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The Optimum Ratio of Risk and Return Accrued Pension Funds as a Factor of Influence on the Well-Being of the Older Generation

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Abstract

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The well-being of the older generation from the perspective of optimal using of pension savings is considered. According to the laws opportunities for investment securities in a simple and portfolio expansion are defined. Four types of securities, which theoretically can be invested pension savings, are analyzed. Diversified portfolios with different levels of risk are composed. The curve of return and risk of different possible investment portfolios is simulated. The fact of the possibility of obtaining a higher level of profitability while maintaining a constant risk is confirmed.

Keywords: Well-being; fund; loan; cash management.

1. Introduction

In recent decades, such phenomenon as the "gray revolution" continues to gather pace. The number of employed and unemployed varies with different rates. Thus, contributions to non-budgetary funds, in particular the Russian Pension Fund are not commensurate with the required annual cash to pay pensions. As a consequence of this, problems of increasing the retirement age and the optimal management of available funds received in the Pension Fund of Russia and to private pension funds are relevant. Management strategy as part of cash management includes obtaining the optimal balance between risk and return. Thus, it is important to invest effectively at a reasonable level of risk in the certain investment portfolio.

The main idea of the research is to construct a model that describes the well-being of the older generation by the impact of the strategy of effective investment of pension savings while increasing profitability and risk diversification of the investment portfolio.

2. Body

2.1. Investigation of possible investment portfolios for pension savings

Under the law of the Russian Pension Fund transfers the ability to manage the accumulated funds to the State Management Company, which forms two investment portfolios: an investment portfolio of government securities and expanded investment portfolio. Capital of citizens, who do not exercise the right of choice of the management company (investment portfolio), are accumulated in the expansion of the investment portfolio. Management strategy of the capital depends on the type of portfolio and the restrictions imposed on each of them. The first investment portfolio permits implement investments exclusively in government securities and bonds of Russian issuers. Advanced portfolio allows investment in government bonds, not backed by a government guarantee in the amount of not more than 40% of mortgage-backed securities - not more than 20%, securities of international financial organizations - not more than 20%. With regard to private management companies, they are also allowed to make investments in equity securities of Russian issuers. (http://moex.com/ru/index/pension/, 2015)

Therefore, the main objective of this study is to establish the best and most favourable directions for investment, taking into account the risk and rate of return.

For this study, four were selected index on the market of securities with varying degrees of profitability and risk premium. The first group is analyzed securities MICEX Index, which includes the price of the market capitalization of the most liquid stocks of the largest and dynamically developing Russian companies (Gazprom, Aeroflot, VTB, Sberbank, and others). The second group of securities is represented by state federal loan bonds, which are considered risk-free investment. The third element is the index of the «second tier», which is the price of shares of Russian companies that were not included in the MICEX index. The fourth group takes the index of corporate bonds with a maturity of 3-5 years. All indexes are taken on the basis of the calculation of "net price", which reflect the change in the value of securities without accrued interest. The choice of the above mentioned indices to calculate is due to the available sources of information and the period of their existence. (http://fs.moex.com/files/961/, 2015)

2.1.1 MICEX index

The graph (Fig. 1) shows the changes in profitability included securities for the period from 1997 to 2015. Standard statistical indicators of data scatter are variance δ^2 and the standard deviation δ. The variance of the yield of the securities represents the expected deviation from the most probable yield squared. Significant fall in share prices is the result of the crisis of 1998 and 2008. The sharp jump in 1999 is due to the development of business in the economy (telecommunications and IT-technologies).

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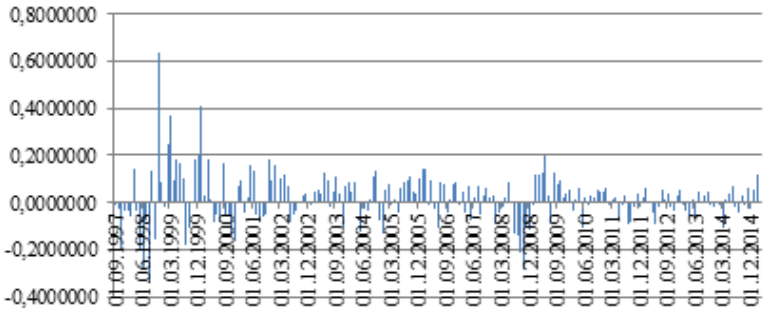

Fig. 1. Dynamics of MICEX Index (http://moex.com/ru/indices, 2015)

The table below shows the calculated statistical indicators. Deviation from the expected return of ordinary shares of Russian issuers is 154.017%. It is indicating a high risk of volatility of returns, which is also reflected in the chart.

Table 1. The calculated statistical indicators for the MICEX index

Deviation	154.017%
Average	0.019020
Dispersion	2.372129
Yield	15.27

2.1.2. The index of government bonds

The graph shows data changes of the level of government bond yields for the period from 2012 to 2015. The sharp fall in the value at the end of 2014 is due to the crisis.

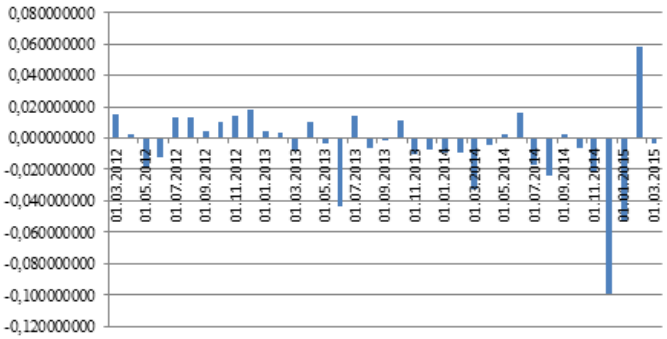

Fig. 2. Dynamics of Government Bond Index (http://moex.com/ru/indices, 2015)

The statistical data of expected yield of government bond is calculated in the table. Deviation from the expected return is 14.9%, which is almost 10 times less than the calculated standard deviation for MICEX.

Table 2. The calculated statistical indicators for the government bonds

Deviation	14.95297%

Average	-0.004687483
Dispersion	0.022359119
Yield	3.11

2.1.3. The second tier

Below there is a graph of the stock return of the "second tier" for the period from 2005 to 2015. Also the values of the variance, standard deviation, and the yield of the securities are shown. Thus, the expected average yield is 103.6% deviation, indicating a high degree of risk. The yield is 17%.

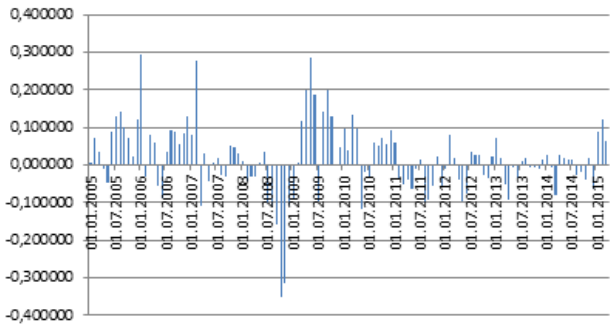

Fig. 3. Dynamics «the second tier» [http://moex.com/ru/indices, 2015]

Table 3. The calculated statistical indicators for the second tier

Deviation	103.6204%
Average	0.014586
Dispersion	1.0737
Yield	17.19

2.1.4. Index of corporate bonds with a maturity of 3-5 years

Below there is a graph of the yield index changing (long-term corporate bonds) for the period from 2006 to 2015. The yield of the securities is 3.16%, which varies between 19%. Significant fall in share prices is the result of the crisis of 1998 and 2008. The sharp jump in 1999 is due to the development of business in the economy (telecommunications and IT-technologies).

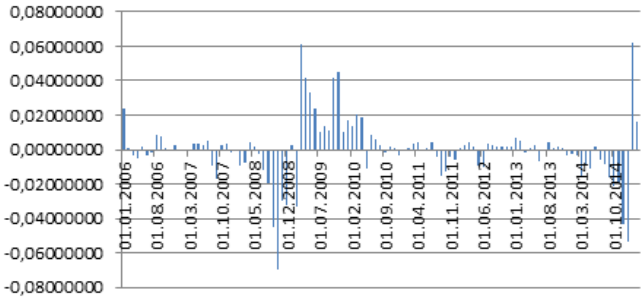

Fig. 4. Dynamics of the Index of corporate bonds with a maturity of 3-5 years [http://moex.com/ru/indices, 2015]

Table 4. The calculated statistical indicators for the index of corporate bonds with a maturity of 3-5 years

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Deviation	19.045689%
Average	-0.00015406
Dispersion	0.03627383
Yield	3.16

Thus, the level of risk of investments in securities is determined by the following procedure: public federal bonds, corporate bonds with a maturity of 3-5 years, shares the "second tier" ordinary shares. In contrast to the generally accepted opinion MICEX securities are more risky investments than "second tier", which may be due to the different periods of the index calculation in the research.

Financial managers claim that diversification reduces the securities portfolio risk. And of particular interest has an investigation of securities with a negative or a lower coefficient of correlation. In this case, even a slight diversification can significantly reduce the risk.

In this case, we study various combinations of the four types of securities with different levels of risk premiums. To determine the expected standard deviation of different portfolios profitability of each type of securities for a specific period of time are added up, respectively. (Masaya, 2014)

Table 5. The calculation of the main statistical indicators for various portfolios

Combination of securities	Average	Dispersion	Standard deviation
1-2	-0.0006174	0.1363922	36.931%
1-3	0.02702628	3.0232065	173.874%
1-4	0.0077094	0.7896373	88.862%
2-3	-0.0066387	0.1370868	37.025%
2-4	-0.0080056	0.0579378	24.070%
3-4	0.00951609	1.2767997	112.996%
1-2-3	-0.0025685	0.37975	61.624%
1-2-4	-0.0039355	0.1892285	43.500%
2-3-4	-0.0099568	0.1942301	44.072%
1-3-4	0,01737954	3.2393184	179.981%
1-2-3-4	-0.0058867	0.4541509	67.391%

where 1- most liquid shares dynamically developing Russian companies (MICEX index);

2 - government bonds, federal (government bond index);

3 - shares of Russian companies unrelated to the most liquid (The second tier);

4 - long-term corporate bonds with a maturity of 3-5 years (index of corporate bonds).

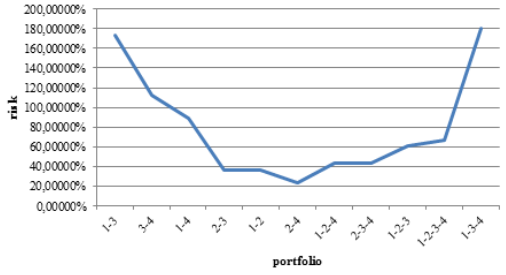

Figure 5. Dependence of the standard deviation (risk) and the number of securities in the portfolio

This confirms the fact of a reducing the risk of the investment portfolio in its diversification. This effect is achieved due to the fact that the prices of various securities vary differently. In the statistics it is said that changes in stock prices have imperfect correlation. If we compare the change in the yield of ordinary shares that have relevant changes of this indicator, and government bonds, which differ in the relative stability of the changes, the decline in prices for some securities is offset by higher prices for others.

Risk, which can be adjusted by diversification, is the individual risk. He represented the result of certain situations on the market that have an impact on certain companies, therefore, for a certain type of securities. Market risk, which is associated with general economic situation, cannot be eliminated through diversification of the portfolio. (Iremadze, 2013)

The chart (Fig.5) illustrates a situation of reducing the standard deviation when a combination of two securities. However, a portfolio risk begins to increase again when the number are raised more. At some point, some decrease in the yield of the securities cannot be compensated by an increase in the yield of others.

2.2. Determining the level of risk and return is equal weighted portfolio

It has been determined that the diversification of portfolio securities will maintain a reasonable rate of return and hedge funds against the risk of the pension fund. Next, it's necessary to calculate the impact of individual risk securities to the whole portfolio to determine their optimal number.

Suppose that the portfolio contains 25% of each class of securities. Thus, the yield of the investment portfolio is:

Portfolio yield = (15.27+3.11+17.19+3.16)*25%=9.68%

However, the standard deviation of the total portfolio cannot be calculated as a weighted average of deviations of certain types of securities, because the prices of stocks and bonds vary differently. (Tchigirinskaya, 2015)

The risk of the entire portfolio is calculated based on the dispersion matrix of all the individual types of securities. The total dispersion of portfolio securities is equal to the sum of the values of the matrix elements.

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Table 6. The dispersion matrix of various securities (Barsukov, 2015)

	MICEX	Government bonds	Second-tier stocks	Corporate bonds
MICEX	$x_1^2\delta_1^2$	$x_1x_2\delta_{12}$ $= x_1x_2\beta_{12}\delta_1\delta_2$	$x_1x_3\delta_{13}$ $= x_1x_3\beta_{13}\delta_1\delta_3$	$x_1x_4\delta_{14}$ $= x_1x_4\beta_{14}\delta_1\delta_4$

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Government bonds	$x_1x_2\delta_{12} = x_1x_2\beta_{12}\delta_1\delta_2$	$x_2^2\delta_2^2$	$x_2x_3\delta_{23} = x_2x_3\beta_{23}\delta_2\delta_3$	$x_2x_4\delta_{24} = x_2x_4\beta_{24}\delta_2\delta_4$
Second-tier stocks	$x_1x_3\delta_{13} = x_1x_3\beta_{13}\delta_1\delta_3$	$x_3x_2\delta_{32} = x_3x_2\beta_{32}\delta_3\delta_2$	$x_3^2\delta_3^2$	$x_3x_4\delta_{34} = x_3x_4\beta_{34}\delta_3\delta_4$
Corporate bonds	$x_1x_4\delta_{14} = x_1x_4\beta_{14}\delta_1\delta_4$	$x_2x_4\delta_{24} = x_2x_4\beta_{24}\delta_2\delta_4$	$x_4x_3\delta_{43} = x_4x_3\beta_{43}\delta_4\delta_3$	$x_4^2\delta_4^2$

where x_i - yield of a certain type of securities;

δ_{ij} – covariance of yield of securities i and j;

β_{ij} – correlation of securities i and j;

δ_i – deviation of securities i.

Covariance is the measure of the variability of joint two types of securities. It is determined by multiplying the correlation coefficient on the standard deviations of specific types of securities. (Ronova, 2011)

Below there is a matrix of dispersions with equally weighted shares of the analyzed securities.

Table 7. The dispersion matrix of analyzed securities

	MICEX	Government bonds	Second-tier stocks	Corporate bonds
MICEX	1482.58	65.79	793.23	104.24
Government bonds	65.79	13.97	35.47	14.41
Second-tier stocks	793.23	35.47	671.07	75.61
Corporate bonds	104.24	14.41	75.61	22.67

In this case, the dispersion of the portfolio is:

$$\delta^2 = \sum_{i=1}^{n} x_i x_j \beta_{ij} \delta_i \delta_j \rightarrow \min$$

$$\delta^2 = 4367.82$$

Thus, the risk of the portfolio's value is defined $\delta = \sqrt{\delta^2} = \sqrt{4367.82} = 66.09\%$. The yield of the portfolio is 9.68%.

The figure reflects the curve of expected return and risk, achieved with different combinations of the four types of securities. The abscissa is the expected return of the portfolio, the vertical axis is the expected level of risk.

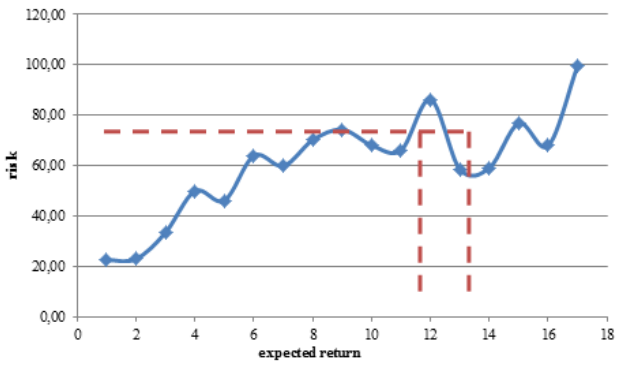

Figure 6. Dependence of the risk and return of the investment portfolio for four different combinations of shares of securities

3. Conclusion

Speaking about the optimal balance between profitability and deviation, maximum profitability while reducing risk will be obtained when moving on the graph to the right and down. This chart illustrates a situation in which two portfolios with the same level of risk may have different yields. The purpose of the investor is to allocate funds, in this case, the accumulation of the Pension Fund, so as to get the greatest return with an acceptable level of risk.

The dotted line shows the possibility of obtaining higher yields of the securities portfolio while maintaining risk at a constant level. It is optimal to achieve a return of 14.6% than the yield of 12.5% for the same degree of risk. (Platonova, 2015)

This model is not entirely perfect, as obvious is the fact that it is impossible to invest pension funds to the high-risk assets. However, it is an example of the possibility of drawing up an investment portfolio with a higher yield for a given level of risk.

Moscow stock exchange indices has calculated yield for different investment strategies of using of pension savings. Since the beginning of 2015 the conservative strategy would yield 4.91%, a balanced portfolio - 7.28% and aggressive - 10%. The degree of return is proportional to the share of funds invested in shares of Russian companies. It was shown above, even stocks of dynamic developing companies have a high level of risk. In order to find the optimal value of risk and return, you can use the above model analysis. (Kundakchyan, 2013)

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