THE RETURN-RISK PERFORMANCE OF SELECTED PENSION FUND IN OECD WITH FOCUS ON THE CZECH PENSION SYSTEM

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Abstract

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This paper focuses on the measuring and comparing investment performance of pension funds in selected European countries. Comparison of the investment performance of pension funds is determined by means of the Sharpe ratio and the Sortino ratio. We used data of nominal appreciation of pension funds from the Czech Republic, Slovakia, Poland, Sweden, Switzerland and the Netherlands in the period 2005–2013. These countries were selected because they have many common features but Sweden, Switzerland and the Netherlands were added to the analysis because we wanted to show the differences between a developed and less developed fully funded system. The last part of this article presents the main causes of the differences in investment performance of pension funds. Conclusions of the paper are focused on a comparison of the results of the Sharpe ratio and the Sortino ratio of pension funds from selected countries and recommendations for the Czech pension system. The article proposes a mechanism for determining the order of the negative Sharpe ratio and the Sortino ratio.

Keywords: Sharpe ratio, Sortino ratio, Performance, Pension funds, Lifetime pensions

INTRODUCTION

The authors performed a selection of these segments of countries based on the parameters of pension systems. We focused on the countries of the OECD and the EU. This restriction pursues the objective to compare countries with similar cultural and financial experience. Out of the remaining countries we chose two groups, the first of which includes the Visegrad countries. These countries have common historical origins and their pension schemes have similar economic characteristics (pension fund industry structure does not contain occupational pension plans). Hungary was excluded from the analysis due to termination and the transformation of the pension system. The second group consists of the following countries: Sweden, the Netherlands and Switzerland. Pension systems in these countries are among the most advanced and they are supported by the pension indicators. We can compare these pension parameters with the parameters of the Visegrad countries.

Our intention was to choose from OECD and EU countries which show the best pension indicators and compare them with the countries of the Visegrad Group (except Hungary).

The objective of the authors for writing this article was a comparison of the capabilities of the Czech pension system with highly developed systems in Europe (Sweden, Switzerland and the Netherlands) and a comparison of the results with Central European countries (Slovakia and Poland), due to which the systems were created after the post-communist era and in a completely new way. Pension funds in the Czech Republic, Slovak Republic and Poland were created less than 20 years ago.

This article provides a view of the direction of development of pension systems in the post-communist countries. In the first part the authors focused on evaluating the performance of pension funds for individual countries using complex tools and in the second part the authors added the analysis of actual changes and opinions whether these post-communist countries are closer to the advanced countries.

MATERIALS AND METHODS

Theoretical Background

W. Sharpe is engaged in the performance of mutual fund and in the article: "Mutual fund performance" in the Journal of Business from 1966 was laid the foundations of modern methods of measuring portfolio performance. He suggested a method which measures not only the profitability of the financial product, but also takes into account volatility. This indicator is called the Sharpe ratio. (Sharpe, 1966)

The World Bank assesses pension systems around the world and among other things, to assess the performance of individual pension funds used indicator Sharpe ratio. Given this fact, it is apparent that this indicator is useful for evaluating investment performance of the pension funds. (Walker and Iglesias, 2010)

The Sharpe ratio measures the risk-efficiency of investments by using standard deviation to represent risk. A disadvantage of this approach is that this penalizes both downside and upside volatility. Therefore, in recent studies begin to emerge modification of the Sharpe ratio.

The aforementioned modification has performed F. Sortino, who proposed an indicator that penalizes only the return that is negative or below the targeted user-defined value. (Sortino and Price, 1994)

The Sharpe and Sortino ratio has shown to draw inconsistent performance rankings when the return premium is negative or below the targeted user-defined value. Based on this problem, it is necessary to compare the values in the same time interval and cannot be averaged positive and negative values of these parameters. (Ferruz and Sarto, 2004)

The authors have designed an auxiliary calculation that ensures a consistent ranking of negative results of the Sharpe and Sortino ratio. The authors calculated the value of both indicators and assessed potential differences in the results.

Objectives and methodology

The main objective is to determine whether the pension systems in post-communist countries are approaching retirement schemes in developed countries, with a focus on the investment performance of pension funds (and other pension parameters). Furthermore, the authors determined aims to design an auxiliary calculation that ensures a consistent ranking of negative results of the Sharpe and Sortino ratio. The authors calculated the value of the Sharpe ratio and the Sortino Ratio and assessed potential differences in the results.

The authors collected data with an annual frequency from both the national and international institutions. As mentioned in the article, it is very important to compare data for the same time instants, therefore the authors used annual frequency which

I: *Pension indicators of selected countries*

Countries	Assets of Pension funds as % of GDP	Basic type of pension system	Evaluation of Mercer global pension index
The Netherlands	166.30 %	Fully funded	+ B
Switzerland	119.00 %	Fully funded	B
Sweden	69.40 %	Fully funded + PAYG	B
The Czech Republic	7.70 %	PAYG	E
Slovakia	10.00 %	PAYG	E
Poland	18.60 %	PAYG	C

Zdroj: OECD,2014; MERCER, 2015

II: *Overview of the input data for the period 2005 – 2013*

Countries	Number of Pension companies	Average gross rate of return in %	Standard deviation gross rate of return
The Czech Republic	11	2.05	0.80
Slovakia	6	2.16	2.24
Poland	13	7.38	9.72
Switzerland	10	4.14	6.70
Sweden	4	7.08	11.26
The Netherlands	2	7.33	10.77

Sources: Local associations of pension companies

was available in all countries. The selected countries are the Czech Republic, Slovakia, Poland, Sweden, Switzerland and the Netherlands.

Data was obtained also for the risk-free interest rate in the time series 2005–2013 in the selected countries. The paper is using two alternative specifications for the risk-free asset: Government bonds with maturities of 10 years (GB_10 y) and the inflation rate in the country. (Eurostat, 2014)

We obtained pivotal data from these associations and governmental organizations:
- Association of pension companies in the Czech Republic.(APF CR, 2014)
- Investments office. (Investments office, 2014)
- Pensioen fonds ABP. (Pensioenfonds ABP, 2014)
- The Organisation for Economic Co-operation and Development.(OECD, 2013)
- Ministry of the Treasury in Poland. (Steindl, 2013)
- Swedish National Pension Fund – AP1, AP2, AP3. (Swedish National Pension Fund – AP1, AP2, AP3, 2014)

Data of performance were divided into two groups: non-guaranteed and guaranteed funds. Guaranteed funds (GF) include a portfolio which is very conservative and consists mainly of bonds and treasury bills. These are usually the funds that are managed by strict regulations. Non-guaranteed funds (NF) represent investment portfolio with a high percentage of shares, usually in combination with bonds.

The Sharpe ratio calculation is based on the following wording. The Sharpe ratio is the average rate of return minus the risk-free return, divided by the standard deviation of the return. The Sharpe ratio (SR) is determined according to the following formula. (Sharpe, 1966)

$$SR = \frac{R - R_f}{\delta} \qquad (1)$$

R.... Nominal gross rate of return
R_f... Risk-freeinterest rate
δ..... Standard deviation of return

The Sortino ratio calculation is based on the following wording. The Sortino ratio is defined as a portfolio return minus a target return divided by downside risks. The target return is either a minimum acceptable return (as in the original definition), or a risk-free rate. Lower Sortino ratio signify investments with a greater risk of large losses and should be avoided by risk-averse investors. (Sortino and Price, 1994)

$$So = \frac{R - R_f}{\delta_D} \qquad (2)$$

R.... Nominal gross rate of return
R_f... Risk-freeinterest rate
δ..... Standard deviation of return (downside volatility)

Evaluation of results is the same for both methods in positive direction (the higher value is better) but when we evaluate the results of negative direction, we need to use auxiliary calculations. Auxiliary calculation is based on the principle that a negative excess return and standard deviation of returns (downside risks) should be minimized.

$$SR^* = -1 \times (R - R_f) \times \delta \qquad (3)$$

The above auxiliary calculation sorts negative values for the Sharpe ratio (smaller value indicates a better result).

$$So^* = -1 \times (R - R_f) \times \delta_D \qquad (4)$$

The above auxiliary calculation sorts negative values for the Sortino ratio (smaller value indicates a better result).

RESULTS

Comparison of results of the Sharpe ratio and the Sortino ratio

This section identifies the main results of a portfolio performance analysis of pension funds that consists in estimating the Sharpe ratio and the Sortino ratio. It is interesting that guaranteed funds are offered only by pension companies from the Czech Republic and Slovakia. These pension companies offer pension funds that invest into bonds and these funds are very popular in these

III: *Sortino ratio of pension companies*

Countries	Sortino ratio – inflation	So*	Ranking	Sortino ratio – GB_10 y	So*	Ranking	Overall ranking
The Czech Republic – GF	−0.21	0.0034	6	−0.95	0.0153	6	6
Slovakia – NF	−0.21	0.0067	7	−0.60	0.0192	7	7
Slovakia – GF	−0.33	0.0029	5	−1.04	0.0097	5	5
Poland	0.81	–	3	0.30	–	4	4
Switzerland	0.85	–	1	0.50	–	3	2
Sweden	0.76	–	4	0.54	–	2	3
The Netherlands	0.84	–	2	0.58	–	1	1

Source: Own research

countries. An overview of the results of the Sortino ratio is in Tab. II.

The results of both types of measurement are almost consistent. The Sortino ratio has a higher value than the Sharpe ratio because it penalizes only the downside risk. When we focused on the ranking of individual countries, we identified a slight difference between Switzerland and Sweden. The Swedish pension funds have better performance (efficiency) but the Swiss pension funds have less risk of large losses. This is a fundamental difference in the interpretation of the results of the Sortino ratio and the Sharpe ratio. Another difference is between the results of individual methods on the Czech and Slovak guaranteed funds. The Czech pension guaranteed funds are more efficient but some Slovak guaranteed pension funds have less risk of large losses.

The Slovak pension funds have even the worst performance of all selected countries. The Polish pension funds have worse performance than the Swedish pension funds but it must be said that the Polish pension funds have the best performance from the Visegrad countries. The Polish pension funds overcame the interest rate government bonds with a maturity of 10 years. The Polish pension funds provide an interesting comparison of the results with the Sharpe ratio – inflation and the Sharpe ratio – GB_10 y. For the other countries the results are similar. The cause of this result is that inflation has a lower rate than interest rate of government bonds with a maturity of 10 years. The countries with developed fully funded system have higher Sharpe ratio than the other countries in both types of measuring. These large differences are mainly due to several reasons. Especially small investment limits, progressive investment portfolios, other culture and mentality of people and investors. The Dutch pension funds achieved the best results of all selected countries in both types of measuring.

Parameters of pensions funds and external environment in the selected countries

Pension funds are used as a method for savings and pay-out phases of different models. These models are mostly based on the Defined benefit and Defined contribution pension plans. The success of the pension system has a significant effect, in which pension companies can invest client's assets without strong regulation.

The figure below shows the asset allocation of the following countries. There is a significant difference between the countries of Western Europe (the Netherlands, Switzerland and Sweden), those monitored by the authors, and Central European countries (the Czech Republic, Slovakia, Poland). The Countries with a long history of private pension schemes have a higher proportion of riskier investments.

The market value of assets accumulated relative to the size of the economy as measured by the GDP is a key indicator of the scale of pension funds' activity. In 2013, only four OECD countries reached asset-to-GDP ratios higher than 100 % – the Netherlands (166.3 %), Iceland (148.7 %), Switzerland (119.0 %) and Australia (103.3 %). Pension fund assets were of varying importance relative to GDP in the other countries. Only thirteen out of thirty-four countries had assets-to-GDP ratios above 20 %, which is considered the minimum for meeting the OECD's definition of a "mature" pension fund market. (OECD, 2014)

Pension Statistics

The Czech pension system consists of two pillars. The first pillar is the PAYG defined benefit (DB) and the third pillar is voluntary pension insurance with a contribution from the government, which is a defined contribution (DC).

- *PAYG DB system*

  The average old-age pension in the Czech Republic from PAYG system to 30.06.2014 was 11,050.00 CZK. It is 402.60 EUR, exchange rate was validated 30.06.2014. (CNB, 2016)

  There were registered 2,353,691 retirees. The annual value of the pensions paid by state amounted to more than 312 billion CZK. (CSSZ, 2014)

- *Pension insurance with a contribution from the government*
  Management of funds carried out by pension companies with permission from the Czech National Bank.

IV: *Sharpe ratio of pension companies*

Countries	Sharpe ratio inflation	SR*	Ranking	Sharpe ratio – GB_10 y	SR*	Ranking	Overall ranking
The Czech Republic – GF	–0.47	0.0007	5	–2.09	0.0133	5	5
Slovakia – NF	–0.20	0.0554	7	–0.65	0.0755	7	7
Slovakia – GF	–0.29	0.0134	6	–1.73	0.0198	6	6
Poland	0.47	–	4	0.20	–	4	4
Switzerland	0.50	–	2	0.33	–	3	3
Sweden	0.49	–	3	0.36	–	2	2
The Netherlands	0.51	–	1	0.38	–	1	1

Source: Own research

According to the Association of Pension Funds of the Czech Republic, deposits of 301 billion CZK were recorded in the accounts of the clients for the 2nd quarter of 2014 (APF CR, 2014).

On the account of Pension Funds there are assets only for one year of the old-age pension from PAYG system in the Czech Republic. Czech citizens are during retirement phase of their life dependent on an income from the first pillar.

The following figure shows the composition of the portfolio of customer deposits. These deposits were managed by the Czech pension funds, originally so-called *"Transformed fund"*. The figure is for the second quarter of 2014.

A local law in the Czech Republic restricts the location of clients' assets. The reasons for the composition of this portfolio are as follows: The owners of pension funds must guarantee non-negative revenue in each calendar year. Pension funds must therefore have extremely cautious investment strategy. The law of pension insurance with a contribution from the government (Act No. 42/1994 Coll.) determines regulatory investment limits. Pension funds must establish legal reserves.

A pension fund offers a new product called Supplementary pension savings from 2013. Clients can choose the investment strategy themselves. This new product is not popular among clients. This is mainly because of the possibility of the loss of value of assets. (Act No. 427/2011 Coll.)

The Czech pension system abolished the second pillar in the pension reform in 2016. The citizens have had two options for securing retirement income since the second pillar was abolished. They are either dependent on the income from the PAYG system or they pay sufficient money of the funds to their accounts in the third pillar.

Pension system in Poland and Slovak Republic

The Polish and Slovak pension systems have under gone extensive changes lately. Based on the decision of the Polish government, all government bonds were taken out of portfolios of the Polish private pension funds, which is subsequently overturned, and were transferred to the state fund. The participants in the private pension funds were given the opportunity to decide if they want to return to the state pension fund. (Patria, 2013)

A setting of the Slovak pension system is regularly changed by the Slovak government. The main reason is the reduce of the impact in the second pillar and reduced transfer of taxes from the first pillar to the private pillar. It reduced payments to the second pillar from 9 % to 4 %. The government offers clients a regular opening of the system of the second pillar. The clients can leave the second pillar and be only in the PAYG system. The system becomes voluntary and is for new clients up to the age of 35. Pension funds are obliged to offer at least one guaranteed fund. The regulation is getting stronger.

It is clear that the financing of the pension fund was limited (based on the above data) in the Czech Republic, Slovak Republic and Poland. The pension system in Slovak Republic was often modified. Regulations in these countries are too large. Assets in pension companies in these countries are low. Distribution of investments is too conservative. People do not save enough money. Legislation in these countries is often changed. There is still a big difference between these countries and Western European countries with developed pension systems.

DISCUSSION

The World Bank in its publication *"Financial Performance of Pension Fund Systems around the World: An Exploratory Study described performance of pension funds on Latin American countries, Central and East European countries"* have focused on evaluating the investment performance of pension funds. We can say that their results are consistent with ours. Investment performance evaluation was done using indicators Sharpe ratio. (Walker and Iglesias, 2010)

Some authors suggest modified Sharpe ratio and evaluate investment performance using the Sortino ratio. (Vovk, 2011) In this article we found out that the results of both methods are very similar but in certain cases there are different interpretations of the results. The Sortino ratio is more suitable for those investors who worry about risk and large financial losses.

The Sharpe ratio and the Sortino ratio must be calculated for the same time and positive and negative values cannot be averaged, how indicate Ferruz and Sarto in the *publication "An Analysis of Spanish Investment Fund Performance: Some Considerations Concerning Sharpe's ratio".* (Ferruz and Sarto, 2004). For this reason, a sequence of positive and negative values cannot be created, since the results could be inconsistent. Based on this problem, we designed auxiliary calculations and we formed a rank (transitivity) of negative values. The values themselves do not mean anything but help us evaluate the order of portfolios that do not achieve the chosen benchmark.
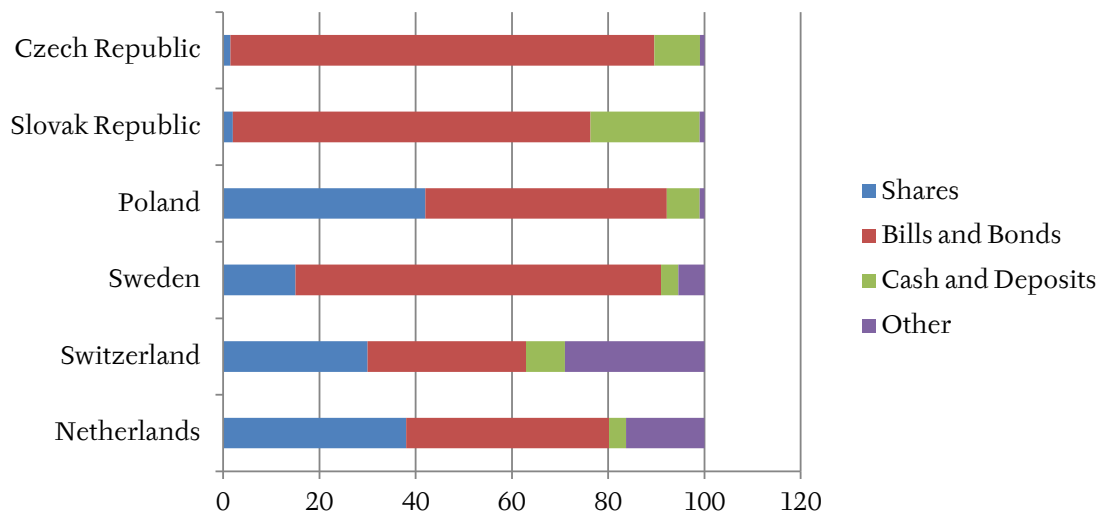
1: *Asset allocation of pension funds in selected countries*
Source: OECD Global Pension Statistics
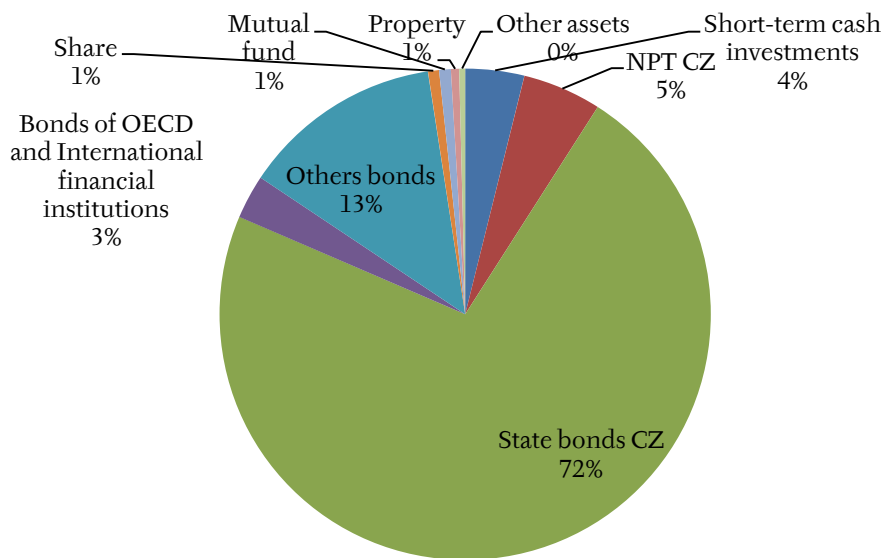
2: *Composition of the portfolio in Czech pension funds*
Source: APF CR, 2014

CONCLUSION

The Sharpe ratio and the Sortino ratio of pension companies from selected countries have very similar results. If there exists an investor seeking riskier investments with higher potential yield, an indicator called the Sharpe ratio is better for him. Conservative investors should rather take advantage of an indicator called the Sortino ratio. Interpretation of the results of both methods is practical for the Swedish and Swiss pension funds. The Swedish pension funds have better performance (have higher value of the Sharpe ratio) but the Swiss pension funds have less risk of large losses (have higher value of the Sortino ratio).

For the Czech Republic, Slovak Republic and Poland are characteristic very common changes in pension systems (the change in pension contributions, the abolition of retirement savings). Pension funds in these countries attain very low real appreciation, which resulted from our surveys and the Sharpe and Sortino ratio indicators, when we compared the results with the pension funds from countries of Switzerland, the Netherlands and Sweden. It is evident that for pension funds a stable legal environment regarding pension law is necessary. If there are strong investment restrictions, pension funds do not have much opportunity to realistically evaluate financial resources.

This is, for example, an issue of the Czech pension funds, whose portfolio is very conservative, and contains 85% of government bonds. The situation is exacerbated moreover the fact that the Czech

pension system is based on the principle of PAYG (pay as you go) – continually funded pension system. This system is suitable for economies where the aging of the population does not occur. Population in the Czech Republic is demographically ageing and in the long term the number of retirees will increase and the number of people who contribute to this continuous system will decrease. Future pension benefits will have to decrease proportionally because funding of pension benefits burdens the state budget. From this perspective, it is essential to have other well-functioning pension pillar. What emerged from our study was that pension funds in Sweden, the Netherlands and Switzerland fulfill their basic function well (evaluation of additional savings of the population and improvement of their financial situation in old age). According to the authors' opinion, we can make recommendations for the Czech Republic which is offered to cancel non-negative appreciation of financial assets that the pension companies must achieve. Because it is necessary to encourage pension companies to achieve higher yields, for example, a higher fee for the valuation of assets (related to the reduce of the fee for managing the funds). All these recommendations must be consistent with the strategic plan regarding the functioning of the pension system in the Czech Republic. Such a long-term plan, which would deal with how these pillars will underpin the future pension system, however, is not treated in the Czech Republic. To recommend to do a long term view of the Czech pension system and show it to the citizens of the Czech Republic to see what demands they can realistically expect from the pension system. The pension system is a part of human life and relates to its large part, it is therefore important to establish operating rules and introduce them to all participants in the system.

Pension systems in Central Europe are being reformed. Success and revenues of the new pension system are affected by frequent changes and increasing regulation. The volume of assets in pension funds is not sufficient and citizens are dependent on the state pension system. For the reasons, pension funds in Central Europe don't achieve such revenue as systems in Western Europe.

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