


# “Inefficiency of pension investment regulation: case of Russia”

<b>AUTHORS</b>	Alexander Nepp
<b>ARTICLE INFO</b>	Alexander Nepp (2017). Inefficiency of pension investment regulation: case of Russia. <i>Investment Management and Financial Innovations</i> , 14(3), 148-159. doi: <a href="https://doi.org/10.21511/imfi.14(3).2017.14">10.21511/imfi.14(3).2017.14</a>
<b>DOI</b>	<a href="http://dx.doi.org/10.21511/imfi.14(3).2017.14">http://dx.doi.org/10.21511/imfi.14(3).2017.14</a>
<b>RELEASED ON</b>	Wednesday, 18 October 2017
<b>RECEIVED ON</b>	Tuesday, 04 April 2017
<b>ACCEPTED ON</b>	Friday, 11 August 2017
<b>LICENSE</b>	 This work is licensed under a <a href="https://creativecommons.org/licenses/by-nc/4.0/">Creative Commons Attribution-NonCommercial 4.0 International License</a>
<b>JOURNAL</b>	"Investment Management and Financial Innovations"
<b>ISSN PRINT</b>	1810-4967
<b>ISSN ONLINE</b>	1812-9358
<b>PUBLISHER</b>	LLC “Consulting Publishing Company “Business Perspectives”
<b>FOUNDER</b>	LLC “Consulting Publishing Company “Business Perspectives”



NUMBER OF REFERENCES

**24**



NUMBER OF FIGURES

**3**



NUMBER OF TABLES

**0**

© The author(s) 2025. This publication is an open access article.



BUSINESS PERSPECTIVES



LLC "CPC "Business Perspectives"  
Hryhorii Skovoroda lane, 10, Sumy,  
40022, Ukraine

[www.businessperspectives.org](http://www.businessperspectives.org)

**Received on:** 4<sup>th</sup> of April, 2017

**Accepted on:** 11<sup>th</sup> of August, 2017

© Alexander Nepp, 2017

Alexander Nepp, Ph.D. in Economics,  
Ural Federal University, Russia.



This is an Open Access article, distributed under the terms of the [Creative Commons Attribution-Non-Commercial 4.0 International license](https://creativecommons.org/licenses/by-nc/4.0/), which permits re-use, distribution, and reproduction, provided the materials aren't used for commercial purposes and the original work is properly cited.

Alexander Nepp (Russia)

# INEFFICIENCY OF PENSION INVESTMENT REGULATION: CASE OF RUSSIA

## Abstract

Inflation risks are one of the major factors faced by funded pension systems. Investment risks affect such key parameters of pension systems as the amount of pension contributions and payments. In order to limit the exposure of pension systems to such risks, governments have introduced instrumental and geographical restrictions on pension investments. These measures are particularly popular in developing countries.

This article discusses the efficiency of pension investment regulation in Russia and demonstrates the inadequacy of the current regulatory measures. The authors show that the negative investment results of pension market players were caused by inefficient government regulation. They also show that pension market players should be given more freedom in their investments and that instrumental and geographical restrictions should be removed. It was proposed to diversify investment portfolios into stocks traded on the leading stock markets, which would allow to increase investment returns and maintain the risk at the current level. Thus, it would be reasonable to invest 76% of funds into foreign assets, which will increase pension benefits and the replacement rate by 2.54 times. If we keep the geographical barriers but lift the restrictions on equity investments, the growth will be by 1.34 times.

## Keywords

pension reform, investment of pension savings, investment risks, portfolio theories, pension payments, replacement rate, Russia

**JEL Classification** G28, G23, F21

## INTRODUCTION

Investment risks have an enormous impact on funded pension systems, since pension funds heavily depend on pension investment returns. Investment risks have almost the same influence on funded systems as demographic risks (Nguyen & Stützle, 2012). Risks in the pension system depend on how aggressive are the assumptions on expected returns of different classes of assets. The assumptions on expected returns affect funding levels. Conservative assumptions on expected returns mitigate the risks. Investment risks affect such key parameters of pension systems as the amount of pension contributions and payments, a fact which has been proven through actuarial computations (Xu, Kannan, & Zhang, 2007). The situation with Enron can serve as a good illustration of the role investment risks play in the sustainability of pension systems. Pension funds, which were the key investors of this corporation, suffered serious damage when it went bankrupt, which severely affected pension payments (Blackburn, 2012).

In order to limit the exposure of pension funds to risks, many states have introduced different restrictions, which can either be instrumental (limiting investments in various assets) or geographical (limiting the investments in the assets of certain countries or inside a particular country). Such restrictive policies have been applied in developing countries (Markovič Hribernik, 2012; Kumara, 2013; Boender, 1998; Stalebrink, 2016). Geographical restrictions are particularly popular in emerging markets. For example, in Brazil, these restrictions have been used to minimize risks (Yamahaki & Frynas, 2016) and, in Taiwan, to cope with recession. It should be noted that geographical restrictions are also used in developed countries, such as the Republic of South Africa (van Heerden, 2013). Many countries with developing markets introduce pension investment restrictions inside the country in order to stimulate investment and maximize macroeconomic parameters and employment. The governments of many developing countries also put a lot of effort into stimulating foreign investments (V. FitzGerald, 2004).

A good alternative to regulation of pension investment might be the liberalization of instrumental restrictions, which would minimize volatility risks (Roig Hernando, 2016). Equally, the liberalization of geographical restrictions can reduce inflation and currency exchange risks (Campbell, Viceira, & White, 2003).

Among developing countries, the case of the Russian pension fund is particularly interesting for a number of reasons. First of all, Russia is the largest country in the world in terms of surface area, and it has a developed financial infrastructure. Russian institutional investors include pension funds, banks, investment funds, and insurance companies. The Russian pension fund by assets is the largest in Eastern Europe<sup>1</sup>. On the other hand, like other developed countries, Russia faces serious demographic problems, such as low fertility rates and ageing population. Furthermore, Russia is characterized by high mortality rates. In order to cope with these demographic risks, Russia reformed its compulsory state pension system and introduced a funded component in 2004. While mandatory pension funds were being formed, most players on the Russian market demonstrated negative rates of return (inflation exceeded their gains), which made the Russian government abolish compulsory contributions to the funded part of the pension.

Our hypothesis is that the negative investment results of pension market players resulted from inefficient government regulation: in many countries, internal administrative barriers hinder international investment. The authors also propose to liberalize geographical and instrumental restrictions and to increase returns on pension investments by building an investment portfolio of stocks traded on the leading global stock markets. Brière and Signori (2013) solved a similar problem: they optimized a portfolio for Brazilian pension funds out of domestic assets and foreign currencies and thus achieved positive investment returns. Findings of Goetzmann and Ukhov (2006) suggest that diversification played an important role in the decision of British investors to allocate a significant fraction of their portfolio to overseas securities. Later, studying the history of the Chinese stock market, they showed that lower barriers to international investment can enhance the efficiency of risk management (see Goetzmann, Ukhov, Zhu, 2007). The authors are going to construct a portfolio of stock market indices in order to significantly increase returns on investment and at the same time, maintain the current level of risk.

This paper is comprised of the following parts: Introduction; 1) Data and methodology; 2) Nature and role of investment risks in the funded pension system. The results of comparative analysis of pension markets in Russia and OECD countries; 3) Measures to improve pension investment efficiency; and Conclusion.

1 Pensions at a Glance 2013: OECD and G20 indicators. OECD Publishing. 2013. 368 p. [Pensions at a Glance 2013: OECD and G20 indicators. OECD Publishing. 2013. 368 p.]

## 1. DATA AND METHODOLOGY

### 1.1. Data

Our analysis of investments of mandatory pension funds by players on the Russian market covers the period between 2004 and 2015. The data were taken from the official website of the Russian Ministry of Finance, which published a review of the pension investment results<sup>2</sup>. The average pension investment returns were calculated as the arithmetic mean.

To analyze the real investment returns, inflation was subtracted from the value of nominal investment returns. The inflation data were provided by the website of the Russian Federal State Statistics Office for the period between 2004 and 2015<sup>3</sup>. For our comparative analysis, we also used the data available for all OECD countries between 2002 and 2011, except for Canada and South Korea, for which the data only covered between 2002 and 2010<sup>4</sup>. To analyze these data, we applied the same procedure, that is, subtracted inflation from the nominal investment returns. The data on inflation in OECD countries for the period between 2002 and 2015 are provided by the World Bank website<sup>5</sup>. Russian pension funds demonstrated negative investment inflation-adjusted returns from 2004 to 2015,  $-4.57\%$  a year, which corresponds to the results obtained by Tumanyants and Gulyaeva (2016).

In other countries, the real rate of return on the investment was positive and varied between  $1.38\%$  in Australia to  $8.15\%$  in Norway, which agrees with the conclusions drawn in the OECD review<sup>6</sup>.

To liberalize geographical and instrumental restrictions and to increase investment returns, we have chosen the largest investment sites in the world.

When choosing the indices, we started from the potential impact of pension funds on the dynamics of stock market indices. This phenomenon was

analyzed and proven by Menshikov (2013), who studied the impact of pension investments on the volatility of the equity market. This effect is considerably reduced if pension funds invest in large capitalized stock markets. Therefore, we have chosen the largest stock markets: DJIA (the Dow Jones Industrial Average) (USA); S&P 500, or the Standard & Poor's 500, a market-value-weighted index (USA); NASDAQ Composite, the index of the NASDAQ stock market (USA); FTSE 100 (Financial Times Stock Exchange Index), the index of the London Stock Exchange (UK); DAX (Deutscher Aktienindex), the index of the Frankfurt Stock Exchange (Germany); CAC 40 (Cotation Assistee en Continu), the index of the Euronext Paris Stock Exchange (France); Nikkei 225 (Nikkei 225 Stock Average), the index of the Tokyo Stock Exchange (Japan); SSE Composite, the Shanghai Stock Exchange Composite Index (China); Ibovespa, the Sao Paulo Stock Exchange Index (Brazil); BSE Sensex, or the S&P Bombay Stock Exchange Sensitive Index (India); KOSPI (Korea Composite Stock Price Index), the index of the Korea Stock Exchange (South Korea); Hang Seng, the index of the Hong Kong stock market (China); RTS Index, the index of the Russian Trading System; and MICEX Index, the index of the Moscow Interbank Currency Exchange. Three of the aforementioned indices are American (the DJIA, S&P 500, and NASDAQ Composite) and two Chinese (Hang Seng and SSE Composite). In our portfolio, we will be taking into consideration all these indices, since they recognize different assets and do not overlap. It should be noted that the RTS and MICEX indices have a similar structure; the difference between them is that the RTS is dollar-denominated while the MICEX is rouble-denominated. Therefore, when approaching our optimization task, we choose to only analyse the MICEX index. The data on the dynamics of the world stock indices were provided by the investment portal cbonds<sup>7</sup>. The aggregated statistical data on the dynamics of the indices are presented in Appendix 6 (available at [https://gsem.urfu.ru/fileadmin/user\\_upload/site\\_15921/docs2/Appendix\\_6.pdf](https://gsem.urfu.ru/fileadmin/user_upload/site_15921/docs2/Appendix_6.pdf)).

2 Data from the official website of the Russian Ministry of Finance. Access: [www.minfin.ru](http://www.minfin.ru). Last accessed: 12/23/2015.

3 Russian Federal State Statistics Office. Access: [www.gks.ru](http://www.gks.ru). Last accessed: 12/23/2015.

4 OECD Global Pension Statistics. Access: <http://dx.doi.org/10.1787/888932371234>. Last accessed: 05/5/2015.

5 Official website of the World Bank. Access: [www.worldbank.org](http://www.worldbank.org). Last accessed: 09/18/2015.

6 OECD (2013), Tax treatment of pensions and pensioners, in Pensions at a Glance 2013: OECD and G20 Indicators, OECD Publishing. Access: [http://dx.doi.org/10.1787/pension\\_glance-2013-14-en](http://dx.doi.org/10.1787/pension_glance-2013-14-en). Last accessed: 01/24/2014.

7 Website of financial and investment information. Access: [www.cbonds.ru](http://www.cbonds.ru). Last accessed: 04/10/2015.

Since we needed to take into account the currency exchange risks involved in pension investments in assets denominated in foreign currencies, we took the currency exchange rates from 2004 to 2015, as published on the Russian Central Bank's website<sup>8</sup>.

## 1.2. Methodology

According to Russian Federal Law No. 173, pension benefits from the funded pension component are formed by employers' contributions from employees' salaries  $Z$ , indexed annually by value  $Q$ , taking into account returns  $A$  from investments during the period between the year  $T$ , when pension funds started to be accumulated, and the year of retirement  $W$ . Pension benefits are paid during the post-retirement period  $d$ :

$$PV = \frac{\sum_{i=1}^{W-T} Z \cdot (1+q)^{i-1} \cdot (1+\alpha)^{W-T-i}}{d \cdot 12}. \quad (1)$$

The second important factor of pension system development is the replacement rate (RR), recommended by the International Labor Organization to characterize the living standards of retired citizens. The replacement rate shows the correlation between the pension payments (PV) and the wages ( $Z$ ) of an insured person<sup>9</sup>.

In the table given in Appendix 7 (available at [https://gsem.urfu.ru/fileadmin/user\\_upload/site\\_15921/docs2/Appendix\\_7.pdf](https://gsem.urfu.ru/fileadmin/user_upload/site_15921/docs2/Appendix_7.pdf)), we provided an overview of all the limitations that the Russian legislation imposes on the system of mandatory pension insurance, including its sources, investment of pension funds, and financing the possible deficit in the Russian pension fund.

To analyze the returns and risks involved in pension in Russia and OECD countries, we calculated the annual average returns for a specific country and then determined the average returns for this country in the given period between 2004 and 2011. In the analysis of the chosen stock indices, we calculated investment returns of each

month and volatility for the period between 2004 and 2015. In order to liberalize instrumental and geographical restrictions and to increase investment returns, we propose building a portfolio consisting of global stock market indices on the basis of Markowitz's theory.

The value  $\delta_p$  denotes the risk level which would be acceptable for the investor. Apart from considering the mean-square deviation of specific assets, it is necessary to take into account the correlation between the returns on the assets,  $r_{ij}$ . The construction of a portfolio according to Markowitz's theory means that the portfolio should be formed out of a set of financial instruments with maximum returns within the constraints described above. When modelling a portfolio by using the Markowitz's model for the investment of the funded component of pension systems, the first constraint is the positive weight of all instruments included in the portfolio (Markowitz, 1959). The second constraint is the accepted level of risk. As we will show later, according to our calculations, the investment risk was 3.8%. Therefore, the results of our calculations correspond to those of the OECD Review (2013)<sup>10</sup>. This means the equation system looks as follows:

$$\left\{ \begin{array}{l} \sum_{i=1}^N x_i = 1 \\ \sum_{i=1}^N x_i \cdot d_i \rightarrow \max \\ \sqrt{\sum_{i=1}^N x_i^2 \cdot \delta_i^2 + 2 \cdot \sum_{i=1}^{N-1} \sum_{j=i+1}^N x_i \cdot x_j \cdot r_{ij} \cdot \delta_j \cdot \delta_i} \leq 0.038 \end{array} \right. \quad (2)$$

where  $x_i$ ,  $x_j$  is the weight of the instrument  $i$ , instrument  $j$ , volatility of the instrument  $I$ , volatility of the instrument  $j$ , and  $r_{ij}$  the correlation between the instruments, which is the risk level acceptable for the investor.

To consider the possible correlation between the investment instruments used for portfolio construction according to model (2), we need to calcu-

8 Official website of the Central Bank. Access: <http://www.cbr.ru>. Last accessed: 05/23/2015.

9 Official website of the International Labour Organization. Access: [www.ilo.org](http://www.ilo.org). Last accessed: 05/25/2015.

10 OECD (2013), Tax treatment of pensions and pensioners, in Pensions at a Glance 2013: OECD and G20 Indicators, OECD Publishing. Access mode: [http://dx.doi.org/10.1787/pension\\_glance-2013-14-en](http://dx.doi.org/10.1787/pension_glance-2013-14-en). Last accessed: 01/24/2014.

late the pair correlation between them. Volatility, which was taken into account when modelling the investment portfolio, was measured by using the indicator of the mean-square deviation. It is important to mention that the analysis of short-term portfolio indicators can be significantly affected by the so-called 'noise effect', which is the influence of rumors, moods, and recommendations; in short, 'noises' which are not supported by objective information. The existence of this effect was discovered and proven by Black (1986) and then described in detail by DeLong, Schleifer, Summers, and Waldmann (1989) in their 'noise theory' of stock market trading. To minimize errors caused by the 'noise effect', our analysis of volatility and returns used monthly data as the starting data.

We followed Markowitz's portfolio theory to model an investment portfolio for the funded component of a pension system out of the world's leading stock indices.

Our research focused on the three following periods:

- The first period, extended, includes the period before the 2008 financial recession, the recession period, and the post-recession period, based on the data from 12/25/2003 to 01/01/2011.
- The second period, post-recession, is based on the data from 01/01/2011 to 04/25/2013.
- The third period, modern, is based on the data from 04/25/2013 to 04/25/2015.

In the first given period, the number of examined values exceeds 70 observations, which makes the sample statistically valid. In the second period, the number of observations is 27, and 40 in the third. Therefore, for more statistical validity we additionally compared and analysed the daily data, which provided us with over 400 observations in each of the given periods. Comparing the results we obtained on the basis of the daily and monthly data, we were able to draw conclusions which would be statistically valid and free from error caused by the 'noise effect'.

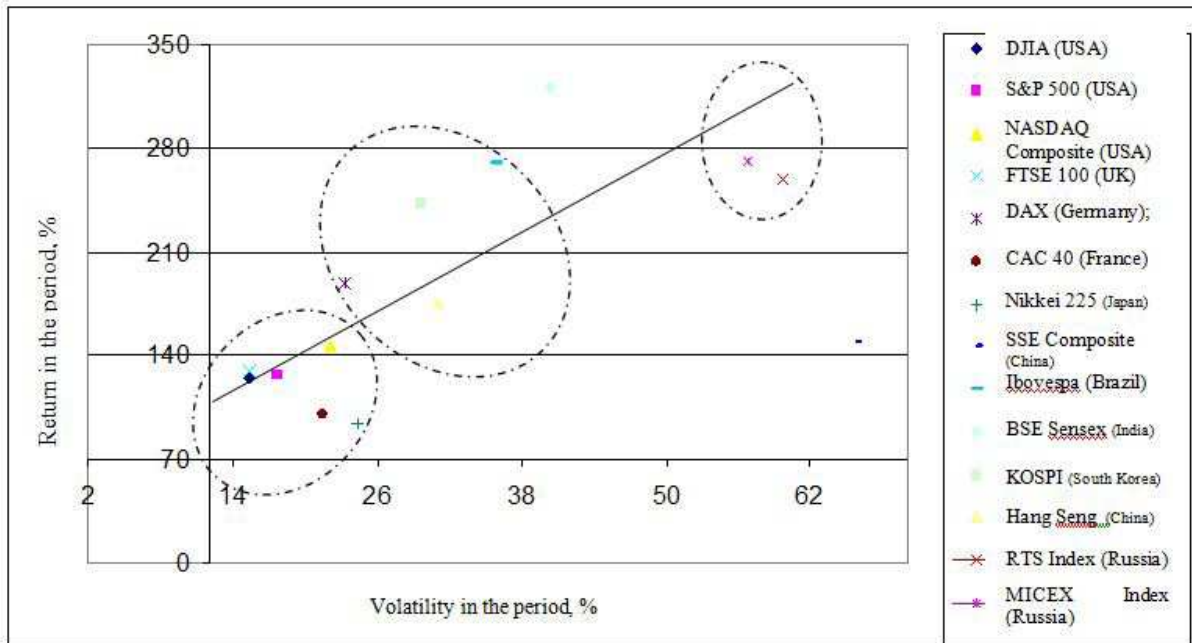
## 2. NATURE AND ROLE OF INVESTMENT RISKS IN THE FUNDED PENSION SYSTEM. RESULTS OF COMPARATIVE ANALYSIS OF THE PENSION MARKETS IN RUSSIA AND OECD COUNTRIES

The negative effect of negative investment return becomes more obvious if we compare it with the inflation level. Since the funded pension component was introduced in 2004, the average investment return was 1.649 by 2015 (2004 = 1), with inflation on the consumer market being 2.406 (2004 = 1)<sup>11</sup>. Thus, the real inflation-adjusted reduction in the value of pension savings was 75.66%. According to the Russian Ministry of Finance, in the period between 2004 and 2015, only four management companies out of 68 managed to demonstrate investment returns exceeding inflation. Obviously, the majority of management companies have the real (inflation-adjusted) negative investment return.

Is the real negative investment return characteristic only of the Russian pension system? Not exactly. For example, in his analysis of European and Spanish pension plans, Marti comes to the conclusion that the investment returns of Spanish pension funds in the period between 2006 and 2010 did not exceed inflation, which means that the real returns were zero. Our analysis of pension funds of OECD countries, has found that in 2008 and 2009 companies in the majority of OECD countries showed negative investment returns.

To find out the reasons for negative investment returns, we compared the pension investments in Russia and OECD countries according to parameters such as risks and level of returns. To analyse investment risks, we use an indicator of the standard deviation of investment returns, which is characterized by the degree of its scatter and variability. The investment activities of Russian pension funds differ from those of OECD countries in terms of maximum risks. In the given OECD countries, the

11 Official website of Statistical Office of the Russian Federation. Access: [www.gks.ru](http://www.gks.ru). Last accessed: 12/23/2015.



Note: The data were provided by cbonds website and the MICEX website. The black line in the graph denotes the trend line.

**Figure 1.** Return and volatility of the main world indices in the period between 2004 and 2011

mean standard deviation of the real investment returns is 3.8%, while in Russia it is 17.9%. Among the OECD countries, the maximum value of the mean standard deviation is characteristic of the funds in New Zealand and Norway, 15.6% and 14.5% respectively, while the minimum value belongs to Belgium (0.2%) and the USA (0.7%). This situation was illustrated by Appendix 1 (available at [https://gsem.urfu.ru/fileadmin/user\\_upload/site\\_15921/docs2/Appendix\\_1.pdf](https://gsem.urfu.ru/fileadmin/user_upload/site_15921/docs2/Appendix_1.pdf))

The first confirmation of this hypothesis was provided by the comparative analysis of the investment results of Russian pension funds and the data of the main Russian stock indices (RTS Index and MICEX Index) (see Appendix 7, available at [https://gsem.urfu.ru/fileadmin/user\\_upload/site\\_15921/docs2/Appendix\\_7.pdf](https://gsem.urfu.ru/fileadmin/user_upload/site_15921/docs2/Appendix_7.pdf)). These include the corporate bond index, municipal bond index, and the government bond index. This analysis is graphically represented in Appendix 2 (available at [https://gsem.urfu.ru/fileadmin/user\\_upload/site\\_15921/docs2/Appendix\\_2.pdf](https://gsem.urfu.ru/fileadmin/user_upload/site_15921/docs2/Appendix_2.pdf)) and demonstrates a high correlation between the MICEX bond index and the returns from investments of the funds from the funded pension component. With the index of cumulative inflation in Russia being 2.15 in the period from 2004 to 2011, the MICEX composite bond index made up 1.64, while the RTS Index made up 2.35. It should be remem-

bered here that the index of pension investment in Russia is 1.53<sup>4</sup>. Federal Law No. 111 and Government Decree No. 379 place severe restrictions on investments in equities and at the same time are less demanding in matters concerning bonds. Therefore, the correlation between the MICEX bond index and the returns from pension investment becomes legally justified.

The second piece of evidence supporting our hypothesis was provided by comparing the investment results of pension funds in OECD countries, Russia, and the world's leading stock indices. The results of the calculations of index volatility and return of the index are shown in Figure 1.

As our analysis has shown (see Figure 1), the Russian stock indices are characterized by high returns and high risks. If we turn to our conclusions (see Figure 1) about the negative returns of the funded component of the Russian pension system, this can serve as one more proof of our hypothesis that investment risks in Russian pension funds are legally reduced, but, unfortunately, to the disadvantage of investment returns.

According to the results of our analysis, there are significant discrepancies between the countries in terms of their investment returns and risks. The

Russian funded pension system is characterized by minimal risks together with negative investment returns. All this led us to the hypothesis that it is to manage pension investments in Russia by applying portfolio theory and constructing an investment portfolio including both Russian and foreign assets without any geographical or country restrictions. This is to maximize investment returns and at the same time limit the risks. It is also essential to take into account the foreign exchange and inflation risks which might occur when investing Russian pension funds on foreign stock markets.

### 3. MEASURES TO IMPROVE PENSION INVESTMENT EFFICIENCY

There is a large body of research literature on issues of investment risk management in pension systems. For example, Bikker and Vlaar (2007) analyzed the reduction in investment, interest rate, and inflation risks in pension and insurance spheres, and suggested creating reserve funds in pension institutions to minimize the impact of risks on the financial results of pension funds and insurance companies. The problems of building up an investment strategy in conditions of external environment risks are discussed in the work of Yang and Huang (2007). Merton suggests using financial performance guarantees to minimize investment risks.

In our opinion, elimination of geographical and instrumental restrictions could become an efficient tool of investment management to deal with considerable differences between stock indices on investment returns and risks (Swensen, 2009). We believe that portfolios can be constructed with the data of the world stock indices serving as investment instruments. Stock indices are the main indicators characterizing the situation in the relevant stock market. Even though the stock index on a particular date is not so important, its dynamics reflect the changes taking place in this or that stock market. Thus, it is possible to estimate the returns and volatility (risk) of securities in the relevant market by analysing the dynamics of stock indices. Therefore, by including the stock indices of the USA, Germany, France, Brazil, and other countries in the portfolio, we can estimate the risks and investment returns on specific

stock markets and compare them with the results of Russian management companies. As such, it will be possible to diversify investment portfolios of pension savings according to a geographical principle and to mitigate the risks. If indices with different levels of risk and returns were to be included in the investment portfolio, this would allow us to achieve the two key indicators which are crucial for pension systems: minimization of the investment risk and an increase in the investment return.

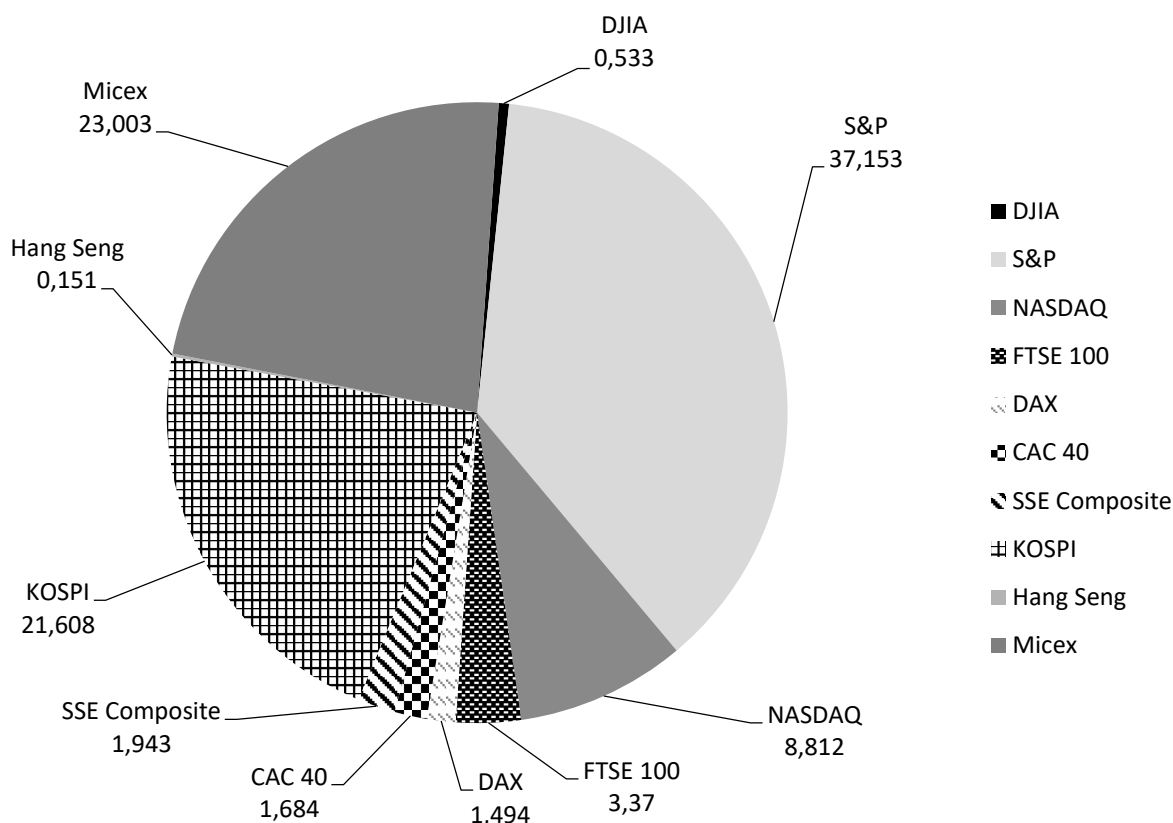
To find the optimal portfolio for pension investment in accordance with Markowitz's portfolio theory, we used the program Investment Portfolio Version 5.0 developed by Elton and Gruber. For the starting data of the model, the daily return of the analyzed indices ( $m_j$ ) was determined by two methods. In accordance with the first method, we calculated the investment return without taking into consideration foreign exchange and inflation risks. In accordance with the second method, we took into consideration the impact of exchange and inflation risks on investment returns. Converting pension savings into the investment currency and back led to exchange risks. Inflation risks reduce the real returns due to inflation in Russia. Thus, investment returns adjusted to inflation and exchange risks ( $M_j$ ) are found using the following formula:

$$M_j = \frac{P_j \cdot K_j - P_{j-q} \cdot K_{j-1}}{P_{j-1} \cdot K_{j-1}} \cdot (1 - \mu_j), \quad (3)$$

where  $K_j$  is the exchange rate of the investment currency against the rouble as of the close of the business day;  $K_{j-1}$  is the exchange rate of the investment currency against the rouble as of the previous day;  $P_{j-q}$  is the daily inflation in the Russian Federation, weight;  $P_j$  is the index value as of the close of the business day;  $P_{j-1}$  is the index value as of the previous day.

The results of the evaluation by applying formula (3) were used as starting data in the program Investment Portfolio for modelling the portfolio. The daily index return and the mean-square deviation of the daily return, used in the program Investment Portfolio Version 5.0, were calculated according to formula (3) respectively (the results are shown in Appendix 3 (available at [https://gsem.urfu.ru/fileadmin/user\\_upload/site\\_15921/docs2/Appendix\\_3.pdf](https://gsem.urfu.ru/fileadmin/user_upload/site_15921/docs2/Appendix_3.pdf))). An





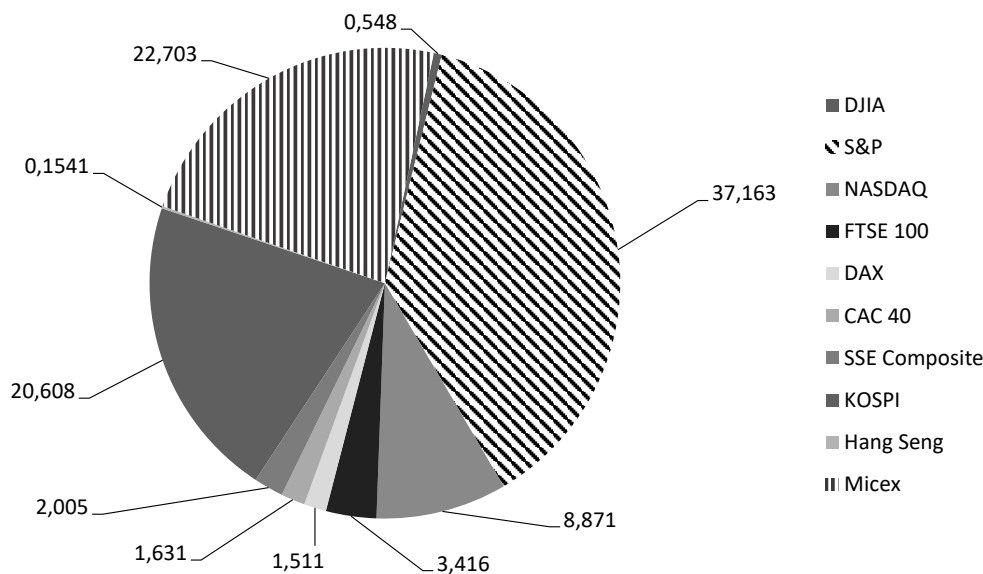
**Figure 2.** The structure of the index portfolio modelled according to Markowitz's theory and based on the data on the return of indices, net of exchange and inflation risks, with a risk (volatility) of 3.8%

investment portfolio modelled on the basis of the analyzed stock indices would contribute to increasing the real returns from the investments of Russian pension funds.

Using the data on the average daily returns of stock indices, we have found the correlations between the daily returns of the world's stock market indices. The results of the calculations are shown in Appendix 4 (available at [https://gsem.urfu.ru/fileadmin/user\\_upload/site\\_15921/docs2/Appendix\\_4.pdf](https://gsem.urfu.ru/fileadmin/user_upload/site_15921/docs2/Appendix_4.pdf)). Based on the data given in Appendix 3 and Appendix 4, we modelled an investment portfolio with the help of the program Investment Portfolio Version 5.0 in accordance with Markowitz's theory by applying formula (2) and assuming that the risks were kept at the average level for the OECD, at the rate of 3.8% (see Appendix 2, available at [https://gsem.urfu.ru/fileadmin/user\\_upload/site\\_15921/docs2/Appendix\\_2.pdf](https://gsem.urfu.ru/fileadmin/user_upload/site_15921/docs2/Appendix_2.pdf)). For the three time periods (from 12/25/2003 to 01/01/2011; from 01/01/2011 to 04/25/2013; and from 04/25/2013 to 04/25/2015), we modelled three alternative portfolios. Of the three portfolios based

on the extended, post-recession, and modern periods, the first portfolio demonstrates the most loyal results to Russian stock markets: Russian indices had heightened risks but were in the group of leaders by returns. The structure of the modelled portfolios based on the data of the extended period from 2003 to 2011 is shown in Figure 3 and 4 and Appendix 8 (available at [https://gsem.urfu.ru/fileadmin/user\\_upload/site\\_15921/docs2/Appendix\\_8.pdf](https://gsem.urfu.ru/fileadmin/user_upload/site_15921/docs2/Appendix_8.pdf)). To model the portfolio shown in Figure 3 and Appendix 8, we used the return of the index, net of exchange or inflation risks, based on monthly data, which allowed us to minimize any errors caused by 'noise'. The portfolio in Figure 4 and Appendix 8 was modelled on the basis of monthly data but was adjusted to exchange and inflation risks. The construction of these portfolios was based on the condition that there was no riskless lending/borrowing allowed.

The investment portfolio shown in Figure 3 has an expected return of 10.9% and a portfolio risk of 3.8%. As Figure 3 demonstrates, the key instruments in the portfolio of pension investment are



**Figure 3.** The structure of the index portfolio modelled according to Markowitz’s theory and based on the data on the return of indices, adjusted to exchange and inflation risks, with a risk of (volatility) 3.8%

the American indices S&P (their weight in the portfolio is 37.9%), NASDAQ (8.64%), the Korean Kospi (20 %), the Russian MICEX (23%), and the British FTSE 100 (3.3%).

As is seen from Figure 3, the weight of the Russian market (MICEX) is 25.6%, which implies the outflow of investments and is a negative factor. Nevertheless, as has been shown above, the system of the existing pension institutions in Russia, with their average return -4.57% from investments by private management companies from 2004 to 2011, does not allow it to provide real returns above the level of inflation. This erodes the real value of pension savings and does not allow companies to minimize the growing demographic risks of distribution pension systems (see Nepp, 2013).

Interestingly, the portfolio adjusted to exchange and inflation risks (see Figure 4) has almost the same expected return as the portfolio from Figure 3: 10.7% vs 10.9%. The portfolio risk was set at the same level, 3.8%.

The structure of the portfolio in Figure 4 is much the same as that of the portfolio from Figure 3. In our opinion, this occurs because of the factor that affected our analysis of index return net of risks and adjusted to risks (see Appendix 3, available

at [https://gsem.urfu.ru/fileadmin/user\\_upload/site\\_15921/docs2/Appendix\\_3.pdf](https://gsem.urfu.ru/fileadmin/user_upload/site_15921/docs2/Appendix_3.pdf)): the rouble devaluation led to exchange and inflation risks that almost fully or partially compensate for each other.

If the legal restrictions on pension investments inside Russia persist, then the investment portfolio will be constructed only out of the assets that are available on the Russian stock market (see Appendix 7, available at [https://gsem.urfu.ru/fileadmin/user\\_upload/site\\_15921/docs2/Appendix\\_7.pdf](https://gsem.urfu.ru/fileadmin/user_upload/site_15921/docs2/Appendix_7.pdf)). The MICEX Index is calculated in roubles. Constructing a portfolio out of those instruments traded on the MICEX, management companies could achieve investment returns and portfolio risk equal to similar indicators of the MICEX Index. Investment return would be 8.8% (in roubles), while the risk level (mean-square deviation) would reach 0.11 (see Appendix 4). Taking inflation into consideration, the real return would be negative and would make up -1.8% in roubles. If the restrictions placed on investment instruments are lifted and if we compare the return of the portfolio constructed out of Russian instruments, then we see that the comparison is not in their favor: there are lower returns with higher risks.

Compared with the actual results of pension investments in Russia (see Figure 1 and Appendix 2,

available at [https://gsem.urfu.ru/fileadmin/user\\_upload/site\\_15921/docs2/Appendix\\_2.pdf](https://gsem.urfu.ru/fileadmin/user_upload/site_15921/docs2/Appendix_2.pdf)), the results demonstrated by the portfolios in Figures 3 and 4 show that there is a possibility for growth in investment returns.

The significance of the possible increase in returns of pension investments cannot be overestimated. To estimate the impact of investment returns on investment returns  $\alpha_i$ , let us plug them into formula (1) one by one and then divide them by each other.

$$\frac{PV_2}{PV_1} = \frac{\sum_{i=1}^{W-T} (1 + \alpha_2)^{W-T-i}}{\sum_{i=1}^{W-T} (1 + \alpha_1)^{W-T-i}}, \quad (4)$$

where  $W$  is the retirement age;  $T$  is the average age of entry into working life;  $\alpha_2$  is the average investment return according to the modelled portfolio, the return of which equals 10.9% a year;  $\alpha_1$  is the average investment return for the given period from 2003 to 2011, which equals -4.57% a year (see Appendix 1, available at [https://gsem.urfu.ru/fileadmin/user\\_upload/site\\_15921/docs2/Appendix\\_1.pdf](https://gsem.urfu.ru/fileadmin/user_upload/site_15921/docs2/Appendix_1.pdf)).

Let us apply formula (4) for a man aged 30 who would retire at 60 and thus would have a savings period of 30 years<sup>12</sup>. Plugging  $W - T = 30$ ; the investment return according to the modelled portfolio in Figure 3  $\alpha_2 = 10.7\%$ ; and the investment return from pension investments by Russian management companies  $\alpha_1 = -4.57\%$  in formula (4), we get the following:

$$\frac{PV_2}{PV_1} = 2.54.$$

Making similar transformations with the replacement rate, we see that the correlation of the replacement rate will still be the same (2.54) provided that the investment return is 10.7% and the replacement rate at the investment return is -4.57%. If the geographical restrictions are not lifted and the investment portfolio continues to be constructed out of Russian instruments with the

real return -1.8% (see above) and the investment return from pension investments by Russian management companies -4.57%, we get the following:

$$\frac{PV_2}{PV_1} = 1.34.$$

The Russian pension system could gain higher expected returns for the given level of risks by liberalizing the principles of its state regulation. If geographical barriers are eliminated and the current risk level is maintained, it will lead to a rise in investment returns and, consequently, a rise in the main indicators of pension systems, such as pension payments and the replacement rate.

If instrument restrictions are lifted but the geographical ones are not, then pension investment will bring a 1.34 times increase in pension payments and the replacement rate. The results of the calculations show that the elimination of geographical and instrumental barriers and the inclusion in the investment portfolio of instruments from the world's leading stock markets will lead to a significant growth in the main indicators of the pension system, such as pension payments and the replacement rate. This could solve the problems of distribution pension systems, which are subject to demographic risks (see Nepp, 2013).

We can draw the conclusion that most of the investments must be allocated in foreign assets, which might conflict with the government's political aims. The state is interested in making pension funds invest in domestic assets to stimulate the macroeconomy. Thus, there is a conflict between the state's current financial interests and the interests of the pension system, with problems being solved at the expense of future retirees.

Addressing the optimization tasks, we confined ourselves only to international equity indices. Even with the restrictions set by the law, the range of instruments could be wider. Apart from equity indices, it would be productive to consider the indices of state, corporate, and municipal bonds, which could become objects for further research.

12 Federal Law No. 167 of 12/19/2016 'On Mandatory Pension Insurance in Russia.'

## CONCLUSION

1. The existing conservative investment portfolios in Russia constructed under the influence of leverages minimize risks but to the detriment of investment returns, which were below the inflation level in some of the given OECD countries.
2. The pension system could gain higher expected returns for the given level of risk by liberalizing the principles of its state regulation.
3. The construction of an investment portfolio according to Markowitz's theory and the elimination of geographical and instrumental restrictions might bring a significant growth in investment returns and prevent risks from exceeding today's average level in OECD countries.
4. If geographical barriers are eliminated and the current risk level is maintained, this will lead to a rise in investment returns and, consequently, a rise in the main indicators of pension systems, such as pension payments and the replacement rate.
5. Improvement of the indicators of funded pension systems will help solve the problems of distribution pension systems, which are affected by demographic risks.
6. The elimination of geographical restrictions on pension investments will lead to a partial outflux of investments from Russia because some of the pension funds will be transferred to foreign assets.

## ACKNOWLEDGEMENT

The author gratefully acknowledges the assistance of Prof. Ostap Okhrin (Dresden University), Prof. Olga Popova (University of Regensburg), and Prof. Vladimir Otrashenko (University of Lisbon) for their constructive comments and critique, which helped to improve the quality of this paper.

I would like to express my deepest gratitude and appreciation to Prof. Oleg Nikonov (sadly deceased) (Ural Federal University) for his wise advice and assistance.

I would also like to thank my colleagues Ekaterina Purgina and Viktoria Polyakova (Ural Federal University) for their help and patience.

This research is supported by the Russian Science Foundation RSF Grant No 15-18-10014 'Projection of optimal socio-economic systems in turbulent external and internal environments'.

## REFERENCES

- 
1. Bikker, J. A., Vlaar, P. J. (2007). Conditional indexation in defined benefit pension plans in the Netherlands. *Geneva Papers of Risk and Insurance: Issues and Practice*, 32(4), 494-515. Retrieved from <http://www.jstor.org/stable/41952958>
  2. Black, F. (1986). Noise. *Journal of Finance*, 41(3), 529-543.
  3. Blackburn, R. (2012). The Enron debacle and the pension crisis. *New Left Review*, 14, 16-35. Retrieved from <https://newleftreview.org/II/14/robin-blackburn-the-enron-debacle-and-the-pension-crisis>
  4. Boender, G. C. E., van Aalst, P., Heemskerk, F. (1998). Modeling and management of assets and liabilities of pension plans in the Netherlands. In Ziemba, W. T., Mulvey, J. M. (Eds.), *Worldwide Asset and Liability Modeling* (pp. 561-580). Cambridge: Cambridge University Press.
  5. Brière, M., Signori, O. (2013). Hedging inflation risk in a developing economy: The case of Brazil. *Research in International*

- Business and Finance*, 27(1), 209-222. <https://doi.org/10.1016/j.ribaf.2012.04.003>
6. Campbell, J. Y., Viceira, L. M., White, J. S. (2003). Foreign currency for long term investors. *The Economic Journal*, 113, 1-25.
  7. DeLong, J., Schleifer, A., Summers, L. H., Waldmann, R. J. (1989). The size and incidence of losses from noise trading. *Journal of Finance*, 44(3), 681-696.
  8. FitzGerald, V. (2004). Financial globalization and poor countries: The impact of international asset demand instability on emerging markets. *IDS Bulletin*, 35(1), 50-59.
  9. Goetzmann, W. N., Ukhov, A. D. (2006). British investment overseas 1870-1913: A modern portfolio theory approach. *Review of Finance*, 10(2), 261-300.
  10. Goetzmann, W. N., Ukhov, A. D., Zhu, N. (2007). China and the world financial markets 1870-1939: Modern lessons from historical globalization. *Economic History Review*, 60(2), 267-312. <https://doi.org/10.1111/j.1468-0289.2007.00376.x>
  11. Van Heerden, J. D., Koegelenberg, F. J. (2013). Optimal asset allocation strategies for South African pension funds. *Journal for Studies in Economics and Econometrics*, 37(1), 29-54. Retrieved from <http://hdl.handle.net/10520/EJC138185>
  12. Roig Hernando, J. (2016). Crowdfunding: The collaborative economy for channelling institutional and household savings. *Research in International Business and Finance*, 38, 326-337. <https://doi.org/10.1016/j.ribaf.2016.03.004>
  13. Kumara, A. S., Pfau, W. D. (2013). Would emerging market pension funds benefit from international diversification: Investigating wealth accumulations for pension participants. *Annals of Finance*, 9(3), 319-335. Retrieved from <https://link.springer.com/article/10.1007/s10436-011-0187-5>
  14. Markowitz, H. (1959). *Portfolio Selection. Efficient Diversification of Investment*. Monograph for Research in Economics of Yale University. John Wiley and Sons. New York, 356 p.
  15. Markovič Hribernik, T., Jakopanec, I. (2012). Pension funds, the requirement of providing the minimum guaranteed return and excessive legislative restrictions of pension fund investments. South East European. *Journal of Economics and Business*, 7(2), 7-22.
  16. Menshikov, S. (2013). The impact of pension funds on the volatility of the Russian stock market. *Corporate Finance*, 1(25), 17-32.
  17. Nepp, A. (2013). The role of demographic risks for unfunded pension systems. *World Applied Sciences Journal*, 27, 234-240.
  18. Nguyen, T., Stützel, R. (2012). Rentenversicherung, Bevölkerungsentwicklung und Kapitalmarkttrendite – Eine Simulationsrechnung. *Zeitschrift für die gesamte Versicherungswissenschaft*, 101(5), 675-691.
  19. Swensen, D. F. (2009). Pioneering portfolio management: An unconventional approach to institutional investment, fully revised and updated. Simon and Schuster.
  20. Tumanyants, K. A., Gulyaeva, E. V. (2016). Individual choice of a pension fund in Russia: Are the investment results of the fund important? *International Journal of Economics and Financial Issues*, 6(4), 1328-1337. Retrieved from <http://www.econjournals.com/index.php/ijefi/article/view/2636>
  21. Stalebrink, O. J. (2016). Public pension funds and alternative investments: A tale of four Swedish national pension funds. *International Journal of Public Administration*, 39(2), 107-121. <http://dx.doi.org/10.1080/01900692.2014.988869>
  22. Xu, J., Kannan, D., Zhang, B. (2007). Optimal dynamic control for the defined benefit pension plans with stochastic benefit outgo. *Stochastic Analysis and Applications*, 25(1), 201-236.
  23. Yamahaki, C., Frynas, J. G. (2016). Institutional determinants of private shareholder engagement in Brazil and South Africa: The role of regulation. *Corporate Governance (Oxford)*, 24(5), 509-527. <http://dx.doi.org/10.1111/corg.12166>
  24. Yang, S. S., Huang, H. C. (2009). The impact of longevity risk on the optimal contribution rate and asset allocation for defined contribution pension plans. *Geneva Papers on Risk and Insurance: Issues and Practice*, 34(4), 660-681.