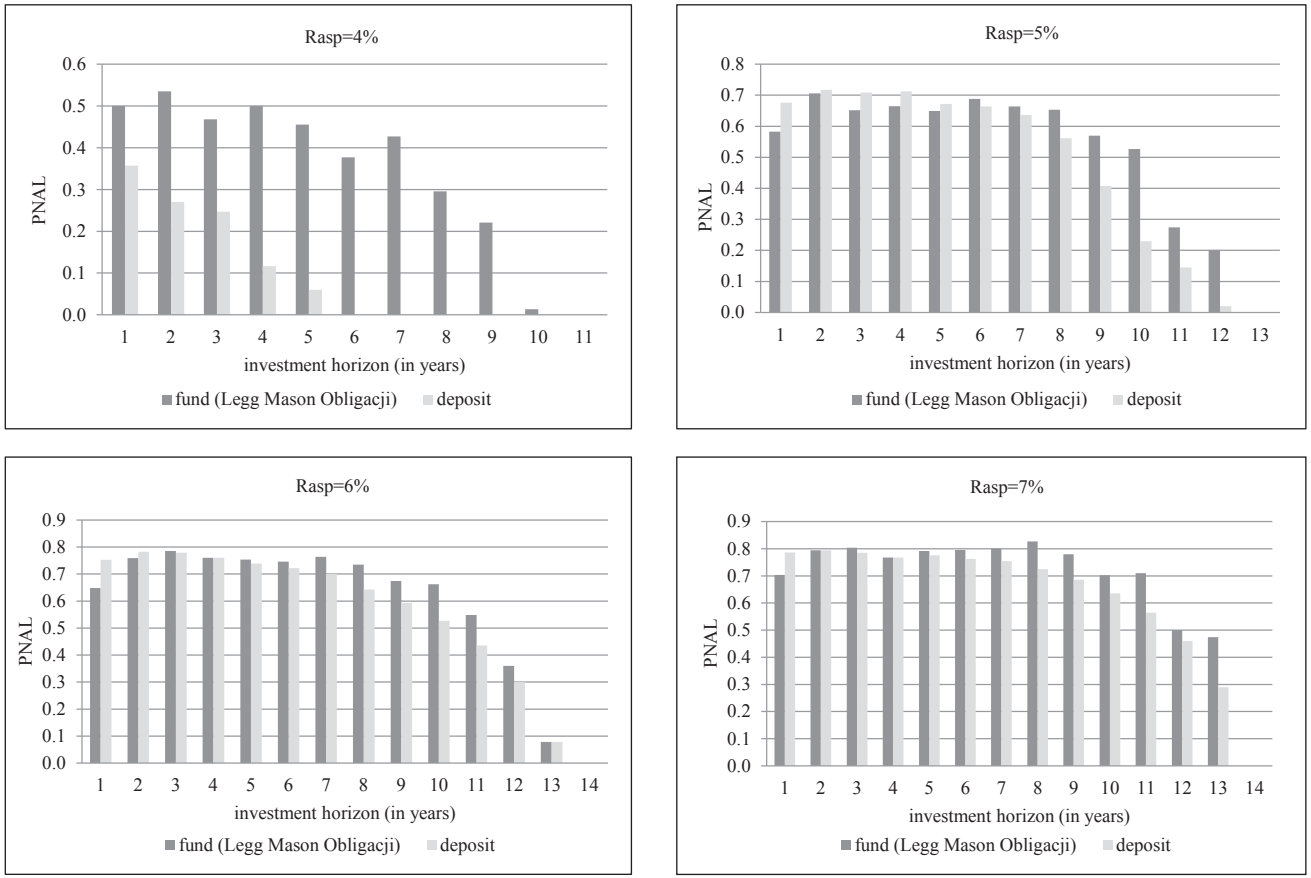

Figure 3. PNALs calculated for selected aspiration levels for Legg Mason Obligacji and bank deposit

Source: own elaboration.

Table 7. PNALs calculated for Arka BZ WBK Obligacji Skarbowych and bank deposit

Investment horizon (in years)	Iumber of observation	PNAL	ASPIRATION LEVEL													
			0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%
1	139	fund	0.04	0.08	0.15	0.19	0.40	0.53	0.74	0.83	0.91	0.94	0.96	0.97	0.99	1
		deposit	0	0	0	0.08	0.47	0.88	0.98	1	1	1	1	1	1	1
2	127	fund	0	0	0	0.02	0.20	0.46	0.83	0.94	0.99	1	1	1	1	1
		deposit	0	0	0	0	0.36	0.94	1	1	1	1	1	1	1	1
3	115	fund	0	0	0	0	0.07	0.30	0.82	1	1	1	1	1	1	1
		deposit	0	0	0	0	0.34	0.96	1	1	1	1	1	1	1	1
4	103	fund	0	0	0	0	0.01	0.29	0.88	0.98	1	1	1	1	1	1
		deposit	0	0	0	0	0.17	0.97	1	1	1	1	1	1	1	1
5	91	fund	0	0	0	0	0	0.21	0.82	0.99	1	1	1	1	1	1
		deposit	0	0	0	0	0.09	0.93	1	1	1	1	1	1	1	1
6	79	fund	0	0	0	0	0	0.15	0.68	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.96	1	1	1	1	1	1	1	1
7	67	fund	0	0	0	0	0	0	0.64	1	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.99	1	1	1	1	1	1	1	1
8 lat	55	fund	0	0	0	0	0	0	0.49	0.96	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.93	1	1	1	1	1	1	1	1
9 lat	43	fund	0	0	0	0	0	0	0.37	0.88	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.77	1	1	1	1	1	1	1	1
10 lat	31	fund	0	0	0	0	0	0	0	0.77	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.55	1	1	1	1	1	1	1	1
11 lat	19	fund	0	0	0	0	0	0	0	0.89	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.47	1	1	1	1	1	1	1	1
12 lat	7	fund	0	0	0	0	0	0	0	0.86	1	1	1	1	1	1
		deposit	0	0	0	0	0	0.14	1	1	1	1	1	1	1	1

Source: own calculations.

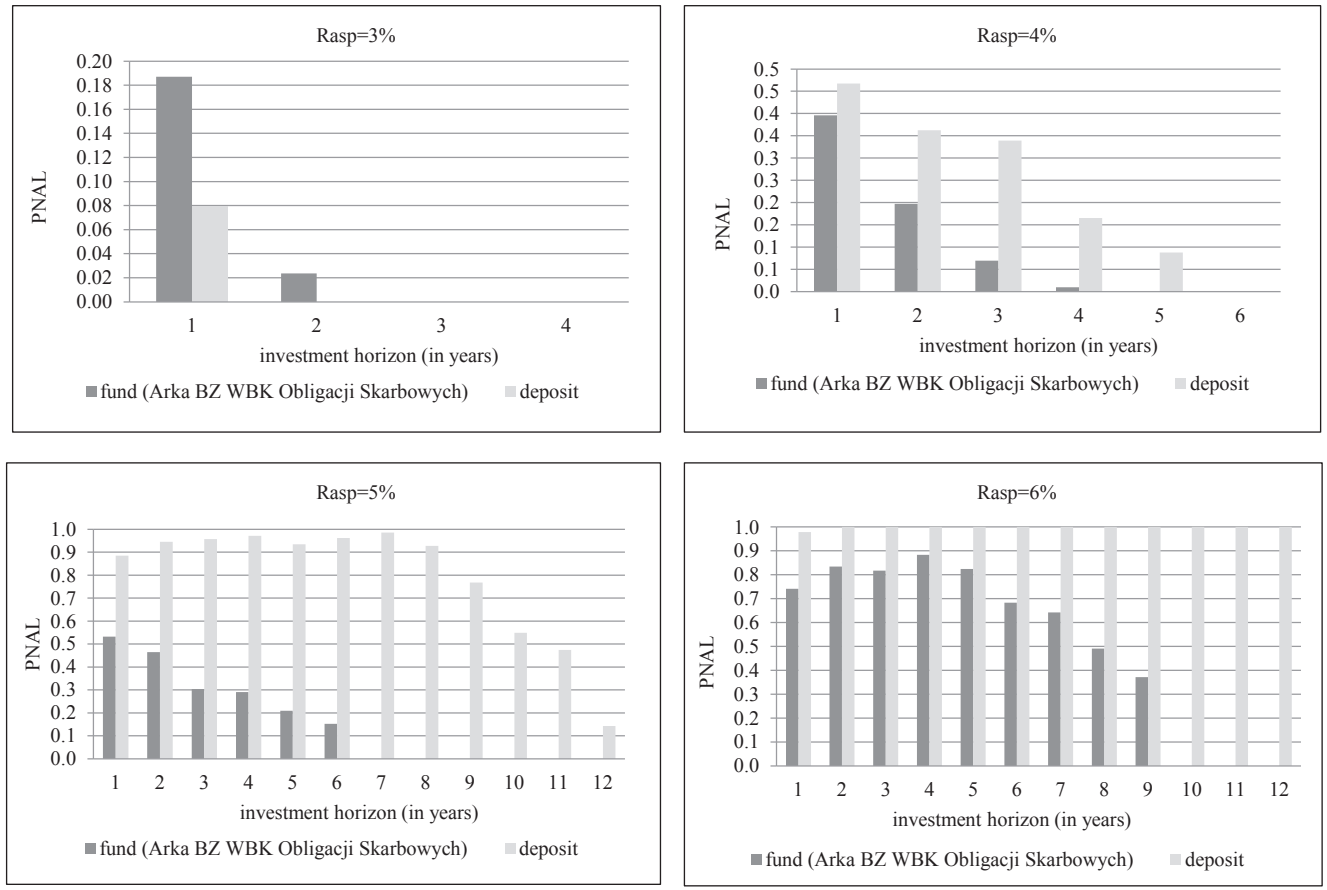

Figure 4. PNALs calculated for selected aspiration levels for Arka BZ WBK Obligacji Skarbowych and bank deposit

Source: own elaboration.

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