

OPTIMAL RISK/RETURN TRADE-OFF OF THE 2ND PILLAR PENSION PLANS IN LATVIA

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ABSTRACT

The 2nd pension pillar in Latvia started to operate in 2001 but systematic quantitative research of all pension plans still has not done. There are 21 pension plans in 2nd pillar and participants always arise a question – which pension plan better to choose.

The aim of this research is to make a quantitative analysis of all 2nd pension pillar pension plans and define the best ones for participants with high, medium and low risk tolerance.

The general statistical analysis of the 2nd pillar pension system has done to bring out the risk/return ratio of each pension plan, the holding period return, the assets over participant ratio and the growth speed of the system in the last five years. Markowitz method of optimization is used to determine the optimal risk/return situation in active, balanced and conservative investment plans and identify the best pension plans by its strategy. The risks and returns of each pension plan were evaluated and compared to the several benchmarks. To test the people's knowledge about their pension plans, the survey was carried out and compared with the viewpoint of professionals.

It was found that there is a large disproportion between the optimal allocation of 2nd pension funds and the actual investment structure. Lack of knowledge of the general public about pension plans was identified. Practical recommendations for pension plan participants have worked out in each risk category, depending on person's risk appetite.

Key words: pension funds, 2nd pension pillar, Markowitz model, optimal risk/return ratio

1.INTRODUCTION

Latvia is one of the first countries in Central and Eastern Europe, launched a multi-level pension scheme. A similar scheme has also been introduced in Sweden, Poland and Italy. Pension reform started in 1996, when the parliament supported the concept of pension reform. The Law on State Pensions, which provided implementation of 1st pension pillar came into force in 1996 and in 1998 entered into force the Law on Private Pension Funds (3rd pillar). The operation of the 2nd pension pillar started in 2001 with the entry into force of State Funded Pensions Act (State Funded Pensions Act, 2001).

The 3-pillar pension system in Latvia is quite new and it is still very hard for the private persons to aware that every member of a pension plan now is an investor. When young adults start their business carriers, they are often struck by a simple yet very difficult question, which 2nd pillar pension plan to choose? All citizens need to have a concise and impartial review on the whole pension system to maximize the efficiency and returns on their investments. It is important to find the right pension plan provider and the right pension plan. Timmerman (2014) shows that using a personalized search process can help to conduct a successful provider. The assessment of performance of state-funded pension plans is quite important to the state to ensure effective operation of pension system. Unfortunately systematic quantitative research of performance of all 2nd pension plans still has not done.

The goal of the current research is to analyze the current situation in the 2nd pillar pension plan system in Latvia, to carry out quantitative analysis of all investment plans of 2nd pension pillar and define the most favourable pension plans for the participants with a high, medium and low risk tolerance. To make a right option of offered pension plans and further application of appropriate life cycle strategy ensures optimal performance. Antolín, Payet and J. Yermo (2010) showed that maintaining a constant exposure to risky assets during most of the accumulation period, switching swiftly to bonds in the last decade before retirement seem to produce adequate results. They provide higher expected benefits for a given level of risk than other life cycle strategies.

To ensure correct assessment of pension plans the statistical analysis of all 2nd pillar pension plans is carried out, the risk/return ratio of each pension plan, the holding period return, the assets over participant ratio and the growth speed of the system is found out. The 5-year period has chosen for analysis to cover the

same period of all 21 now existing 2nd pillar pension plans. This research follows a purely quantitative method of analysis using statistical and risk management techniques to make conclusions and provide guidelines for participants of the 2nd pillar pension plans. Markowitz model of optimization is used to determine the optimal risk/return ratio in each risk category of investment plans and identify the best-performing pension plans.

In addition, the survey is carried out to test the people's knowledge about their pension plans. The viewpoint of professionals was found out as well in in-depth interviews and both compared with real situation.

2. STRUCTURE AND OPERATION OF PENSION SYSTEM

According to Fabozzi (2001) there are two basic and widely used types of pension plans: defined contribution (DC) plans and defined benefits (DB) plans. In a DC plan, the plan sponsor is responsible only for making specified contributions into the plan on behalf of qualifying participant. In a DB plan, the plan sponsor agrees to make specified payments to qualifying employees at retirement. Clark and Urwin (2011) point out that nowadays DB pension plans are mostly replaced by DC pension plans in OECD countries. In some cases, this is the result of the closure of DB plans (e.g., the UK) whereas in other countries the dominance of DC plans reflects the evolution of industry structure, employment practices and regulation (e.g., the US) (Clark and Urwin, 2011).

Pension system in Latvia is based on DC pension plans as well. Pension capital is funded by regular payments as a certain percentage of individual's salary (State Funded Pensions Act, 2001). Pension system reform in Latvia was developed 1994.-1995. (Ministry of welfare, 1996) and realized since 1996 (Zilite, 2000). The system includes a state compulsory unfunded pension scheme as the 1st pillar pension, a state funded pension scheme as the 2nd pillar pension and a 3rd pillar that is a private voluntary pension scheme. The pillars are thought to protect the system's participants from demographical and financial risks associated with retirement fund management. The pension system serves as both "obligatory (1st and 2nd pillars) and voluntary (3rd pillar)" (State Funded Pensions Act, 2001) demand for retirement fund savings. It combines both individual interests of people to save money for retirement and the solidarity for the elderly participants. The main idea behind the pension system is that if a participant makes "bigger contributions to the system – the larger the retirement fund he will accumulate during his life.

The 1st pension pillar is a state compulsory unfunded or non-accumulated pension scheme (Latvijas Centralais depozitārijs, 2015). The contributions to this pillar are made through a social security tax that is deducted from a person's gross salary. The funds that have been paid by the existing workforce are divided between the workers themselves and the actual generation of pensioners. This pension pillar follows the logic of social security contributions – as longer the participant is working and paying social taxes as bigger the state unfunded pension he will receive by the time of his retirement (Latvijas Centralais depozitārijs, 2015). To become a member of the 1st pillar pension an individual should have worked at least 10 years in a paid employment (State Funded Pensions Act, 2001).

The 2nd pillar pension started to operate after 1st of July 2001 when the State Funded Pensions Act entered into force and some part of the social contributions was allocated for investments in capital markets. These actions provide the possibility for capital gains of the existing pool of funds in the pension system. The objective of the 2nd pillar is to increase the value of the retirement funds over time by growing capital and investing. The growth of the value of the personal retirement fund provides larger repayments as well as increasing the overall amount of the pension. The main goal of the 2nd pillar pension is to provide "a faster-than-inflation growth of the invested funds" (Latvijas Centralais depozitārijs, 2015). The contributions to the 2nd pillar pension are obligatory if a participant is born after 1st of July 1971 and are made automatically from the gross salary of the participant who is paying social tax (State Funded Pensions Act, 2001). Participant of 2nd pillar pension system do not have to make additional social insurance payments. Total amount of payments for retirement capital (20% from gross income) is constant and is divided in two parts: for 1st pillar pension and for 2nd pillar pension. The proportion between 1st and for 2nd pillar is defined by law. The part of 2nd pillar has varied from 2% to 8% since 2001, and now, in 2015, it is 5% (SSIA, 2013). The 3rd pillar pension is a pension scheme that provides a possibility for participants to accumulate and grow their additional retirement savings on voluntary bases. The aim of this pillar is to increase the potential gains and the volume of retirement savings of a given participant. It means that in addition to the state's 1st and 2nd pillar pension the 3rd pillar pension participant may receive additional funds (Latvijas Centralais depozitārijs, 2015).

Processing of pension system in Latvia is carried out in accordance with Law on Private Pension Funds (1997). The main counterparts involved in this process are pension funds, investment management companies (IMC), custodian banks, the State Social Insurance Agency (SSIA) and the Financial and Capital Market Commission (FCMC).

The main tasks of the SSIA is to ensure functioning of the 1st and 2nd pillar pension schemes, i.e., register the socially insured persons and their contributions into the personal social insurance account, administer the contributions of the participants of the 2nd pillar pension scheme as well as to perform pension payment out of the resources accumulated from the social insurance contributions made by the employers and employees (SSIA, 2015).

Private pension funds work out pension plans and in accordance with law and those pension plans accumulate and invest the funds of pension plan members to ensure those participants supplementary pension (Law on Private Pension Funds, 1997). Pension plans worked out by pension funds have to be registered in FCMC. Pension funds have the rights to start operations only after receiving license from FCMC. According to the law pension funds can freely choose investment management companies. The State Funded Pensions Act (2000) stated the State Treasury to stop to manage state funded pension plans. 2nd pension pillar can be managed by the private investment management companies, which are registered in the state funded pension scheme managers register, maintained and updated by the Financial and Capital Market Commission (Law on Private Pension Funds, 1997). To become a funded pension scheme manager, an investment management company also has to receive a license from the Financial and Capital Market Commission. The manager makes decisions on investment of funds and is responsible for managing the funds entrusted to him in order to ensure 2nd pillar pension capital preservation and growth. The manager keeps track of financial market trends and makes decisions about where to invest in the most beneficial way. Managers can invest the entrusted funds only in accordance with the investment regulations and investment plan prospectus (Cabinet of Ministers regulation No.72s, 2003). One of the main principles to be observed by the fund manager and that is defined in the investment rules, is the investment diversification. This means that in order to reduce the risk, funds would be invested in various securities, so that fluctuations in individual securities have no negative impact on portfolio as a whole in the long term. Individuals and also government are fully relying on IMC of pension funds. In these institutions responsible for the pension funds typically do not have a stake in the structure and performance of the plan. It gives significant protection to retirement capital of individuals. Dragota and Susanu (2010) are assuming pension plan members (PPMs) to be by default risk averse.

Settlements with pension scheme funds IMC carries out with the custodian bank on a custody agreement basis (State Funded Pensions Act, 2000). The custodian provides custody for the pension fund shares of any given participant. Pension funds are kept in a custodian bank as well.

Monitoring of pension funds in Latvia is based on a double safety mechanism. Firstly, from the part of the state, pension fund investment is supervised by the FCMC. Secondly, fund managers are monitored by the custodian bank, because the monitoring of the pension funds is managed separately from its storage. Manager shall be required to provide regular information to the SSIA, so that it could provide information on fund manager performance and investment plans to the pension plan participants (Latvijas Centralais depozitarijs, 2015). In Latvia according to the law own balance sheet and all financial actions of pension fund management institution is separated from assets of pension fund it is managing. There is only management fee subtracted from fund share value and added to management institution's profit. Individual gets net share value on which management institution does not have any right. Additionally there are several limitations of investments both in single financial instrument and in certain category or group of financial instruments (State Funded Pensions Act, 2001).

Pension plans in Latvia are divided according to proportion of risky assets in investment portfolio. Most common types according to this division are: with the lowest proportion of risky assets (conservative), balanced and active with the highest proportion of risky assets, but limited to be not more than 50% of pension plan assets (Latvijas Centralais depozitarijs, 2015). Requirements of performance and risk are different for each type of pension plan. It has to be taken in consideration that there will be lower performance results but also lower risk in conservative pension plans and higher – in active plans. Those types differ mostly by proportion of risky and risk free assets in investment portfolio of each pension plan. The focus of this research is performance of 2nd pillar pension plans.

3. RESEARCH METHODOLOGY

The research was divided into three parts. For each of the parts a separate research methodology was

used.

In the first part the collection of secondary data was carried out through the download of daily values of each pension plan on the manapensija.lv domain (Latvijas Centralais depozitarijs, 2015). To cover the same almost 5-year period of all now existing pension plans the downloaded information spans from 2nd of February 2009, when the last of the 21 current pension plans started its operations, till 19th of December 2014. The daily prices of the investment plans have been converted to weekly by taking every 5th price of the distribution, as the pension plans do not evaluate their shares on weekends and holidays. All in all secondary data counts 6237 weekly prices of the investment plans and 6216 weekly continuous returns. In order to analyze the secondary data, general statistical functions, such as continuous returns, average of continuous returns (mean expected return), standard deviation of continuous returns (expected risk), holding period returns, holding period yields, growth and risk/return calculations have been used. Applying these calculations to the benchmarks gave the perspective tendencies of the 2nd pillar pension plans to the general market.

In the second part of the research the secondary data from the first part was analyzed using the mean-variance model (Bodie, Kane and Marcus, 2014). The risks and returns of each pension plan were evaluated and compared to the several benchmarks. The following analysis procedures were carried out:

- Evaluation of the General statistics of the pension plan by its strategy. The General statistics include Expected returns, Risk, Risk/Return ratio, Holding period return and Holding period yield.
- Evaluation of the average weights of each of the above mentioned financial indices.
- Construction of the covariance matrix using the MS Excel available data analysis tools and the calculated daily holding period yields of each pension plan.
- Minimization of the variance of the portfolio of pension plans by strategy in order to achieve the minimal variance portfolio.
- Maximization of expected return of the portfolio of pension plans by strategy in order to achieve the target return portfolio.
- Maximization of the slope to the efficient frontier enabled evaluation of the best performing investment plan by percent's in the portfolio weights.

All six steps mentioned above were used to determine the best performing investment plan by strategy.

In the third part of the research the survey was carried out to test the people's knowledge about their pension plans. In order to achieve statistically significant results 521 random people was surveyed in the age of 18 to 65. The respondents were asked to answer 4 simple questions elaborating on their age, 2nd pillar pension plan that they enlisted for, the expected annual return on their contributions to the plan and the probable risk of losing a portion of their investments. To compare the opinion of ordinary people to professional one, the same questions were asked in in-depth interviews to 5 professionals from banking sector.

GENERAL STATISTICAL REVIEW OF THE 2ND PILLAR PENSION PLANS

During almost the 5-year period from the inception date of the last of now present investment plans (02.02.2009) to the end of 2014 the 2nd pillar pension system in Latvia according with the publically available information (Latvijas Centralais depozitarijs, 2015) has grown significantly (see Table 1.).

Table 1

Growth of the 2nd pillar pension system from 2009 till 2014

Category	Date		Change
	02/02/2009	19/12/2014	
PARTICIPANTS	1 074 549	1 249 433	+16.3%
ASSETS, EUR	707 730 335	1 989 125 470	+181%
SHARE PRICE (average)	1.62127	2.18358	+34.7%
ASSETS/PARTICIPANTS	658.63	1 592.01	+142%

Source: Latvijas Centralais depozitarijs (2015)

For the past 5 years the number of 2nd pension pillar participants has increased by 16%, meaning that workforce and the general labour climate has improved in Latvia. The assets under management have almost tripled over 5 years. However the increase of 35% in 1 share price of all pension plan portfolios have lowered the rate of generating of these shares in the pension accounts. An increase of 142% in assets under management (AUM) over participants is a major improvement in the expected return of these portfolios.

At the end of December 2014 there were 21 investment plans of the 2nd pillar pension in Latvia held by 7 investment management companies (IMC) – mostly subsidiaries of corresponding commercial banks (see Table 2).

Table 2

**General statistics of the 2nd pillar pension plans of Latvia December 2014
(and binding investment plans to one letter, ascending)**

Investment management company	Investment plan	Category	Share price	Total value EUR	Participants	Binding letter
CBL Asset Management	„Aktivais pensiju plans”	Active	2.5403049	206 125 006	123 760	A
	„Universalais pensiju plans”	Conservative	2.3579823	86 227 949	56 155	B
DNB Asset Management	„Aktivais ieguldījumu plans”	Active	2.1385527	62 173 912	33 069	C
	„Konservatīvais ieguldījumu plans”	Conservative	2.2446768	60 259 852	33 179	D
	„Sabalansētais ieguldījumu plans”	Balanced	2.1590238	76 599 336	37 355	E
Finasta Asset Management	„Konservatīvais ieguldījumu plans”	Conservative	2.3771415	17 899 536	21 144	F
	„EKSTRA PLUS”	Active	1.8226379	12 183 934	14 269	G
	„KOMFORTS”	Balanced	1.9617551	10 246 463	9 992	H
Nordea Pensions Latvia	„Aktivais ieguldījumu plans”	Active	1.762524	64 975 125	21 062	I
	„Konservatīvais ieguldījumu plans”	Conservative	1.6360245	22 361 748	10 069	J
Norvik ieguldījumu parvaldes sabiedrība	„Daugava”	Conservative	2.2051143	21 996 993	24 400	K
	„Gauja”	Active	2.4531193	30 287 179	31 029	L
	„Venta”	Balanced	2.1961173	25 259 306	24 243	M
SEB Wealth Management	„Aktivais plans”	Active	2.2505069	195 179 033	117 205	N
	„Eiropas plans”	Active	2.2116149	30 801 670	17 657	O
	„Safari”	Active	2.4345695	16 302 659	12 675	P
	„Konservatīvais plans”	Conservative	1.9792331	13 782 301	11 837	Q
	„Latvijas plans”	Conservative	2.4802642	120 960 941	79 085	R
	„Sabalansētais plans”	Balanced	2.2585562	85 832 011	47 610	S
Swedbank Ieguldījumu Parvaldes Sabiedrība	„Dinamika”	Active	2.1726269	642 873 630	415 026	T
	„Stabilitate”	Conservative	2.2128403	186 796 886	108 622	U

Source: Latvijas Centralais depozitārijs (2015)

The data show (Latvijas Centralais depozitārijs, 2015) that JSC “Swedbank Ieguldījumu Parvaldes Sabiedrība” with its two investment plans is a strong market leader managing over 42% of the 2nd pillar pension submissions. The second place goes to JSC “SEB Wealth Management” with 23%, third to JSC “CBL Asset Management” (IMC of Citadele bank) with 15% of market share. All the first three companies have around 80% of the market share. One can consider risks to individuals and 2nd pension pillar retirement capital as a whole, caused by so high market concentration.

RETURNS, RISKS AND BENCHMARK TESTING

Every investment strategy has its own unique set of risks and returns. In this paragraph the expected return of each investment plan and the risks associated with these investments have been analyzed. As a background the authors have chosen to analyze weekly changes in the price of the shares of investment plans. It was found that there are 8 pension plans performing worse than the average holding period yield (HPY) of the industry, but 13 are performing better. The leader of the HPY is a pension plan “Dinamika” held by “Swedbank Ieguldījumu Parvaldes Sabiedrība” with an increase of more than 51% over 5 year period, but

at the same time it has a very high risk/return ratio, which makes it possibly risky investment. Then come two investment plans, which carry 2 times less risk and have approximately the same HPY as the leader. In any case investment plans “Gauja” and “Venta” from “Norvik Ieguldījumu Parvaldes Sabiedrība” are the best performers considering risk and return.

We would also to point out that between all 2nd pillar pension plans “Nordea aktīvais ieguldījumu plans” has the largest assets/participant ratio (3084,95 EUR, when the average assets/participant ratio in 2nd pillar is 1592,01 EUR), but at the same time – high risk and gives only 24% HPY over 5 years, 9% lower than the average industry return.

The authors choose benchmark testing as one of the reasonable way to get the big picture of the performance of the financial instrument to the general market indexes. Four benchmarks have been chosen (see Table 3) to test the performance of the pension plans. Each of the benchmarks is related to the European bond and equity markets and to the US Treasury bill market – that is considered a risk-free investment.

Table 3

Benchmark	Value			
	Weekly expected return	Weekly Standard deviation	Risk / Return ratio	HPY
DAX INDEX (^DAX)	0.24%	2.91%	12.37	105.5%
ISHARES EURO CORP BOND FUND (IBCX LN)	0.05%	0.53%	10.13	17.05%
US TRESURY 5-7 YEAR BILL FUND (IEF US)	0.09%	0.93%	10.25	32.08%
S&P 500 INDEX (SPY US)	0.31%	2.32%	7.41	161.3%

The table shows that the holding period yield of the equity markets has performed fabulously during the past 5 years with S&P index fund achieving 161,3% growth over this time with German DAX index earning 105,5%. The EU large capital corporate bond traded fund as well as the 5-7 year US Treasury bond fund performed weaker than the equity indexes, earning just 17,05% and 32,08% respectively. On the other hand the US treasury bills are considered to be risk free assets, so an increase of 32% over this period gives a hint on the actual risk free rate in the US. Fig. 1 demonstrates the result in more clear way - the weekly expected returns and weekly risk of all the investment plans and benchmarks.

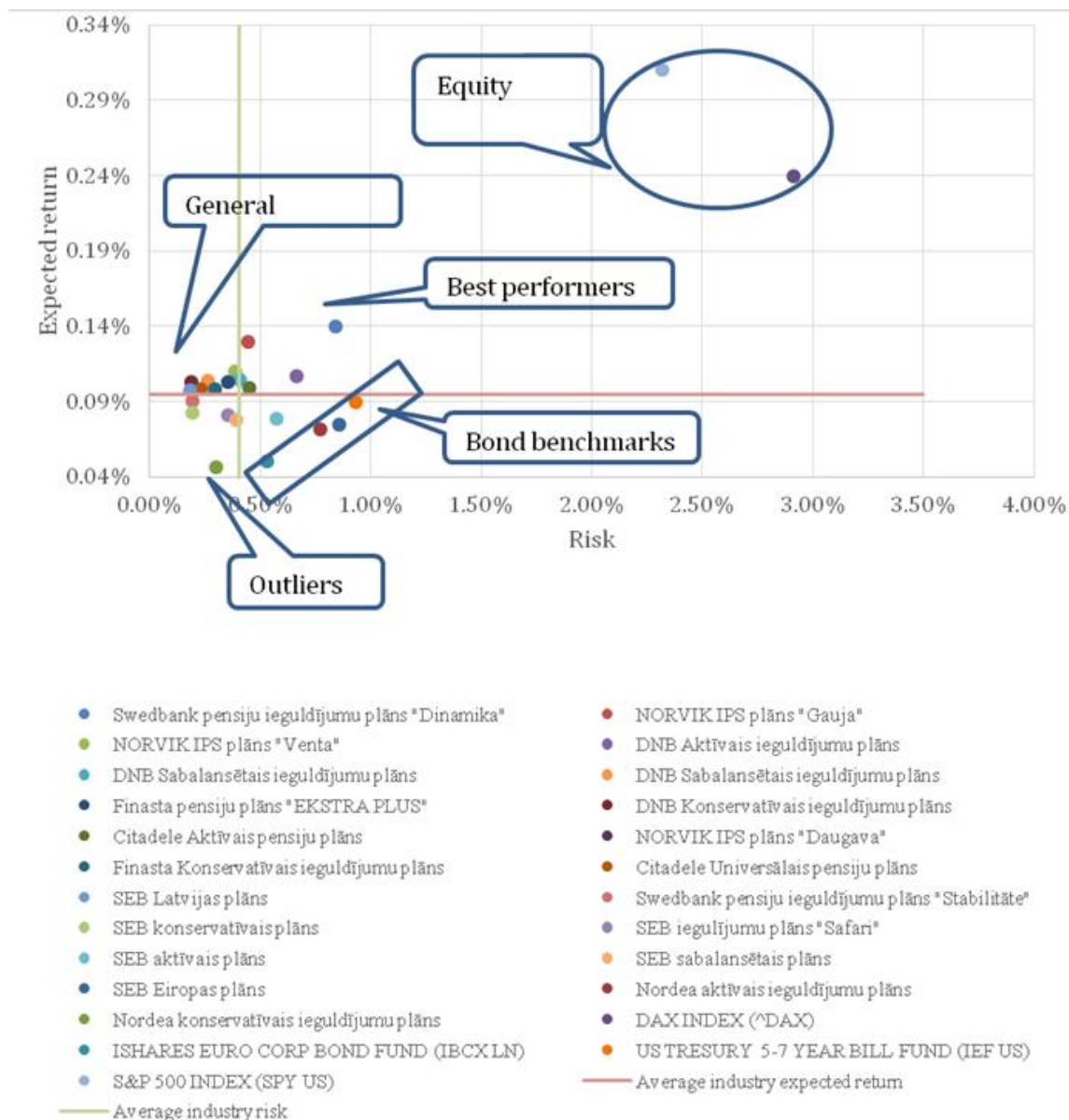


Figure 1. Benchmark testing results plotted on the Risk vs. Expected return graph

As seen from the graph five distinct patterns emerge. Two of them are bond and equity benchmarks. Equity benchmark has both large expected return and risk. Two bond benchmarks are both below the average expected return of the 2nd pillar pension system and the risk is above average. This makes them worse investments than the general 2nd pillar pension system. There are four outliers – a conservative and active plans held by IMC “Nordea Pensions Latvia” and two active plans held by IMC “SEB Wealth Management” - “Eiropas plans” and “Aktīvais plans”. When a conservative plan of “Nordea Pensions Latvia” has less expected return than the average in the industry, it has less risk. “Nordea aktīvais ieguldījumu plāns” and both IMC “SEB Wealth Management” active plans - “Eiropas plans” and “Aktīvais plans” have higher risk and less return comparing to the industry average and perform somewhere in the middle of US and EU bond funds. General tendency of the industry is represented by most of the investment plans, however there are two distinct leaders – both active plans, “Gauja” from IMC “Norvik Ieguldījumu Parvaldes Sabiedrība” and “Dinamika” from IMC “Swedbank Ieguldījumu Parvaldes Sabiedrība”. While “Dinamika” could be a leader under a question mark due to high risk associated with it. Thus pension plan “Gauja” could be the most recommended choice to make.

Analysis of benchmarking shows that the average 2nd pillar pension plans expected return is well below the return of equity markets, however it has less risk associated with investing. EU and US bond funds perform worse than the 2nd pillar pension system.

Also the authors have identified the best choice for investing from risk/return point of view – an active plan “Gauja” held by IMC “Norvik Ieguldījumu Parvaldes Sabiedrība”.

EVALUATION OF THE INVESTMENT PLANS BY THEIR STRATEGY

This paragraph reviews the research into efficient portfolios of active, balanced and conservative investment plans. The best investment plan is determined by the percentage weight in the tangency point portfolio – the greater the percentage – the better.

The table of general statistical data used for evaluation of active investment plans is presented in table 4.

Table 4

General statistics of Active investment plans

	A	C	G	I	L	N	O	P	T
E(r)	0.099%	0.107%	0.103%	0.072%	0.130%	0.078%	0.075%	0.081%	0.140%
σ	0.450%	0.666%	0.352%	0.771%	0.443%	0.572%	0.856%	0.354%	0.841%
$\sigma/E(r)$	4.5326	6.2363	3.4196	10.750	3.4200	7.3060	11.435	4.3822	6.0283
HPR	1.3417	1.2867	1.3560	1.2366	1.4678	1.2606	1.2480	1.2699	1.5116
HPY	34.17%	28.67%	35.60%	23.66%	46.78%	26.06%	24.80%	26.99%	51.16%

E(r) – weekly expected return; σ – weekly standard deviation; $\sigma/E(r)$ – Risk-Return ratio; HPR – holding period return; HPY – holding period yield.

These statistics show that active plans have a greater HPY, yet some of them are lagging behind and have very high risk/return ratios, such as plan “I” and plan “O”. Plan “T”, has the highest HPY and an average risk/return ratio. Investment plan “L” is an impressive candidate for being the best active plan, with the smallest risk/return ratio, yet high HPY.

The author began to construct the joined portfolio of these investment plans to determine, which plan gets the most percent’s in the optimal scenario. Therefore the covariance matrix was introduced using the data analysis of the continuous returns of each investment plan. This matrix is the key to the minimization of the variance of the joined portfolio of investment plans. The variance of the portfolio is calculated through the multiplication of three matrixes and follows the formula (1):

$$\min_{var \rightarrow 0} \text{Variance} = [w_A \ w_C \ w_G \dots] * \begin{bmatrix} var_A & covar_{AC} & covar_{AG} \\ covar_{AC} & var_C & covar_{CG} \dots \\ covar_{AG} & covar_{CG} & var_G \end{bmatrix} * \begin{bmatrix} w_A \\ w_C \dots \\ w_G \end{bmatrix} \quad (1)$$

By changing weights, where the sum of weights equal to 100% and cannot be negative, of the investment plans in the portfolio the author has optimized the variance of the portfolio to be minimal. In the result the Global minimal variance portfolio for the active investment plans gave the following percentage distribution (table 5).

Table 5

Percentage distribution of Global minimal variance portfolio to active investment plans

	A	C	G	I	L	N	O	P	T
Weight	-	-	44.38%	-	15.17%	-	-	40.44%	-

This means that if a participator in the 2nd pillar pension fund is willing to be a member of an active investment plan, but wants to be relatively safe from high volatility of active investments, he should choose between three plans “G”, “P”, or least favourable “L”.

The Expected return of this portfolio was calculated using the multiplication of Expected return and the Weights of the portfolio following the formula (2):

$$\text{Portfolio } E(r) = [E(r)_A \ E(r)_C \ E(r)_G \dots] * \begin{bmatrix} w_A \\ w_C \dots \\ w_G \end{bmatrix} \quad (2)$$

As a result the portfolio statistics for the Global minimal variance portfolio for active investment plans are shown in a table 6.

Table 6

Global minimal variance portfolio (active plans)			
Variance	Portfolio E(r)	Portfolio σ	$\sigma/E(r)$
$9.73 \cdot 10^{-6}$	0.098%	0.3119%	3.1830

Another efficient portfolio is introduced to develop the efficient frontier. This portfolio is configured to be best yielding portfolio with a target return.

Investment plan "T" has the best weekly-expected return, so it will represent the "Target return portfolio". This investment idea will suit people, who do not care much about risk, their main goal is to earn as much as possible.

The statistics for this portfolio will be the same as for the investment plan "T" and are presented below (Table 7).

Table 7

Another efficient portfolio (active plans)			
Variance	Portfolio E(r)	Portfolio σ	$\sigma/E(r)$
$7.08 \cdot 10^{-5}$	0.14%	0.8415%	6.0283

The Optimal risky portfolio implies another optimization method. This method optimizes the slope to the efficient frontier, enabling to evaluate the best performing investment plan by percent's in the portfolio weights. In order to do so the author has devised a formula (3):

$$\max_{\text{slope} \rightarrow \infty} \text{SLOPE} = \frac{[E(r)_A \ E(r)_C \ E(r)_G \dots] * \begin{bmatrix} w_A \\ w_C \dots \\ w_G \end{bmatrix} - RFR}{\sqrt{[w_A \ w_C \ w_G \dots] * \begin{bmatrix} \text{var}_A & \text{covar}_{AC} & \text{covar}_{AG} \\ \text{covar}_{AC} & \text{var}_C & \text{covar}_{CG} \dots \\ \text{covar}_{AG} & \text{covar}_{CG} & \text{var}_G \end{bmatrix} * \begin{bmatrix} w_A \\ w_C \dots \\ w_G \end{bmatrix}}} \quad (3)$$

By changing weights, where the sum of weights equal to 100% and cannot be negative, of the investment plans in the portfolio the slope of CML has been optimized to be maximal. In the result the Optimal risky portfolio for the active investment plans gave the following percentage distribution.

Table 8

Percentage distribution of Optimal risky portfolio to active investment plans									
	A	C	G	I	L	N	O	P	T
Weight	-	-	52.22%	-	47.78%	-	-	-	-

Investment plans "G" and "L" are the optimal way of investing in the active plans. They deliver both reasonable return and are optimally balanced in risky situations, therefore being less volatile. As a result the portfolio statistics for the Optimal risky portfolio for active investment plans are shown in a table 9.

Table 9

Optimal risky portfolio (active plans)				
Slope	Variance	Portfolio E(r)	Portfolio σ	$\sigma/E(r)$
0.2773	$1.16 \cdot 10^{-5}$	0.1157%	0.3409%	2.9472

This leads to the construction of the efficient frontier and plotting these three portfolios on it. The process of portfolio optimization has been finished by the author, yet there is one more thing to be calculated – the covariance between the Global minimal variance portfolio and the Another efficient portfolio. The formula (4) used for calculations is shown below.

$$\text{Cov}_{\text{Efficient port}}^{\text{Minimal var port}} == [w_A^M \ w_C^M \ w_G^M \dots] * \begin{bmatrix} \text{var}_A & \text{covar}_{AC} & \text{covar}_{AG} \\ \text{covar}_{AC} & \text{var}_C & \text{covar}_{CG} \dots \\ \text{covar}_{AG} & \text{covar}_{CG} & \text{var}_G \end{bmatrix} * \begin{bmatrix} w_A^E \\ w_C^E \dots \\ w_G^E \end{bmatrix} \quad (4)$$

By multiplying the weight matrixes against the covariance matrix, the covariance between two portfolios is calculated to be $1.676 \cdot 10^{-5}$. Looking back at the conducted research on the active investment plans, a summary table of the proposed portfolios has developed (table 10).

Table 10

Statistics of all efficient portfolios for active investment plans				
Efficient portfolios (active plans)				
Portfolio	Variance	Portfolio E(r)	Portfolio σ	$\sigma/E(r)$
Minimal variance	$9.73 \cdot 10^{-6}$	0098%	0.3119%	3.1830
Another efficient	$7.08 \cdot 10^{-5}$	0.14%	0.8415%	6.0283
Optimal	$1.16 \cdot 10^{-5}$	0.1157%	0.3409%	2.9472
Industry average	-	0.098%	0.590%	6.3901
Covariance Minimal variance & Another efficient			$1.676 \cdot 10^{-5}$	

The optimal risky portfolio is a manifestation of the portfolio optimization. It has more expected return with just slightly more volatility, comparing to the Minimal variance portfolio. Therefore the investment plans that are included in the Optimal portfolio are the best choice to make.

Efficiency of the portfolios can be checked via a construction of the efficient frontier and the Capital Market line (CML). In order to do so the authors have managed to construct two tables, representing the curvature of the efficient frontier and the linear function of the CML.

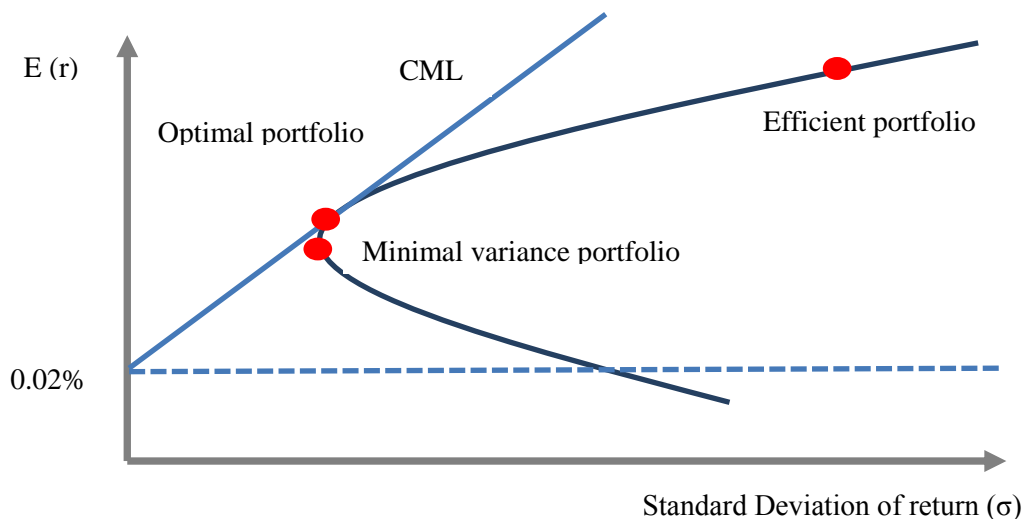


Figure 2. Indicative graph of the efficiency frontier, CML, Minimal risk, Another efficient and Optimal portfolios

The calculated results from the table have made possible to project the findings on the graph (see Fig. 2), where Optimal portfolio has coordinates of 0.3409%; 0.1157%. Efficient portfolio has coordinates of 0.8415%; 0.14%. The Minimal variance portfolio has coordinates of 0.3119%; 0.098%.

To summarize the research into active pension plans, we can point out the preferably recommended plans depending on the participant's strategy and risk tolerance:

Plan „EKSTRA PLUS” or plan „Safari” - if the participant wants his investment to be less volatile, yet being actively managed. Plan „Dinamika” - if the participant has a large risk tolerance and is focused on the biggest expected return of the industry. Plan „Gauja” or plan „EKSTRA PLUS” - if a participant wants a balance between the risk and return in the active investment plan sphere.

Using the same methodology into balanced pension plans, the authors found that investment plan „KOMFORTS” is the best decision for a participant to invest in balanced pension plans. It has a low risk to return ratio, which is compatible with conservative plans, its HPY is the second in the industry of balanced portfolios. This investment plan fits participants, who want to take additional risk, but are not willing to increase risk to levels of active investment plans.

The research on conservative investment plans showed that, in case a participant wants to participate in a conservative portfolio and has a very low risk tolerance, he should choice to participate in „Konservatīvais plans” or „Latvijas plans”. If a pension plan member wants to participate in a conservative investment plan,

yet is willing to have the highest possible expected return, he should choose the investment plan „Konservatīvais ieguldījumu plans” In order to achieve a balanced risk/return scenario the participant should choose between investment plans „Latvijas plans”, „Konservatīvais ieguldījumu plans” or „Daugava”. Investment plans “Universālais pensiju plans” and „Konservatīvais ieguldījumu plans” are outsiders of conservative plan category, having the worst risk/return ratios, therefore having no representation in the percentage distribution in any of the optimization processes.

VIEWPOINT ON 2ND PILLAR PENSION PLANS

Pension system in Latvia is quite new, and it is important to understand how close to the real situation is the evaluation of the risks and returns of pension plans by ordinary participants and compare it with the view of the professionals and the real situation.

The survey showed real lack of knowledge of participants. 50,48% of 521 respondent, taking part in the survey, did not even know in which pension plan they are enlisted in. Thus we observe different pension plan participant behaviour in Latvia. It was shown by Ballester (2014) that “in Spanish, European and International markets a positive, significant relationship between pension plan flows and return, risk adjusted return takes place. Participants make significant contributions to plans that have achieved high returns in the past while the contributions and transfers to plans with poorer returns are smaller and less significant. The legal status of the management company also has a significant effect on the monetary input into the pension plans”. Participants pay increased attention to performance of pension plans during the crisis periods. Dushi, Iams and Tamborini (2013) found that economic downturn had a considerable impact on workers’ participation and contributions to DC plans.

The weighted risk anticipated by the Latvia’s respondents showed a 4.74% standard deviation from mean of weighted anticipated annual return of 7.18%. Applying the risk/return formula the authors has calculated the anticipated risk/return ratio of the respondents to be 0.66. This is a strong indicator that respondents are not aware of the risks that can emerge in investment plans. The Global minimal variance portfolio for Conservative investment plans has a risk/return ratio almost 3 times higher, than the respondents think.

On the other hand the authors have managed to interview some people working in this industry. The professionals were asked the same questions and the authors has performed the construction of the efficient frontier and plotted the efficient portfolios, the real situation portfolio of 2nd pillar pension plans, the situation as it’s been seen by the general public, the vantage point of the professionals and the optimal portfolio (see Fig.3.).

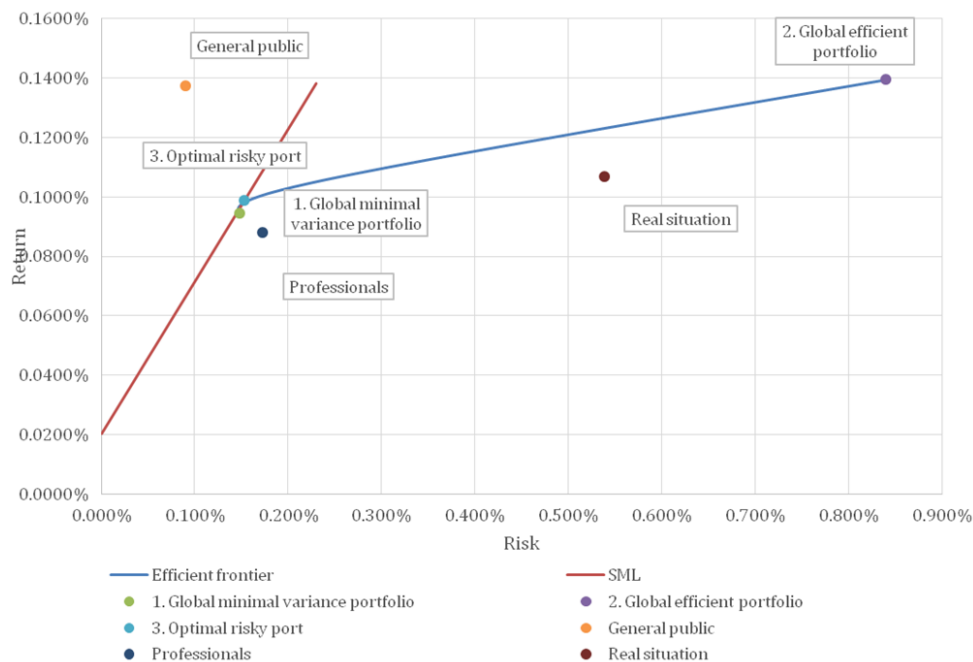


Figure 3. The constructed graph of the 2nd pillar pension plan system, featuring what people and professionals think and what is the real situation (daily values).

Figure 3 shows that the general public tends to overestimate the expected return and underestimate risks. General public underestimates risks that are 6 times larger, than they think, and overestimate the expected return by 1.6% annually. Professionals do better in this question. They consider the risk to be high, because they are familiar with the financial markets. Professionals think that the annual risk in 2nd pillar pension funds is 9% that is not far from the 8% that the optimal portfolio can offer. Moreover the professionals underestimate expected annual return by 0.56% from the optimal scenario. Looking at the real situation, the professionals underestimate both risks and expected returns, but are far more accurate than the general public.

4. CONCLUSIONS

1. In the investigated period from February 2nd 2009 to December 19th 2014 all of the main indicators of 2nd pillar pension funds in Latvia (total assets, participants and price of one share) grew. Three investment management companies (JSC "Swedbank Ieguldījumu Parvaldes Sabiedrība", JSC "SEB Welth Management" and JSC "CBL Asset Management") have taken 80% of the market share thus creating some risk of high market concentration. The most popular single outstanding plans are "Dinamika" held by JSC "Swedbank Ieguldījumu Parvaldes Sabiedrība" and "Aktīvais pensiju plans" held by "CBL Asset Management".
2. Benchmark testing showed that all 2nd pillar pension plans are performing worse than the equity benchmarks, such as the S&P500 index and DAX index, but better than the bond benchmarks, such as European large corporation bond fund and the 5-7 year US Treasury bond ETF.
3. The analysis of performance of all 21 Latvia's 2nd pillar pensions plan during 5-year period has done in order to optimize risks and returns. To make a right option of offered pension plans the recommendations for participants with different risk tolerance have worked out. A participant with high-risk tolerance should preferably choose active investment plans „EKSTRA PLUS” or „Gauja”. To medium risk tolerance better corresponds balanced investment plan „KOMFORTS”. Participant with low risk tolerance should choose between conservative investment plans „Latvijas plans”, „Konservatīvais ieguldījumu plans” and „Daugava”.
4. The survey showed a lack of knowledge of general public about basics of pension system. 50,48% respondents, taking part in the survey, did not even know in which pension plan they are enlisted in. General public overestimates the annual return and have no sense of the actual risk vs return ratio, evaluating it at 0.66, in comparison to the 5.0 ratio in the real situation. The professionals have a greater sense of the risk/return trade-off and evaluate this ratio at 2.65, which is not far from the Optimal ratio of 1.54.

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