TALLINN UNIVERSITY OF TECHNOLOGY

School of Business and Governance

Department of Economics and Finance

Roman Lutšit

Performance evaluation of Estonian second pillar funds. A comparison with selected European pension funds.

Master's thesis

Program: Finance and Accounting, specialization: Finance

Supervisor: Karsten Staehr, PhD

Tallinn 2021

Tallinn 2021

I hereby declare that I have compiled the paper independently
and all works, important standpoints and data by other authors
has been properly referenced and the same paper
has not been previously presented for grading.

The document length is 12 334 words from the introduction to the end of conclusion.

Roman Lutšit ……………………………

(signature, date)

Student code: 200838TARM

Student e-mail address: 2007roman@gmail.com

Supervisor: Karsten Staehr, PhD

The paper conforms to requirements in force

……………………………………………

(signature, date)

Chairman of the Defence Committee:

Permitted to the defence

…………………………………

(name, signature, date)

TABLE OF CONTENTS

ABSTRACT

OECD research has shown that the performance of Estonian pension funds is far from the best when compared to other members of OECD (OECD 2020). However, the research by the OECD is done for the countries overall and there is no information for the specific funds. Thus, the aim of this master thesis is to evaluate the performance of selected Estonian second pillar funds and to determine factors that affect the return of these pension funds. The author of this study uses comparative analyses methodology and compares the investment performance of Estonian pension funds with selected European pension funds.

First, this thesis focuses on widely accepted risk and return measures to see what funds are more risky and to know risk-adjusted returns of selected funds. Second, Fama-French-Carhart factors analysis was undertaken to understand what drives the returns of pension funds. In order to achieve the objective of the thesis, the author analyses the performance of pension funds over two time periods: 10.2011-09.2021 and 10.2016-09.2021.

The results demonstrated that investors should consider not only average returns, but also risk-adjusted returns of funds. Investors should be aware about risks of invested funds and if active fund management could outperform the market when adjusted for systematic risk. Results showed that foreign European pension funds had good risk-adjusted performance for the last decade, but not all Estonian second pillar funds were the same successful if we talk about risk-adjusted returns. Moreover, Estonian pension funds do not use actively risk factors in their investment strategy comparing to selected European funds.

Keywords: risk, return, performance evaluation, pension fund, multifactor model, risk-adjusted return, risk factor

INTRODUCTION

Pension system is the import part of modern society. The role of the pension system in society is to ensure the wellbeing by safeguarding the livelihood for population during their retirement. Following the OECD categorisation, Estonia has a three-pillared pension system and the second pillar was introduced in 2002 (OECD 2011). Since then, the second pillar represents the pension fund, which is managed by financial institutions. The second pillar was until recently mandatory for those born in 1983 and later, and people could not leave the pension fund or influence on its management.

However, recently the topic of pension system began to be again popular in Estonia. In 2020 the Government announced that people can exit from the pension fund of the second pillar. It is from 2021 allowed to take savings from the fund of second pillar, which person could save during those years. As of July 2021, 20% decided to take savings from the second pillar fund. (Estonian Funded Pension Registry 2021)

One of the arguments against the compulsory saving in second pillar pension funds was that the performance of funds was not very strong, whereas costs, which banks take to manage the fund, were high. Research of OECD has also shown that the performance of Estonian pension funds is far from the best one comparing to other countries that are members of the OECD (OECD 2020). However, the research of OECD is done for the countries in general. There is no information for the specific funds. Thus, the author of this thesis wanted to evaluate the performance of specific Estonian second pillar pension funds comparing to others defined pension funds in Europe countries.

The aim of the thesis is to evaluate the performance of selected Estonian second pillar pension funds comparing to others defined pension funds in Europe and to determine how various factors influence the returns of the funds. The thesis relies on advanced evaluation methods of investment portfolios. Most of research nowadays has been done for portfolios of mutual funds, however more and more empirical studies touch on topic of performance evaluation for pension funds' portfolios. The difference between pension funds and mutual funds is that the investment policy of pension funds is in a more strict investment framework. For example, pension funds in European Union countries typically follow environmental, social and governance targets. For example, pension funds may not invest in so-called 'sin stocks'. Moreover, pension funds objectives are more long perspective, horizons for risk and return of pension funds are often measured in **y**ears, if not decades.

In the thesis the author addresses the following research questions:

What are the risk and return characteristics of Estonian second pillar pension funds compared to selected European pension funds?
What pension funds outperformed the market when adjusted for systematic risk and got positive alpha?
What risk factors affected on the return of pension funds?

In order to achieve the objective of the thesis, the author analysed the performance of pension funds over the two periods: 10.2011-09.2021 and 10.2016-09.2021. Based on the average return data an evaluation of risk and risk adjusted return is done, which makes it possible to assess the performance of Estonian second pillar pension funds over the last 10 and 5 years. Moreover, multifactor regression models were used to understand what factors drove the return of pension portfolios.

The object that is being researched is the Estonian, Finnish, Swedish and Norwegian pension funds. The data used in the study was mainly collected from the Estonian Funded Pension Registry, Kenneth French data library, financial statements and web pages of companies. The period of observation is last 10 and last 5 years. The method used to achieve the tasks of the thesis include comparative analyses methodology with applied linear regression using the least squares method.

The thesis is divided into three main chapters. Chapter 1 gives an overview of the conceptual background of the topic necessary to conduct the research. It discusses evaluation methods of investment portfolio and gives also theoretical background of risk and return measures. Moreover, the chapter presents previous empirical research studies and findings regarding evaluation of investments portfolios. Chapter 2 describes the data used in the study and explain the methodology. Moreover, it introduces measures, which has been used to evaluate the performance of pension funds. Chapter 3 presents the main results of the study. The unnumbered final section summarizes the findings and presents the main conclusions concerning the performance of Estonian second pillar funds compared to selected European pension funds.

The author would like to thank his supervisor Karsten Staehr for his support through the course of writing the thesis. Furthermore, the author is thankful to Katrin Rahu from Swedbank for her invaluable advices regarding pension funds evaluations. Last, but not least, the author is grateful to Maarit Hirvensalo from Keva for providing data that was not publicly available.

1. PENSION FUNDS EVALUATION METHODS

1.1. Portfolio theory

Pension fund is an investment portfolio and the aim of portfolio construction is to maximize expected investments returns compatible with acceptable personal level of portfolio risk. Modern investment portfolio studies originate from the portfolio theory proposed by Harry Markowitz (1952), which was published in the article 'Portfolio Selection' in the *Journal of Finance*. The ideas presented in this article have come to form the foundations of what nowadays called as Modern Portfolio Theory (MPT). Even now, seventy year later, those financial principles are used in scientific and daily works by financial specialists and investors (Fabozzi *et al.* 2002).

If we want to measure the actual single-period portfolio return, we can calculate it using the following (Fabozzi *et al.* 2008):

$$R_P = w_1 R_1 + w_2 R_2 + \cdots + w_I R_I \tag{1.1}$$

where
R_P – rate of return on the portfolio over the period,
R_{iI} – rate of return on asset **i** over the period, i = 1,…, *I*,
w_{iI} – weight of asset i in the portfolio at the beginning of the period, i = 1,…, *I*,
I – number of assets in the portfolio.

The important point in the modern portfolio theory is to find balance between expected return and accepted risk. The expected portfolio return in this case is the weighted average of the expected return of each asset in the portfolio and that is (ibid., 5):

$$E(R_P) = w_1 E(R_1) + w_2 E(R_2) + \cdots + w_I E(R_I) \tag{1.2}$$

where
$E(\,)$ – signifies expectations,
$E(R_p)$ – expected portfolio return.

Harry Markowitz created a portfolio selection model to determinate the efficient portfolios. The model is based on the expected return and the risk of the diversified portfolio. In order to identify the portfolio with absolute minimum variation, the model involves the correlation of the portfolio securities (Markowitz 1991). Markowitz was not the first to consider the desirability of diversification. In 1738 in the famous article about the St. Petersburg Paradox, Bernoulli wrote that risk-averse investors would want to diversify: *". . . it is advisable to divide goods which are exposed to some small danger into several portions rather than to risk them all together"* (Bernoulli 1954). However, Markowitz's paper was the first mathematical formalization of the idea regarding diversification of investments that the whole if greater than the sum of its parts. As such we can say that it was the birth of modern financial economics. (Rubinstein 2002)

Markowitz had understanding that diversification would reduce risk, but it would not totally eliminate it. Through diversification, risk can be reduced without the expected portfolio return changing. Markowitz wrote that minimizing portfolio variance of return investor could maximize expected portfolio return. Very important idea of Markowitz's work was to show that security's own risk was not so important comparing to the contribution, which security makes to the variance of the entire portfolio of investor. Thus, important question is what covariance of this security with all the other securities in the portfolio. This idea we can put into the relation between variance of portfolio's return (σ_P^2) and the variance of its component securities return (σ_i^2 for i = 1, 2,..., I) (Rubinstein 2002, 1042):

$$\sigma_P^2 = \sum_i w_i^2 \sigma_i^2 + \sum_i \sum_{j \neq i} w_i w_j \rho_{ij} \sigma_i \sigma_j \tag{1.3}$$

where
σ_P^2 – variance of the return of a portfolio,
w_i – portfolio proportions, $\sum_i w_i = 1$,
ρ_{ij} – securities *i* and *j* correlation of the returns.

Covariance and correlation are mathematically related and expressed in this way:

$$\rho_{1,2} = \frac{Cov_{1,2}}{\sigma_1 \sigma_2} \tag{1.4}$$

where
$\rho_{1,2}$ – the correlation between assets 1 and 2,
$Cov_{1,2}$ – the covariance between assets 1 and 2,

σ_1 – the standard deviation of asset 1,
σ_2 – the standard deviation of asset 2.

Knowing this relationship between covariance and correlation we can write the equation for variance of portfolio return in this format:

$$\sigma_P^2 = \sum_i w_i^2 \sigma_i^2 + \sum_i \sum_{j \neq i} w_i w_j Cov_{ij} \tag{1.5}$$

The advantages of portfolio diversification are clear; investor has to choose the level of diversification that suits him best. The efficient set of portfolios can be described through graphical representation called the efficient frontier (Fabozzi et al. 2008). The curve in Figure 1.1 represents Efficient Frontier. All the dots closest to the efficient frontier, which represents portfolios, can produce maximum return for a given level of risk. Thus, such efficient portfolios satisfy the condition that there is no other portfolio with a higher expected return and the same standard deviation of the return (Merton 1972).

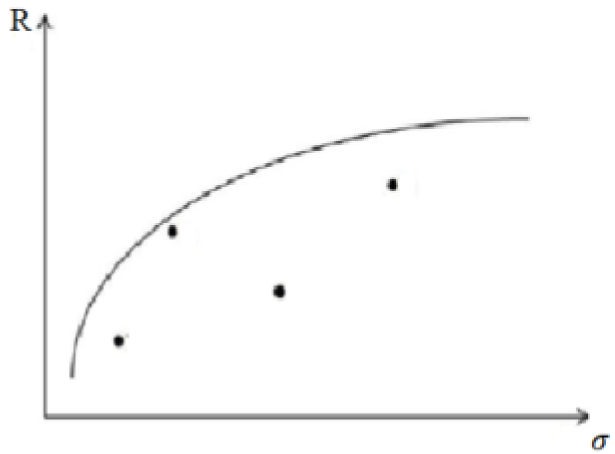

Figure 1.1. The Efficient Frontier
Source: Fabozzi et al. 2008; elaborated by the author.

All in all, the Markowitz model is very useful for investors. It can determine the optimal portfolio, which would satisfy with return for a given level of risk (Baltes, Dragoe 2015). Figure 1.2 represents modern portfolio selection theory process.

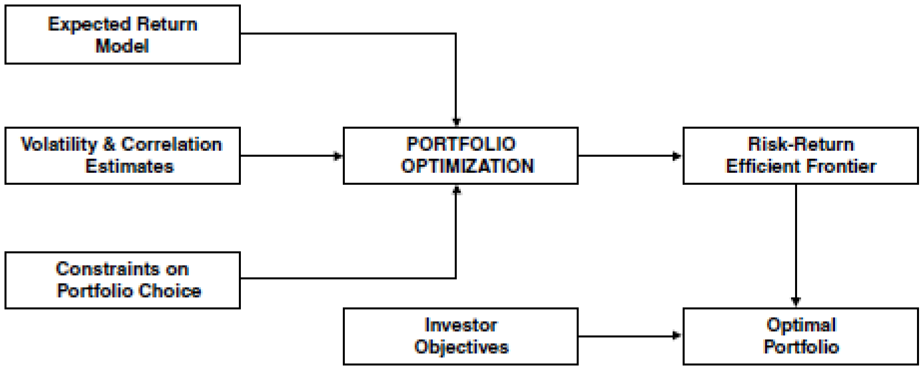

Figure 1.2. The modern portfolio theory investment process
Source: Fabozzi *et al.* 2002, 8.

Risk-return which is mentioned on the Figure 1.2 will be observed in the next section, where we look at risk-return measures what help to evaluate performance of portfolios.

1.2. Portfolio performance evaluation methods

As mentioned in the previous section, the aim of the investment portfolio is to maximize investment return compatible with personal level of risk. Investors want to obtain higher returns, but at the same time they want to take smaller risk. Regular Estonian second pillar fund investor can observe rate of returns at the website of the Estonian Pension Fund Registry. It does not, however, provide a full picture of the performance, because average return is not adjusted on the risk of the investment. In order to understand whether portfolio of a pension fund can be acceptable to the personal level of risk, investor needs also to know risks and risk-adjusted returns of pension fund.

There is a large number of performance evaluation methods. The methods were broadly reviewed by Aragon and Ferson (2006), Ingersoll et al. (2007) and Christopherson et al. (2009). Markowitz (1952, 1959) defined the concept of risk using statistical measures such as variances and covariances, as already mentioned in the previous section. Markowitz described the risk of the portfolio risk as the sum of investments variances and covariances among the investments (Fabozzi *et al.* 2008).

Conceptually variance and standard deviation as a measure of risk are equivalent. The principle of Markowitz diversification states that as the correlation between the assets returns that are combined in a portfolio decrease, so does the standard deviation of the portfolio's return (Fabozzi *et al.* 2008). Standard deviation is a measure of risk, which reflects volatility of asset or portfolio. It is a statistical measure that shows the average deviation from the portfolio's mean return and is calculated as the square room of the variance (equation 1.6) (Bacon 2013).

$$\sigma = \sqrt{\frac{\sum_{i=1}^{i=n}(r_i - \overline{r})^2}{n-1}} \tag{1.6}$$

where
σ – standard deviation of portfolio,
r_i – return of portfolio in period i,
$\overline{r}$ – mean of i returns,
n – number of periods.

Larger standard deviation number denotes greater fluctuation in fund return. It means that the portfolio's return is less predictable and therefore such portfolio is more risky.

William Sharpe (1966), using mean-variance theory, introduced another modern performance measure, the Sharpe ratio. Nowadays it is still one of the best known and widely used (Ingersoll *et al.* 2007) and expressed as:

$$\text{Sharpe ratio} = \frac{R_p - R_f}{\sigma_p} \tag{1.7}$$

where
$R_P - R_f$ - the excess return of the portfolio over risk-free rate R_f,
σ_P – standard deviation of the portfolio.

The Sharp ratio helps to understand the return of an investment compared to its risk. The Sharpe ratio measures the degree to which a portfolio is able to earn return above the risk-free return per unit of risk.

Another popular measure is the Treynor ratio introduced in Treynor (1965). The Treynor ratio can be used to measure the risk and return of a portfolio. While Sharpe ratio identifies the total risk of portfolio and uses a portfolio's standard deviation to adjust the portfolio returns, Treynor ratio takes systematic risk into account (equation 1.8).

$$\text{Treynor ratio} = \frac{R_P - R_f}{\beta_P} \quad (1.8)$$

where
β_P – portfolio beta (systematic risk).

The Treynor ratio as a performance measure determines how much excess return was generated per unit of market exposure. The higher the ratio is, the more extra return gained the fund per unit of taken risk in terms of beta.

Talking that Treynor ratio takes portfolio systematic risk into account we talk about beta, which measure the risk of portfolio in comparison to the market. Beta is calculated by dividing the covariance of the portfolio's returns and the market's returns by the variance of the market's returns (equation 1.9).

$$\beta_P = \frac{Cov\ (R_p, R_m)}{\sigma_m^2} \quad (1.9)$$

The beta helps investors to understand whether portfolio moves in the same direction as the overall market and how volatile portfolio is in comparison to the market.

1.3. From single to a multifactor model

An investment fund such as a pension fund can achieve higher returns by taking higher risk. In order to analyse later the excess return sources of pension funds, we will familiarise in this section with the models of risk and expected return.

What drives stock return is the primary question in finance. The best-known model of stock returns is the Capital Asset Pricing Model (CAPM) (Sharpe 1964). CAPM explains the relationship between systematic risk and expected return for securities and expressed as:

$$R_e = R_f + \beta(R_m - R_f) \quad (1.10)$$

where
R_e – expected return of investment,

R_f – risk free rate,
β – beta of the investment,
R_m – the realized return of the suitable market index,
$(R_m - R_f)$ – market risk premium.

The beta here is a measure, which will show how much risk the investment will add to a portfolio. The beta of the market portfolio is equal to one; riskier asset has higher than one and less risky asset less than one. CAPM model is a single factor model. Based on the CAPM, Jensen (1968, 1972) introduced one of the famous performance measures, i.e. Jensen's alpha or simply alpha (equation 1.11).

$$\alpha = R_P - \left[R_f + \beta_P(R_m - R_f)\right] \tag{1.11}$$

where
α – Jenseni alpha,
R_P – the realized return of a portfolio.

Alpha is a risk-adjusted performance measure and it tries to explain the abnormal return of the portfolio if it was above or below predicted by CAPM. A positive alpha shows that the portfolio earned excess return and a negative alpha means that the portfolio underperformed the market when adjusted for systematic risk. This illustrated on the Figure 3. Fund managers often turn to alpha to explain excess return and show his stock-picking skills (Bacon 2013, 72).

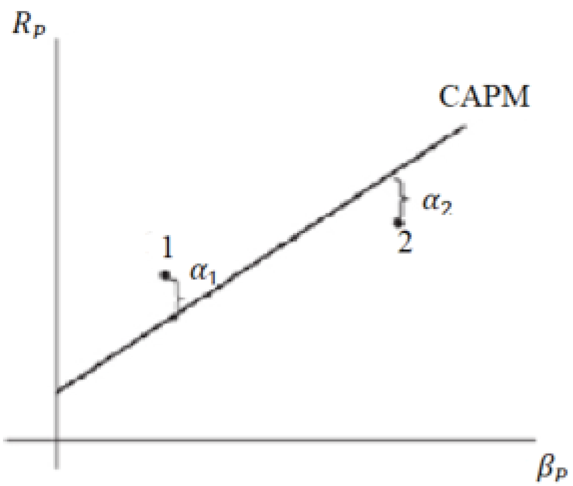

Figure 3. Illustration of Jensen's alpha
Source: Francis, Kim 2013; elaborated by the author.

CAPM model that's the single factor model and it assumes that only systematic market risk can influence on a security's return. In addition to the market factor, King (1966) found proofs for Industry factors. Rosenberg (1974) also found evidence for other risk sources in addition to market-wide and industry factors, such as economy-wide corporate earnings and liquidity factors.

Ross (1976) proposed the arbitrage pricing model, which describes what drives stock returns and where there is more than one risk factor. Such a model, where there is more than one factor, is called multifactor model. There are three categories (Fabozzi et al. 2008, 18):

Macroeconomic factor models: compare security's return to macroeconomic factors such as inflation, employment and interest;

Statistical factor models: compare the returns of different securities using statistical techniques such as principal components analyses;

Fundamental factor models: analyse the relationship between a security's return and security's financials, such as capitalization, debt level and profit. For example, popular factors nowadays are value, size, growth, momentum.

Most widely used model for the evaluation of securities and portfolios is the fundamental factor model. The Basic relationship to be estimated in multifactor model can be expressed as follows (ibid., 18):

$$R_P - R_f = \beta_{P,F1} R_{F1} + \beta_{P,F2} R_{F2} + \dots + \beta_{P,FJ} R_{FJ} + \varepsilon_P \quad (1.12)$$

where
$\beta_{P,FG}$ – sensitivity of portfolio P to risk factor J,
R_{FJ} – rate of return on risk factor J,
ε_P – nonfactor return on portfolio P.

In the following section we will look at multifactor models, which are commonly used nowadays in empirical studies.

1.4. Review of previous empirical studies

This section reviews multifactor models and risk factors, which can drive returns of fund portfolios. Moreover, will be also observed evaluation performance methods in previous empirical studies.

Many studies analysed the investments results and efficiency of portfolios covering different research periods and using various research methods. When we talk about fund evaluation then it is important to understand concerning fund management efficiency. Empirical studies were evaluating fund managers skills and showed that it was difficult for managers to earn alpha. Studies by Gruber (1996), Wermers (2003), and Jones and Wermers (2011) confirm that generally the median active manager does not outperform the capitalization-weighted benchmark and those who does usually are able to outperform the market only for short periods of time. (Bender *et al.* 2013)

It is important to understand what factors are significant in explanation of portfolio returns. For sure, the market can be viewed as the most important equity factor. Beyond the market factor, researchers looking for factors that could explain excess return of investments. One of the best-known multifactor models was suggested by Fama and French (1992, 1993). The model explains equity returns with three factors: the market (based on the CAPM model), the size factor (firm's market capitalization – small and large) and the value factor (firm's book-to market value ratio).

Fama and French added two additional factors to the market model, and the extended model had statistical power to explain cross-section of return in diversified portfolio, comparing to the single factor model. With this model Fama and French tried to explain US equity market returns. Empirical study (Fama and French 1992) showed that the average small cap portfolio earned monthly return of 1.47% compared to the average large cap portfolio, which earned 0.9% from July 1962 to December 1990 (Bender *et al.* 2013). Simply saying, researchers found that small capitalization companies had higher returns compared to large capitalization companies. Basically, it is logical, because large companies are considered as safe investment and often have lower returns, while small companies are often riskier and have higher expected return (Donaldson and Marcus 2014). Moreover, the average high to book-to-market portfolio earned monthly return 1.63% in contrast to the average low book-to-market portfolio, which earned 0.64% monthly return (Bender *et al.* 2013). In other words, value companies, who have high book-to-market ratios outperform growth companies. All in all, according to Fama and French's three-factor model, portfolios with smaller firms and value firms can give a higher return on investment in long-term perspective.

Carhart (1997) in his work suggested using a four-factor model, where in addition to Fama and French's three factors was included momentum factor. Carhart discovered that return of stocks in previous year was the appropriate variable to explain return of mutual fund. According to momentum factor, those stocks which showed good performance in the past most likely outperform also in the future. Lieksnis (2011) used Fama-French-Carhart factors to explain cross-section returns, which are traded in Baltic stock market. Lieksnis in his work advised investors to include momentum and value investing strategies for their Baltics stock market portfolios, because both strategies showed good performance results.

Studies also found that active managers often use Value and Size factors in their portfolios. Mok et al. (2014) using US Institutional fund returns showed in their work that Fama and French factors accounted for around 50% of average alpha.

Most of the early research on investment performance evaluation considered equity funds. However, there are nowadays research which are also concentrated on pension funds. For example, Ang et al. (2009) analysed the Norwegian Government Pension Fund's active returns and used Carhart four factor model for evaluation of Norwegian fund. Researchers recommended to use size, value and momentum factors investment strategy in the portfolio, because those factors could positively drive return of this pension fund.

There was interesting empirical study of the Swedish AP-Funds and the Norwegian Government Pension Fund Global, where Hoepner and Schopohl (2018) empirically analyzed the performance effect of exclusion unethical companies (so called 'sin stocks') and if it can harm or increase fund performance. Authors mainly tested the performance of funds using two regression models: CAPM model and four-factor model with Fama-French-Carhart factors. Hoepner and Schopohl found that exclusions did not harm fund performance financially and at the same time it did not increase fund performance.

In 2014 Fama and French (2015) developed their original three factor model and added two additional risk factors: robust-minus-weak profitability (RMW) factor and conservative-minus-aggressive investment (CMA) factor. The new model suggests that companies who report robust operating profitability and companies who invest conservatively have higher returns in the stock market. Dopierala and Mosionek-Schweda (2021) in their empirical work evaluated Polish pension and mutual funds' performance, where they used in the regression model Fama-French five factors as well as momentum factor. Authors analysed alpha parameter and were looking what factors managers took into account when constructing portfolios during the period 2007-2018.

Bohl et al. (2011) compared in their study the performance of Polish and Hungarian pension funds. The authors used in their work for comparative analyses Sharpe ratio and Treynor ratio for risk and return analysis, as well as CAPM based model regression. The results showed strong underperformance by Hungarian pension funds comparing to Polish pension funds.

2. DATA AND METHODOLOGY

The second chapter begins in Section 2.1. with overview of selected pension funds. Section 2.2. provides information on the methods and variables used in the master's thesis. Finally, Section 2.3. introducing a description of data used in the empirical research.

2.1. Overview of selected pension funds

The author decided to concentrate in this study on the Estonian second pillar pension funds with active management and aggressive or progressive investment strategy, which reported the highest rate of return (converted to annual basis) for the last 10 years.

These are the requirements which were applied to Estonian pension funds to be included for the research:

1. Second pillar fund;
2. In Estonian market at least 10 years;
3. The portfolio has higher risk class with aggressive or progressive strategy;
4. If there is more than one fund from the same investment company, which falls into above criteria, then include into the research the one with higher return for the last 10 years.

Below four Estonian second pillar pension funds have been chosen for the main research.

Swedbank K100. Pension fund with aggressive strategy. Up to 100% of the fund's assets can be invested in the instruments with equity risk.

LHV XL. Pension fund with aggressive strategy. The assets of the fund may be invested in their entirety in equities and equity funds.

Luminor A Pluss. Pension fund with aggressive strategy. Up to 100% can be invested in equities and assets of similar risk.

SEB Energiline. Pension fund with progressive strategy. Fund invests up to 75% of its assets in shares, with the remainder allocated to bonds and deposits. (Estonian Funded Pension Registry, 2021)

Author wanted also to evaluate performance of foreign selected European pension funds and compare results with Estonian funds. For the comparable analyses pension funds from Finland, Sweden and Norway were selected, because pension funds market in those countries is older and more mature compared to Estonian pension market. Moreover, the selection was based on the Global top 300 pension funds (2021), where it was possible to see the largest pension funds. Finally, author of the thesis tried to include pension funds with different risk level. Below European funds have been selected for the research.

Keva. It is Finland's largest pension provider. Members of Keva pension fund are employees who work on local government, State, Bank of Finland. This pension fund serves a total of 1.3 million public sector employees and pensioners. In the interim report for 1 January – 30 June 2021 was mentioned that the investments of Keva fund had a market value of EUR 63.3 billion. On 31 December 2020 52.5% of Keva pension fund assets were equities. (Keva pension fund 2021)

Alecta Optimal 60. Alecta manages occupational pension plans for 2.6 million private customers and 35,000 corporate customers in Sweden. Alecta is the fifth largest occupational pension provider in Europe. On 30 September 2021 market value of pension fund portfolio was reported SEK 948 billion (EUR 94.8 billion). Focus of Alecta Optimal 60 to invest 60% of assets in shares. (Alecta pension fund 2021)

AMF Småbolag. AMF is one of the leading pension companies in Sweden and one of the largest owners on Nasdaq OMX Nordic Stockholm. AMF focuses on occupational pensions for both private and corporate customers and has approximately 4 million customers in total. On 30 September 2021 in asset management of AMF fund was SEK 790 billion (EUR 79 billion).
AMF Småbolag invest at least 85% of assets in the stock market. (AMF pension funds 2021)

Government Pension Fund Norway (GPFN). Fund is state owned and managed by

Folketrygdfondet on behalf of the Norwegian Ministry of Finance. On 30 September 2021 market value of GPFN portfolio was NOR 326 billion (EUR 32.5 billion). Strategic asset allocation of fund is 60% equities and 40% fixed income. (The Government Pension Fund Norway 2021)

2.2. Methodology

Author of this thesis wants to evaluate the performance of Estonian second pillar funds and answer the questions, which were raised in the introduction. To provide a first insight into the performance of selected pension funds simple risk return measures are calculated.

Further, more advanced portfolio evaluation methods will be applied. CAPM and multifactor model regressions will help to measure the performance relative to the overall market and understand the management style of selected portfolios of pension funds.

Another question was how do we compare the results, what could be the benchmark? To answer this question the author uses in this study comparative analyses methodology. Thus, the performance results of the Finnish, Swedish and Norwegian pension funds were also provided and analysed. The author compares the investment performance of Estonian pension funds with selected pension funds of Northern Europe.

2.2.1. Risk and return measures

To answer the first question raised in introduction regarding the risk and return characteristics of Estonian second pillar pension funds compared to selected European pension funds, below four risk and return measures will be calculated.

Standard Deviation (equation 1.6). It is one of the key risk measures in finance which portfolio managers use nowadays. In contrast to variance, the standard deviation has the same dimensionality as the variable for which the standard deviation is calculated. If for instance the variable is in percent, then the standard deviation will be in percentage points. The standard derivation is therefore a measure which is quite easy to understand, therefore that can be the reason why this statistic measure is often reported to the customers. In the case of Estonian pension funds this measure is also reported in the reports and webpages of companies.

Sharp Ratio (equation 1.7). Widely accepted risk-reward performance measure is Sharp ratio. Author of the thesis would like to use this measure partly because of the reason that Estonian pension funds managers also provide it for the end customer. Fund managers use it as a performance measure to compare the Sharp ratio of the fund with ratio of the benchmark. The fund performs better than the benchmark in case if the fund's ratio is higher (Ferson 2010). In our case, ratio result figure of some specific pension funds does not provide much information, but we also can compare it with Sharp ratio of other portfolios. If two funds provide same nominal rate of return, then Sharp ratio can help here to understand, which fund to prefer. The fund with the highest ratio has the best performance.

Beta (equation 1.9). This risk measure will help to show the variability of fund's return in respect to the entire market. By how much does the return of portfolio change if market goes up or down by 1%.

Treynor ratio (equation 1.8). This well-known risk-adjusted classical performance measure will help to reflect how well the portfolio of pension fund perform. The higher is the measure the higher extra return portfolio deliver per unit of takes risk.

To answer the question what pension funds outperformed the market when adjusted for systematic risk and got positive alpha, CAPM model regression will be applied. The perhaps most well-known classical measure of investment performance is Jensen's alpha. It will help us to estimate the market risk premium corresponding to the pension fund's excess return. Market risk measuring by beta captures the level of funds volatility, which is related to the market. In practise Jensen's alpha model can be expressed with below regression equation:

$$\mathrm{R_{Pt}} - \mathrm{R_{ft}} = \alpha_\mathrm{P} + \beta_\mathrm{P}(\mathrm{R_{Mt}} - \mathrm{R_{ft}}) + \varepsilon_\mathrm{Pt} \qquad (2.1)$$

where
$\mathrm{R_{Pt}}$ – return of a portfolio P at time t,
$\mathrm{R_{ft}}$ – risk free rate of return at time t,
$\mathrm{R_{Mt}}$ – return of the market portfolio M at time t,
α – Jensen's alpha of a portfolio P,
β_P – market beta of the portfolio P,
ε_Pt - independent disturbance term of portfolio P over the period.

This model is easy to apply in the context of portfolio because the beta of portfolio is a weighted average of the betas of the assets in the portfolio (Donaldson and Ingram 2014). The beta is here capturing the systematic risk of the portfolio of pension fund. With this regression, we will get to know the abnormal risk-adjusted returns of investigated funds. Furthermore, alpha will help us not only to indicate risk adjusted performance of a fund, but also ability of a fund manager to select stocks.

2.2.2. Factor-adjusted return

To answer the last question raised in the introduction about risk factors affected on the return of pension funds, multifactor models' regressions will be applied. As introduced in the section 1.3. there are also other factors besides the market risk, which are commonly used for the evaluation of portfolio performance. Therefore, three different factor models will be used, which can help to explain the return of selected pensions funds.

First multifactor model, which will be applied is the Fama and French (1992) three-factor model (equation 2.2).

$$R_{Pt} - R_{ft} = \alpha_P + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_{Pt} \quad (2.2)$$

where
SMB – size factor (small minus big),
HML – value factor (high minus low book-to-market equity),
β_2, β_3 – factor coefficients.

The second model, which will be used in this study is Fama and French (2015) five-factor model:

$$R_{Pt} - R_{ft} = \alpha_P + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + \varepsilon_{Pt} \quad (2.3)$$

where
RMW – profitability factor (robust minus weak),
CMA – investment factor (conservative minus aggressive),
β_4, β_5 – factor coefficients.

Finally, in the last model momentum factor will be additionally added, as it was noted by Blitz *et* *al.* (2018) the classic Fama-French model ignores widely accepted momentum effect. The six-factor model can be expressed in the following way (Fama and French 2018):

$$R_{Pt} - R_{ft} = \alpha_P + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + \beta_6 MOM_t + \varepsilon_{Pt} \tag{2.4}$$

where
MOM – momentum factor,
β_6 – momentum factor coefficient.

All the models were estimated using Ordinary Least Squares times series regression. The regression helps us to compare the performance of different asset pricing models and to draw the conclusion about the relationships between selected variables. The regression will show what factors going to be sensitive to our variables. Moreover, the purpose of the regression is to ascertain if previous earnings have predictive power and can be used to form profitable strategies in the future. If obtained factor β is statistically significant and has a positive sign, it means that those factors and returns could be also predictable in the future (Maniušis and Urba 2007).

2.3. Data

Comparing to mutual funds, pension funds objectives are typically more long perspective. Horizons for risk and return of pension funds are often measured in years, if not decades. Thus, the thesis focuses on the Estonian second pillar pension funds, which were available for Estonian population for at least 10 years. Following the report on factor and risk-adjusted return for Government Pension Fund Global from Norges Bank Investment Management (2020), those two sample periods were considered: last 10 years (October 2011 – September 2021) and last 5 years (October 2016 – September 2021).

The necessary data of Estonian second pillar pension funds' performance was extracted from Estonian Funded Pension Registry (2021) webpage. Pension Registry website provides daily net asset value (NAV) for all the Estonian pension funds. The author uses monthly data on pension fund portfolios returns. In some empirical studies researchers have sometimes also used quarterly data (Bohl et al. 2011). It can be the reason because often pension funds report only quarterly data. In this work the author selected one month as a unit interval, because it enables generation of higher number of observations. Thus, the power of the various statistical tests was increased.

The author was interested to get monthly return data for the pension's portfolios, therefore last day NAV of each month was used to calculate monthly return (equation 2.5).

$$R_p = \frac{P_1 - P_0}{P_0} \quad (2.5)$$

where
R_p – portfolio monthly rate of return,
P_0 – value of portfolio at the beginning of the period,
P_1 – value of portfolio at the end of the period.

The process of collecting the data for North European pension funds differed from Estonian funds. In North Europe there is other pension system, instead of second pillar there is mandatory occupational pension. It means that person cannot choose pension fund like in Estonia, it is done usually by his or her employer who has the agreement with pension company. That could be the reason why in those countries there is no common website like Estonian Funded Pension Registry, where it would be possible quickly find NAV values or rate of return.

Finnish companies use in their reports quarterly data, which would be not enough for the research. Finnish Centre for Pensions (Eläketurvakeskus) and The Finnish Pension Alliance (TELA) use as well in the statistics only quarterly data, which is provided directly by pension companies. Keva could provide the author data concerning the fund's monthly return, noticing that this data and the figures are unofficial.

In Sweden some pension companies provide NAV history or monthly return data for their pension funds. Alecta (2021) and AMF (2021) pension funds provide such information on their webpage, although this data is possible to find only on Swedish version of company's website.
Monthly returns of Norwegian Pension Fund Norway can be found on the Norwegian language version of Folketrygdfondet webpage (The Government Pension Fund Norway 2021).

For the main models Fama-French factors were used. Risk factors are available from Kenneth French's data library (2021). From the Kenneth French's data library website were collected global factor returns for the CAPM, Fama and French (1992) three-factor model, Fama and French (2015) five-factor model and Momentum factor (Carhart 1997) (Table 2.1). For each of these six factors, Fama and French constructed portfolios sorting securities on financial variables and the difference in returned of those constructed portfolios are the risk factors (Donaldson and Ingram 2014). For the risk-free rate the yield on one-month U.S. treasury bills were used, which is also collected from the Kenneth French's data library.

Table 2.1. Factor descriptions and source

Factor	Description	Source
Market (MKT)	Market minus risk free	Kenneth French data library
Size (SMB)	Small Minus Big. Return difference between small cap and large cap stocks	Kenneth French data library
Value (HML)	High Minus Low. Return difference between high book-to-marketand low book-to-market stocks	Kenneth French data library
Profitability (RMW)	Robust Minus Weak. Retrun difference between high and low profitability stocks	Kenneth French data library
Investment (CMA)	Conservative Minus Aggressive. Return difference between stocks with low and high investment ratios	Kenneth French data library
Momentum (MOM)	Winners minus losers. Return difference between past stocks winners and losers	Kenneth French data library

Source: Kenneth French data library (2021)

3. EMPIRICAL RESULTS

In the final chapter calculation results are provided, which will help to answer the research questions raised in the introduction. Section 3.1. presents risk-adjusted performance results. Section 3.2. describes the factor regression results for Estonian and foreign pension funds. Finally, Section 3.3. provides summary and discussion of the empirical results.

3.1. Results of risk-adjusted returns

Calculations in this section will help to answer the first research question about risk and return characteristics of Estonian second pillar funds in comparison with selected European pension funds. Before turning to the results of risk-adjusted performance measures, we provide the relative returns for all the investigated pension funds in Table 3.1. The table introduces annualized and monthly return arithmetic averages before management costs.

Table 3.1. Selected pension funds average relative returns

Pension fund	Period	Average annual rate of return %	
		10 years	last 5 years
Swedbank K100	Oct 2011 - Sep 2021	7.60	8.18
Luminor A Pluss	Oct 2011 - Sep 2021	7.63	7.82
SEB Energiline	Oct 2011 - Sep 2021	6.49	7.46
LHV XL	Oct 2011 - Sep 2021	5.44	4.82
Keva	Oct 2011 - Sep 2021	7.83	7.39
Alecta Optimal 60	Oct 2011 - Sep 2021	11.07	9.72
AMF Småbolag	Oct 2011 - Sep 2021	21.9	22.25
GPFN	Oct 2011 - Sep 2021	10.19	9.98

Source: compiled by the author using data described in Section 2.3.

From the above table we can see that only Swedish pension fund AMF Småbolag outperformed the general market return with the annual value return 21.9% (market factor results can be seen in Table 3.4).

For 10 years period Estonian pension funds showed lower annual returns comparing to other European pension funds. However, for last 5 years Swedbank K100, Luminor A Pluss and SEB Energiline outperformed Finnish pension fund Keva on the annual return basis. If this higher return of Estonian funds was justifiable in terms of additional risk in comparison with Keva fund, we can find out using simple risk-adjusted performance measures.

Table 3.2 presents the main performance result of risk-adjusted returns for the period of 10 years. Looking at volatility of funds the most volatile is AMF Småbolag what is logical as fund beat the market and provided 21.9% annual average return. Swedbank K100, Luminor A Pluss and SEB Energiline were more volatile than foreign funds Keva, Alecta Optimal 60 and Government Pension Fund of Norway. LHV XL was least volatile among all the selected pensions funds.

Looking at Sharpe ratio all the foreign funds outperformed Estonian second pillar funds. The best Estonian pension fund with risk adjusted terms is LHV XL with the Sharpe ratio value 1.21, what is logical because this fund was not so volatile comparing to other Estonian funds.

The highest beta has the fund with highest average annual return - AMF Småbolag (0.98) and the lowest beta has the fund with the lowest average annual return during this period – LHX XL (0.21). Swedbank K100, Luminor A Pluss and SEB Energiline have higher beta comparing to Keva, Alecta Optimal 60 and GPFN, it means that Estonian funds have stronger correlation with a general market and systematic risk is higher.

Looking at Treynor ratio, LHV XL shows the highest ratio 23.36. That means that for unit of market exposure Estonian fund got the highest excess return comparing to other funds. The result is logical, because LHV XL also have the smallest beta. Treynor ratio of foreign European funds is also quite high and all the values above 20. Swedbank K100, Luminor A Pluss and SEB Energiline have Treynor ratio almost twice lower comparing to all the other selected funds.

Table 3.2. Risk adjusted results for selected pension funds (10 years period)

Pension fund	Period	Standard deviation (%)	Beta	Sharpe ratio	Treynor ratio
Swedbank K100	Oct 2011 - Sep 2021	8.98	0.57	0.79	12.44
Luminor A Pluss	Oct 2011 - Sep 2021	9.53	0.60	0.74	11.85
SEB Energiline	Oct 2011 - Sep 2021	8.60	0.52	0.69	11.38
LHV XL	Oct 2011 - Sep 2021	4.05	0.21	1.21	23.36
Keva	Oct 2011 - Sep 2021	5.82	0.35	1.25	20.84
Alecta Optimal 60	Oct 2011 - Sep 2021	8.16	0.50	1.29	20.94
AMF Småbolag	Oct 2011 - Sep 2021	16.87	0.98	1.27	21.90
GPFN	Oct 2011 - Sep 2021	7.12	0.43	1.35	22.34

Source: compiled by the author using data described in Section 2.3.
Note: Standard deviation, Sharpe ratio and Treynor ratio are annualized

During last 5 years standard deviation and beta value of all pension funds, except LHV XL, increased comparing to 10 years period (Table 3.3). During this period AMF Småbolag was more risky than the market, because beta of AMF Småbolag is even higher than the general market beta (1.02 versus 1). However, looking at Sharpe ratio and Treynor ratio we can say that such taken risk by this Swedish fund pays off, because it has higher values of Sharpe and Treynor among all the comparable funds.

The only pension fund whose Sharpe and Treynor ratios slightly outperformed for last 5 years period comparing to 10 years period is SEB Energiline. However, in general risk adjusted performance measure results of SEB pension fund anyway lags far behind from foreign and LHV pension funds.

Table 3.3. Risk adjusted results for selected pension funds (5 years period)

Pension fund	Period	Standard deviation (%)	Beta	Sharpe ratio	Treynor ratio
Swedbank K100	Oct 2016 - Sep 2021	9.88	0.61	0.72	11.70
Luminor A Pluss	Oct 2016 - Sep 2021	10.71	0.65	0.63	10.51
SEB Energiline	Oct 2016 - Sep 2021	9.10	0.55	0.71	11.64
LHV XL	Oct 2016 - Sep 2021	3.50	0.19	1.08	19.55
Keva	Oct 2016 - Sep 2021	6.59	0.38	0.96	16.89
Alecta Optimal 60	Oct 2016 - Sep 2021	8.74	0.52	0.99	16.74
AMF Småbolag	Oct 2016 - Sep 2021	18.07	1.02	1.17	20.74
GPFN	Oct 2016 - Sep 2021	7.74	0.44	1.15	20.27

Source: compiled by the author using data described in Section 2.3.
Note: Standard deviation, Sharpe ratio and Treynor ratio are annualized

3.2. Factor-adjusted returns analysis

The aim of this section is to analyse factor exposures through various regressions. The results of Estonian second pillar funds are presented in Section 3.1.1. and foreign pension funds in Section 3.1.2.

Before turning to the analysis, we can observe average global returns for Fama-French-Carhart factors in Table 3.4. The table introduces annualized arithmetic averages for two time periods: 10 years and last 5 years.

Table 3.4. Performance of the factors for selected time periods

Factor	Period	Average annual rate of return (%)	
		10 years	last 5 year
Market- Risk free (MKT)	Oct 2011 - Sep 2021	12.54	13.12
Size (SMB)	Oct 2011 - Sep 2021	-1.05	-1.88
Value (HML)	Oct 2011 - Sep 2021	-3.57	-6.48
Profitability (RMW)	Oct 2011 - Sep 2021	2.96	3.63
Investment (CMA)	Oct 2011 - Sep 2021	-1.50	-4.35
Momentum (MOM)	Oct 2011 - Sep 2021	5.58	3.05

Source: compiled by the author based on the Kenneth French data library

As we can see three from six factors underperformed and showed negative return for last decade: SMB, HML and CMA. This fact was also confirmed by Blitz (2020) that Fama-French factors had negative return on average for the last decade. Similar performance of these factors were over the years 1990-1999. (Blitz 2020)

3.2.1. Results of Estonian pension funds

Calculations in this section will help to answer the remaining two questions concerning market outperformance of fund when adjusted for systematic risk and risk factors affected on the return of pension funds. In this section we can see regression results for Estonian second pillar pension funds with Fama-French-Carhart global return factors for two considered time periods: last 10 years and last 5 years. The dependent variables are monthly returns on pension fund portfolios subtracted risk free rate.

Swedbank K100. Table 3.5 considers 10 years period. Columns presents regression results for the four different factor models: one-factor model, the Fama and French (1992) three-factor model, Fama and French (2015) five-factor model and six factor model. The table shows how factor exposures change with the extension of the model. Table 3.6 summarizes regression results for the period of last 5 years.

The market factor (MKT) exposure was statistically significant for all the variations of the regression models for 10- and 5-years periods.

We can see that profitability factor (RMW) was statistically significant for the fund during 10 period, however, last 5 years K100 invested less into the companies, who showed robust gross profit. Moreover, fund had positive and, in some models, statistically significant value factor (HML) during both periods. We can say that most likely companies who reported high book to market ratio with high gross profits influenced on this pension fund return. Moreover, Fund management could not get positive alpha for either of the two time periods considered.

Table 3.5. Multi-factor regression output for Swedbank K100 (10 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	-0.0048 (-0.0370)	0.0141 (0.1063)	-0.0217 (-0.1622)	-0.0116 (-0.0841)
MKT	0.5673*** (17.4862)	0.5656*** (17.1814)	0.5602*** (15.7353)	0.5561*** (14.6830)
SMB	–	-0.0564 (-0.6121)	-0.0059 (-0.0605)	-0.0028 (-0.0280)
HML	–	0.0743 (1.3470)	0.1780* (1.8665)	0.1580 (1.3993)
RMW	–	–	0.2548* (1.9016)	0.2568* (1.9069)
CMA	–	–	-0.1107 (-0.6569)	-0.0938 (-0.5312)
MOM	–	–	–	-0.0211 (-0.3324)
Observations	120	120	120	120
R^2	0.7215	0.7261	0.7348	0.7350

Source: compiled by the author using data described in Section 2.3

Notes:

1. *, **, *** indicate a significance at 10%, 5%, 1%
2. t-statistics are shown in parentheses

Table 3.6. Multi-factor regression output for Swedbank K100 (5 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	-0.0722 (-0.4515)	0.0300 (0.1917)	0.0171 (0.1075)	0.0385 (0.2415)
MKT	0.6099*** (16.9095)	0.5926*** (16.3216)	0.5792*** (14.2646)	0.5584*** (12.7515)
SMB	–	0.0518 (0.4688)	0.0840 (0.7024)	0.0983 (0.8222)
HML	–	0.1391*** (2.7270)	0.1930* (1.9122)	0.1217 (1.0513)
RMW	–	–	0.1454 (0.9331)	0.1364 (0.8786)
CMA	–	–	-0.0488 (-0.2497)	-0.0251 (-0.1285)
MOM	–	–	–	-0.0927 (-1.2354)
Observations	60	60	60	60
R^2	0.8314	0.8539	0.8564	0.8604

Source: compiled by the author using data described in Section 2.3
Notes:

1. *, **, *** indicate a significance at 10%, 5%, 1%
2. t-statistics are shown in parentheses

LHV XL. Table 3.7 summarized regression results of LHV XL pension fund for the period of 10 years. Interesting result here that for 10 years period fund got positive and statistically significant alpha. It means that pension fund slightly outperformed the market when adjusted for systematic risk alone. We can also observe that beta of market factor is quiet small comparing to Swedbank K100 market beta and that could the result why LHV XL got positive alpha. Small beta of the market shows us here that pension fund is not so much volatile compared to the overall market. Moreover, Momentum factor (MOM) is statistically significant at 10% level, and it is negative. Coefficient of MOM has weak negative relationship, and it is only -0.076, however we could say that fund managers had not used momentum trading strategy during 10 years period.

Looking at last 5 years period of LHV XL (Table 3.8), we can see that alpha has not been statistically significant, however other factors influenced on the excess return of the fund. Profitability factor was statistically significant at 1% level. Furthermore, value companies could also contribute on the rate of return, as HML factor was statistically significant at 10% level for 5-factor and 6-factor models.

Table 3.7. Multi-factor regression output for LHV XL (10 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	0.1890** (2.3242)	0.1872** (2.2597)	0.1943** (2.3018)	0.2308*** (2.6979)
MKT	0.2097*** (10.4097)	0.2088*** (10.1650)	0.1984*** (8,8425)	0.1834*** (7.8068)
SMB	–	0.0441 (0.7674)	0.033 (0.5358)	0.0444 (0.7254)
HML	–	-0.0223 (-0.6487)	0.028 (0.4661)	-0.0438 (-0.6245)
RMW	–	–	0.0094 (0.1107)	0.0164 (0.1960)
CMA	–	–	-0.1235 (-1.1627)	-0.0627 (-0.5724)
MOM	–	–	–	-0.076* (-1.9295)
Observations	120	120	120	120
R^2	0.4787	0.4825	0.4886	0.5049

Source: compiled by the author using data described in Section 2.3
Notes: 1. *, **, *** indicate a significance at 10%, 5%, 1%
2.t-statistics are shown in parentheses

Table 3.8. Multi-factor regression output for LHV XL (5 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	0.1035 (1.2363)	0.1103 (1.2545)	0.0877 (1.0547)	0.0817 (0.9720)
MKT	0.1932*** (10.2287)	0.1912*** (9.3679)	0.1679*** (7.9233)	0.1737*** (7.5241)
SMB	–	0.0143 (0.2303)	0.0676 (1.0829)	0.0636 (1.0088)
HML	–	0.0045 (0.1564)	0.0994* (1.8879)	0.1192* (1.9535)
RMW	–	–	0.2452*** (3.0153)	0.2477*** (3.0266)
CMA	–	–	-0.0929 (-0.9107)	-0.0995 (-0.9655)
MOM	–	–	–	0.0258 (0.6526)
Observations	60	60	60	60
R^2	0.6434	0.644	0.6983	0.7007

Source: compiled by the author using data described in Section 2.3
Notes: 1. *, **, *** indicate a significance at 10%, 5%, 1%
2. t-statistics are shown in parentheses

Luminor A Pluss. Looking at Luminor A Pluss pension fund regressions (Table 3.9 and Table 3.10) we can see that basically only market drives portfolio return. During the period of last 5 years HML factor was statistically significant at 10% level only for the 3-factor model, therefore most likely this factor has not influenced on the return of the pension fund. Average market beta for the 10 years period is 0.59 and 0.62 for the 5 years period, what is higher comparing to already observed Estonian pension funds Swedbank K100 and LHV XL. We can say that Luminor A Pluss is quite volatile in relation to the overall market.

Table 3.9. Multi-factor regression output for Luminor A Pluss (10 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	-0.0342 (-0.2419)	-0.0289 (-0.1998)	-0.0503 (-0.3434)	-0.0645 (-0.4282)
MKT	0.5976*** (17.0565)	0.5976*** (16.6871)	0.5846*** (15.0202)	0.5905*** (14.2664)
SMB	–	-0.0307 -(0.3064)	-0.0014 (-0.0135)	-0.0059 (-0.0545)
HML	–	0.0268 (0.4466)	0.1491 (1.4305)	0.1771 (1.4349)
RMW	–	–	0.2034 (1.3880)	0.2006 (1.3631)
CMA	–	–	-0.19 (-1.0310)	-0.2137 (-1.1068)
MOM	–	–	–	0.0297 (0.4275)
Observations	120	120	120	120
R^2	0.7114	0.7121	0.7184	0.7188

Source: compiled by the author using data described in Section 2.3
Notes:
1. *, **, *** indicate a significance at 10%, 5%, 1%
2. t-statistics are shown in parentheses

Table 3.10. Multi-factor regression output for Luminor A Pluss (5 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	-0.1404 (-0.7358)	-0.0548 (-0.2819)	-0.0705 (-0.3546)	-0.0600 (-0.2979)
MKT	0.6454*** (14.9931)	0.6295*** (13.9567)	0.6159*** (12.1514)	0.6057*** (10.9484)
SMB	–	0.0609 (0.4435)	0.0669 (0.4479)	0.0739 (0.4891)
HML	–	0.1087* (1.7157)	0.1761 (1.3979)	0.1411 (0.9648)
RMW	–	–	0.0716 (0.3683)	0.0672 (0.3427)
CMA	–	–	-0.1277 (-0.5231)	-0.1161 (-0.4698)
MOM	–	–	–	-0.0455 (-0.4797)
Observations	60	60	60	60
R^2	0.7949	0.8075	0.8089	0.8097

Source: compiled by the author using data described in Section 2.3

Notes:

1. *, **, *** indicate a significance at 10%, 5%, 1%
2. t-statistics are shown in parentheses

SEB Energiline. Table 3.11 summarizes regression results for 10 years period and Table 3.12 for last 5 years period respectively. The result of regressions here is quite similar with Luminor A Pluss pension fund. The main return driver is also market factor, no other factors icluding alpha are not statistically significant for SEB Energiline.

Table 3.11. Multi-factor regression output for SEB Energiline (10 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	-0.0507 (-0.3713)	-0.0621 (-0.4463)	-0.0802 (-0.5705)	-0.0749 (-0.5170)
MKT	0.5224*** (15.4277)	0.5269*** (15.2625)	0.5091*** (13.6231)	0.5069*** (12.7473)
SMB	–	-0.0867 (-0.8977)	-0.0627 (-0.6110)	-0.0610 (-0.5895)
HML	–	0.0030 (0.0516)	0.1484 (1.4833)	0.1379 (1.1630)
RMW	–	–	0.2072 (1.4733)	0.2083 (1.4729)
CMA	–	–	-0.247 (-1.3962)	-0.2381 (-1.2835)
MOM	–	–	–	-0.0111 (-0.1672)
Observations	120	120	120	120
R^2	0.6686	0.6709	0.6806	0.6807

Source: compiled by the author using data described in Section 2.3

Notes: 1. *, **, *** indicate a significance at 10%, 5%, 1%

2.t-statistics are shown in parentheses

Table 3.12. Multi-factor regression output for SEB Energiline (5 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	-0.0682 (-0.4299)	-0.0425 (-0.2571)	-0.0592 (-0.3512)	-0.0451 (-0.2651)
MKT	0.5516*** (15.4235)	0.5508*** (14.3745)	0.5364*** (12.4833)	0.5227*** (11.1815)
SMB	– –	-0.0332 (-0.2846)	-0.0285 (-0.2255)	-0.0191 (-0.1498)
HML	–	0.0556 (1.0320)	0.1275 (1.1937)	0.0806 (0.6523)
RMW	–	–	0.0709 (0.4301)	0.0650 (0.3922)
CMA	–	–	-0.1397 (-0.6753)	-0.1241 (-0.5947)
MOM	–	–	–	-0.061 (-0.7610)
Observations	60	60	60	60
R^2	0.804	0.8076	0.8098	0.8119

Source: compiled by the author using data described in Section 2.3

Notes: 1. *, **, *** indicate a significance at 10%, 5%, 1%

2. t-statistics are shown in parentheses

3.2.2. Results of selected European pension funds

The regression analyses undertaken for Estonian pension funds are now repeated for selected European pension funds for both periods: 10 years and last 5 years. The dependent variables are monthly returns on pension fund portfolios subtracted risk free rate.

Keva. Table 3.12 considers 10 years period. We can see that alpha is statistically significant for all the regressions models at 1% level. Market factor is also statistically significant what is logical for all the portfolios who invest in the stocks market. Other factor, which is also statistically significant for 5-factor and 6-factor models' regression is value factor. Profitability factor was statistically significant only for the model with 5 factors at 10% level, therefore we cannot be sure that it influenced on the return of Keva fund.

Looking at regressions results for the period of 5 years (Table 3.14), we could notice that alpha basically was not statistically significant for this period, but other factors influenced to the excess return of this pension fund. Value and size (SMB) factors are the factors that could also explain positive return of Keva fund during the last 5 years.

Table 3.13. Multi-factor regression output for Keva (10 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	0.2417*** (2.5183)	0.2727*** (2.8241)	0.2552*** (2.6174)	0.2324** (2.3256)
MKT	0.3496*** (14.7041)	0.3423*** (14.3017)	0.3328*** (12.8414)	0.3421*** (12.4638)
SMB	–	0.0637 (0.9513)	0.0876 (1.2317)	0.0805 (1.1271)
HML	–	0.0599 (1.4933)	0.1531** (2.2063)	0.1979** (2.4178)
RMW	–	–	0.1602* (1.6424)	0.1558 (1.5964)
CMA	–	–	-0.1417 (-1.1548)	-0.1796 (-1.4027)
MOM	–	–	–	0.0475 (1.0312)
Observations	120	120	120	120
R^2	0.6469	0.6582	0.6682	0.6713

Source: compiled by the author using data described in Section 2.3
Notes:
1. *, **, *** indicate a significance at 10%, 5%, 1%
2. t-statistics are shown in parentheses

Table 3.14. Multi-factor regression output for Keva (5 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	0.1181 (0.8327)	0.2301* (1.6830)	0.2031 (1.4799)	0.2053 (1.4733)
MKT	0.3759*** (11.7460)	0.3480*** (10.9697)	0.3244*** (9.2720)	0.3223*** (8.4232)
SMB	–	0.1725* (1.7864)	0.1849* (1.7945)	0.1864* (1.7836)
HML	–	0.1010** (2.2657)	0.2166** (2.4908)	0.2094** (2.0692)
RMW	–	–	0.1299 (0.9672)	0.1290 (0.9506)
CMA	–	–	-0.2150 (-1.2759)	-0.2126 (-1.2441)
MOM	–	–	–	-0.0094 (-0.1430)
Observations	60	60	60	60
R^2	0.7040	0.7513	0.7622	0.7623

Source: compiled by the author using data described in Section 2.3
Notes:
1. *, **, *** indicate a significance at 10%, 5%, 1%
2. t-statistics are shown in parentheses

Alecta Optimal 60. As it can can be observed from table 3.15, besides of market factor Alecta pension fund has also positive and statistically significant alpha for the period of 10 years, but alpha does not have statistically significant effect on explaining return of fund during the last 5 years (Table 3.16).

For 10 years period pension fund tilted towards large cap stocks, as size factor has negative and statistically significant coefficient.

Moreover, profitability factor has statistically significant effect, which could explain return of Alecta fund for both time periods.

Momentum is statistically significant at the 5% level for 5 years period, but it has negative linear relationship, what tells us that Momentum trading strategy has not been used by the funds managers during this time period.

Table 3.15. Multi-factor regression output for Alecta Optimal 60 (10 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	0.3518*** (2.7850)	0.3155*** (2.5095)	0.2936** (2.3296)	0.3240*** (2.5089)
MKT	0.5028*** (16.0675)	0.5153*** (16.5346)	0.4969*** (14.8355)	0.4844*** (13.6577)
SMB	–	-0.2105** (-2.4142)	-0.1811** (-1.9699)	-0.1716* (-1.8593)
HML	–	-0.0165 (-0.3153)	0.1403 (1.5639)	0.0804 (0.7603)
RMW	–	–	0.2345* (1.8602)	0.2404* (1.9060)
CMA	–	–	-0.2593 (-1.6354)	-0.2086 (-1.2609)
MOM	–	–	–	-0.0634 (-1.0662)
Observations	120	120	120	120
R^2	0.6863	0.7028	0.7158	0.7186

Source: compiled by the author using data described in Section 2.3

Notes:

1. *, **, *** indicate a significance at 10%, 5%, 1%
2. t-statistics are shown in parentheses

Table 3.16. Multi-factor regression output for Alecta Optimal 60 (5 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	0.1564 (0.9493)	0.1276 (0.7477)	0.0873 (0.5266)	0.1255 (0.7783)
MKT	0.5185*** (13.9504)	0.5343*** (13.4951)	0.4943*** (11.6961)	0.4571*** (10.3222)
SMB	–	-0.1572 (-1.3047)	-0.0804 (-0.6457)	-0.0548 (-0.4532)
HML	–	0.0242 (0.4348)	0.1937* (1.8439)	0.0664 (0.5674)
RMW	–	–	0.3790** (2.3366)	0.3629** (2.3116)
CMA	–	–	-0.2014 (-0.9896)	-0.1591 (-0.8043)
MOM	–	–	–	-0.1656** (-2.1824)
Observations	60	60	60	60
R^2	0.7704	0.7773	0.8004	0.8169

Source: compiled by the author using data described in Section 2.3

Notes:

1. *, **, *** indicate a significance at 10%, 5%, 1%
2. t-statistics are shown in parentheses

AMF Småbolag. Swedish fund AMF Småbolag has strong positive market factor beta (Table 3.17 and Table 3.18). 1- and 3-factor models for 5 years period have even >1 beta and that is higher than general market beta, which is 1 by definition. It means that portfolio of this pension fund could be more risky than a market.

Another factor what drives this fund return for both periods is profitability factor, where we can observe positive statistically significant coefficient >0.7 for all the models' variations.
Moreover, alpha has is statistically significant for 10 years period, but it does not have statistically significant power for the last 5 years.
For 10 years period we can also observe that AMF invested more in firms with aggressive investment strategy, as CMA coefficient demonstrates strong negative correlation with the dependent variable.

Table 3.17. Multi-factor regression output for AMF Småbolag (10 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	0.7607*** (2.6073)	0.6527** (2.2720)	0.5854** (2.0662)	0.6301** (2.1640)
MKT	0.9752*** (13.4913)	0.9896*** (13.8966)	0.9358*** (12.4276)	0.9174*** (11.4729)
SMB	–	0.1590 (0.7981)	0.2495 (1.2073)	0.2634 (1.2658)
HML	–	-0.3589*** (-3.0094)	0.1062 (0.5264)	0.0182 (0.0765)
RMW	–	–	0.7067*** (2.4932)	0.7153*** (2.5155)
CMA	–	–	-0.7628** (-2.1400)	-0.6884* (-1.8454)
MOM	–	–	–	-0.0931 (-0.6945)
Observations	120	120	120	120
R^2	0.6067	0.6353	0.6624	0.6638

Source: compiled by the author using data described in Section 2.3
Notes:
1. *, **, *** indicate a significance at 10%, 5%, 1%
2. t-statistics are shown in parentheses

Table 3.18. Multi-factor regression output for AMF Småbolag (5 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	0.6492* (1.6831)	0.5218 (1.3309)	0.4517 (1.1691)	0.4468 (1.1390)
MKT	1.0226*** (11.7542)	1.0304*** (11.3277)	0.9576*** (9.7230)	0.9623*** (8.9343)
SMB	–	0.1150 (0.4153)	0.2896 (0.9981)	0.2863 (0.9731)
HML	–	-0.2533** (-1.9813)	0.0395 (0.1615)	0.0558 (0.1960)
RMW	–	–	0.7891** (2.0879)	0.7912** (2.0718)
CMA	–	–	-0.2668 (-0.5625)	-0.2722 (-0.5659)
MOM	–	–	–	0.0212 (0.1148)
Observations	60	60	60	60
R^2	0.7043	0.7237	0.7453	0.7454

Source: compiled by the author using data described in Section 2.3
Notes:

1. *, **, *** indicate a significance at 10%, 5%, 1%
2. t-statistics are shown in parentheses

Government Pension Fund of Norway. The main factors for Norwegian pension fund, which drove portfolio return during 10 and last 5 years period were alpha and market (Tables 3.19 and 3.20). We could also say that pension fund had in their portfolio stocks of companies with high book to market ratio for 10 years period, as value factor is statistically significant at 10% level for 5-factor model and 5% level for 6-factor model. For 5 years period HML factor is statistically significant only for 3-factor model at 10% level. Thus, we could make a conclusion that during the recent years the number of companies in the portfolio with high book to market value decreased.

Table 3.19. Multi-factor regression output for Government Pension Fund of Norway (10 years period)

	1-factor	3-factor	5-factor	6-factor
Alpha	0.3525*** (3.0665)	0.3778*** (3.2448)	0.3636*** (3.0651)	0.3276*** (2.7026)
MKT	0.4315*** (15.1504)	0.4272*** (14.7992)	0.4201*** (13.3261)	0.4350*** (13.0668)
SMB	–	-0.0046 (-0.0564)	0.0150 (0.1735)	0.0038* (0.0437)
HML	–	0.0712 (1.4724)	0.1429* (1.6920)	0.2138** (2.1537)
RMW	–	–	0.1269 (1.0696)	0.1200 (1.0137)
CMA	–	–	-0.1066 (-0.7139)	-0.1666 (-1.0731)
MOM	–	–	–	0.0751 (1.3464)
Observations	120	120	120	120
R^2	0.6605	0.6668	0.6709	0.6761

Source: compiled by the author using data described in Section 2.3

Notes: 1. *, **, *** indicate a significance at 10%, 5%, 1%

2.t-statistics are shown in parentheses

Table 3.20. Multi-factor regression output for Government Pension Fund of Norway (5 years period)42

	1-factor	3-factor	5-factor	6-factor
Alpha	0.2627 (1.5781)	0.3581** (2.1395)	0.3529** (2.0963)	0.3335** (1.9714)
MKT	0.4409*** (11.7398)	0.4186*** (10.7793)	0.4088*** (9.5262)	0.4277*** (9.2082)
SMB	–	0.1280 (1.0825)	0.1961 (1.5513)	0.1831 (1.4431)
HML	–	0.0945* (1.7309)	0.1135 (1.0647)	0.1782 (1.4511)
RMW	–	–	0.2338 (1.4198)	0.2420 (1.4695)
CMA	–	–	0.0928 (0.4492)	0.0713 (0.3437)
MOM	–	–	–	0.0842 (1.0580)
Observations	60	60	60	60
R^2	0.7038	0.7292	0.7402	0.7455

Source: compiled by the author using data described in Section 2.3

Notes: 1. *, **, *** indicate a significance at 10%, 5%, 1%

2.t-statistics are shown in parentheses

3.3. Summary of results

The most risky pension fund is AMF Småbolag with standard deviation almost twice higher than all of the selected funds. For 5 years period AMF had beta of 1.02 what tells us that volatility of this fund was higher comparing to the overall market. The result is logical, because fund mainly invest in stocks (at least 85 percent in the stock market). Description of AMF Småbolag funds says that they have aggressive strategy with high level of risk (AMF pension fund 2021). However, Sharpe and Treynor ratios showed us that such risks paid off for the investors of this Swedish pension fund. Such high annual return of AMF Småbolag (21.9% for 10 years and 22.5% for last 5 years) was justifiable in terms of additional risk what the fund has taken. The goal of the fund is for the return to be higher than the market. Thus, we can say that fund management successfully reached their goal.

Excepting the most risky fund AMF Småbolag, Estonian second pillar funds Swedbank K100, Luminor A pluss and SEB Energiline showed highest standard deviation and beta values among the rest selected funds for both analyzed periods of time (see Tables 18 and Table 19). It means that they are quite risky. Unlike AMF Småbolag, we could say that the risk of those funds did not pay off, as Estonian funds showed quite low Treynor and Sharpe ratios. Treynor ratios of Swedbank K100, Luminor A pluss and SEB Energiline were almost twice lower compared to other funds for 10 years period. Thus, we could say that investments of those funds were not so successful in providing compensation to investors for taking on investment risk.
Results of risk adjusted analysis showed that Estonian second pillar funds Swedbank K100, Luminor A pluss and SEB Energiline underperformed foreign European funds for both periods of 10 years and last 5 years. It means that they did not deliver much extra return per unit of taken risk comparing to other funds.

Swedbank K100, Luminor A Pluss and SEB Energiline also underperformed Estonian fund LHV XL in terms of risk adjusted return. LHV XL is the least risky fund with the smallest standard deviation and beta values among the compared pension funds for both time periods. The result is logical, because fund invest a lot in debt securities, which are less risky and not fully captured by stock market movements. On the moment of 30th of November 2021 LHV XL reported that 30.01% of fund’s investments are debt securities. In annual report 2020 the fund reported debt securities part 43.05%, in 2019 56.54%, in 2018 59.11% and in 2017 64.10%. (LHV pension fund 2021)

Treynor and Sharpe ratios of LHV XL are basically on the level of foreign pension funds. Treynor ratio for 10 years period was the highest one among comparable funds and constituted 23.36. The reason here that even with smallest average annual return in the analyzed funds group, LHV XL have small beta, which is almost twice less than other funds have. We could say that LHV XL provided satisfyingly results of risk-adjusted returns for 10 years and last 5 years periods.

Keva, Alecta 60 and Government Pension Fund of Norway in average showed similar risk-adjusted results. They are more risky than LHV XL with higher standard deviation and beta values. However, these funds made higher average annual return for both periods, therefore risk-adjusted return is quite similar. Sharpe ratio was the highest one for Norwegian fund with the annual value 1.35 for 10 years period. It means that GPFN fund return on investments compared to its risk was the most optimal during this period.

Taking everything into consideration we can make a logical conclusion that foreign European funds beat three of the four Estonian funds on risk-adjusted return. Now we could turn to the multifactor analysis to understand what were the main return drivers for the pension funds.

Regression analyses demonstrated that the main driver of Luminor A Pluss (Table 7 and Table 8) and SEB Energiline (Table 9 and Table 10) pension funds was the market factor for both analyzed periods. Those funds also had negative alpha values, although it should be noted that it was not statistically significant.

Swedbank K100 had statistically significant profitability factor for 10 years period and value factor for 5 years (Table 3 and Table 4). We could say that companies with robust operating profitability positively influenced on excess return of Swedbank pension fund. However, companies with high book to market values for the last 10 years in general showed negative return (Table 2), therefore those companies most likely also had negative influence of the return of Swedbank K100.

LHX XL had positive alpha value for both periods (Table 5 and Table 6). It was statistically significant for 10 years period but had not statistical power for the last 5 years. We could say that managers of LHV XL slightly outperformed the market when adjusted for systematic risk only.

When we talk about alpha then we adjust only for the market beta for systematic risk and, as we have mentioned above, the market beta of this fund is quite small, therefore the result is logical. We could also say that most likely LHV XL started to invest more into the companies with robust operating profitability, because RMW factor coefficient was positive and statistically significant at 1% level for the period of 5 last years. Moreover, pension fund of LHV had statistically significant Momentum factor for 10 years period, which was negative. That means that pension fund portfolio moved in the opposite direction from the average return of Momentum portfolio. Momentum factor portfolio had positive average return (Table 2), therefore LHV XL had not used this time successful momentum investment strategy.

Looking at regression results of foreign pension funds, we can obtain that all funds have positive alpha values. The main factor, besides market, which drove excess return of foreign funds was profitability factor. The only fund, which probably invested less during analyzed periods in the firms with robust operating profitability was Government Pension fund of Norway. Although RMW coefficients of Norwegian fund were positive, they were not statistically significant.
Value factor was statistically significant with positive coefficient for Keva, Alecta Optimal 60 and GPFN funds. Size factor had statistically significant affect with positive coefficient only for Keva and GPFN funds. However, both portfolios of value and size factors were showed negative average return for those periods of time (Table 2).

It is interesting to follow AMF Småbolag investment strategy, who had highest annual average return for both analyzed periods. Besides strong positive linear relationship with market and profitability factors, value and investment factors had also statistically significant effect. However, both coefficients of value and investment factors were negative, therefore we can assume that AMF Småbolag did not invest much in the companies with high book to market ratio and in the companies, who prefer conservative investment strategy. And we could say that it was good investment strategy for this Swedish pension fund, as both portfolios of HML and CMA factors showed negative annual average return for analyzed periods.

CONCLUSION

The issue of the performance of second pillar pension funds in Estonia is very topical during the last year, as pension funds looking for various ways to meet their return target benchmarks at a reasonable level of risk and return customers back to the second pillar fund. The aim of this master's thesis was to evaluate the performance of selected Estonian second pillar funds and to determine factors that affect the return of these pension funds. The author used in this study comparative analyses methodology. Thus, the author compared the investment performance of Estonian pension funds with selected pension funds operating in more mature markets of Europe: Finland, Sweden and Norway.

To answer the first question about risk and return characteristics of Estonian second pillar funds in comparison with selected European pension funds, the standard deviation, market beta, Sharp ratios and Treynor ratios were calculated and compared for all of the selected pension funds. Estonian fund LHV XL had the lowest annual rate of return in comparable group of Estonian pension funds; however, in terms of risk adjustment return LHX XL outperformed Swedbank K100, Luminor A Pluss and SEB Energiline. It is also interesting to note that LHV XL and the most risky Swedish fund AMF Småbolag have different nominal return and different level of risk but their risk adjustment returns are quite similar. It means that nominal return of both funds was justifiable in terms of risk what the fund managers have taken. Treynor ratio of LHV XL for 10 years period was even the highest one among comparable funds. Treynor ratio of LHV XL a bit decreased for the last 5 years period, which could be explained that fund started to invest more in stocks market. Anyway, risk return measures of LHV XL were approximately at the same level with analyzed foreign European pension funds for both periods.

All in all, we could say that LHV XL provided satisfying results of risk-adjusted returns for the last 10 years and for the last 5 years, however, we could not say the same regarding other Estonian funds - Swedbank K100, Luminor A Pluss and SEB Energiline. Those three Estonian second pillar funds are quite risky, and we can conclude that their portfolios did not deliver much extra return per unit of taken risk comparing to LHV XL and selected European pension funds.

To answer the remaining two questions about what pension funds outperformed the market when adjusted for systematic risk and what risk factors affected on the return of pension funds, multi-factor regressions were performed. First of all, using CAPM regression model we could determine whether alpha was statistically significant. Among the Estonian pension funds only LHV XL had positive and statistically significant alpha. We can say that managers of LHV XL slightly outperformed the market when adjusted for systematic risk only. Alpha for Luminor A Pluss and SEB Energiline was negative for both of the periods considered, albeit it did not attain statistical significance. These results for the Estonian funds cannot be encouraging, because all four foreign pension funds had a positive alpha, which for at least one of the two observed periods was statistically significant.

Finally, Fama-French-Carhart factors analysis was undertaken to understand what was driving the returns of pension funds. Multifactor analyses demonstrated that the main driver for the pension funds of Luminor A Pluss and SEB Energiline was the market factor. Other factors generally did not attain statistical significance.

Besides market, portfolios of pension funds Swedbank K100 and LHV XL had positive and statistically significant profitability factor. We could say that companies with robust operating profitability positively influenced on the returns of those two Estonian second pillar funds. Moreover, most likely Swedbank K100 and LHV XL also invested in companies with high book to market value, as the coefficient of value factor was positive and statistically significant for some multifactor models of those funds. However, average return of value factor for the period of last 10 and 5 years was negative, so most likely companies with higher book to market values in general also had negative effect on the return of Swedbank K100 and LHV XL.

Besides the market, the main factor driving returns for foreign selected European pension funds was the profitability factor, where the coefficient was positive and statistically significant for three from four founds (Keva, Alecta Optimal 60 and AMF Småbolag). Furthermore, multifactor analysis showed that most likely foreign pension funds using investment strategy of Fama-French factors more actively comparing to Estonian second pillar funds, albeit that size, value, and investments factors had negative return for last 10 years. Besides mentioned above market and profitability factor, the coefficient of the value factor was statistically significant for all of the foreign funds analyzed. The size factor had statistically significant affect for three founds (Keva, Alecta Optimal 60 and GPFN funds). Moreover, investment factor was statistically significant for explaining return of AMF Småbolag. Confirmation that foreign funds likely use more actively Fama-French factors in their investment strategy than is the case for the Estonian funds can be found in the factor-adjusted returns reports from Folketrygdfondet (2020) and Norges Bank Investment Management (2020), who manage Government Pension Fund of Norway and Norwegian Government Pension Fund Global respectively.

Based on the results in this thesis, we can make the conclusion that for the last decade Estonian second pillar pension funds with aggressive or progressive strategy could not reach high rate of return at a reasonable level of risk. If the main driver of returns for the active management fund is the market and fund management cannot outperform the market when adjusted for systematic risk, then in this case, a good option for an investor could be pension fund with passive management and lower management costs.

Investors are advised not to invest in the aggressive pension funds if there are less than 15 years until the retirement. However, looking at the risk level of LHV XL it seems that such fund could also be the appropriate option for investors more than 49 years old if pension fund will continue to suggest the same level of risk adjusted return.

Estonian pension market is still at a relatively early stage and might further develop and improve. Considering the findings above, the author suggests that Estonian second pillar fund managers could use more actively different risk factors in their investment strategy. If fund managers cannot provide investors higher returns, then they could look for options on how to decrease fund risks. For example, alternative investments could be the option how to provide better diversification, which would decrease volatility and funds risks.
A few years ago, second pillar funds could not yet allow to invest 100% in the stock market. Nowadays aggressive pension funds inform that up to 100% of the fund’s assets can be invested in the instruments with equity risk. Thus, it will be interesting to evaluate the performance of aggressive pension funds in the future and to see if they could provide risk adjusted return with a higher taken risk.

KOKKUVÕTE

2021. aastal oli Eestis väga aktuaalsemaks teemaks saanud pensioni teine sammas. Pensionifondide haldurid otsisid aina paremaid viise, kuidas mõistliku riskitaseme juures oma tootluseesmärki täita ja kliente teise pensionisamba fondi tagasi tuua või sellega liita. Käesoleva magistritöö eesmärk oli hinnata erinevate teise pensionisamba fondide efektiivust ja välja selgitada tegurid, mis mõjutasid fondide tootlust. Autor kasutas uuringus võrdlevate analüüside metoodikat. Autor võrdles Eesti pensionifondide investeerimistulemust juba tegutsevate ja kogemustega Euroopa turgudel head tulemust näidanud Soome, Rootsi ja Norraga. Selleks, et vastata esimesele küsimusele, mis puudutas fondide riske ja tootlusnäitajaid võrreldes eelnevalt mainitud Euroopa pensionifondidega, arvutas ja võrdles autor kõikide fondide standarthälvet, turu beetat, Sharpi ja Treynori suhtarvu.

Konspektiivselt võib öelda, et LHV XL fond andis viimase 10 ja 5 aasta kokkuvõttes kõige rahuldavama tulemuse vaadeldes riskiga korrigeeritud tulu. Kahjuks ei saa seda öelda teiste Eesti fondide kohta nagu Swedbank K100, Luminor A Pluss ja SEB Energiline. Viimased kolm fondi on olnud küllaltki riskantsed ning sellest tulevalt saab autor järeldada, et nende portfellid arvestades riskiühikut ei suutnud toota piisavalt tootlust võrreldes LHV XL fondi ja teiste valitud Euroopa fondidega.

Selleks, et vastata ülejäänud kahele küsimusele, mis puudutasid turu parimat tulemuslikkust, kui seda on korrigeeritud süstemaatilise riski ja pensionifondide ületootlust mõjutavate riskiteguritega, viidi läbi mitmeteguriline regressioon. Esiteks saime OLS-i regressioonide abil kindlaks teha, kas alfa oli statistiliselt oluline. Eesti pensionifondidest oli positiivne ja statistiliselt oluline alfa vaid LHV XL. Autor tõi välja, et LHV XL juhid edestasid turgu veidi, kui arvestada ainult süstemaatilist riski. Luminor A Plussi ja SEB Energiline alfa oli mõlemal vaatlusalusel perioodil negatiivne, kuigi ta ei saavutanud statistilist olulisust. Selline tulemus Eesti fondide jaoks ei ole kahjuks julgustav, sest kõigil neljal välismaisel pensionifondil oli positiivne alfa, mis vähemalt ühel kahest vaadeldud perioodist oli statistiliselt oluline.

Lõpus viis autor läbi Fama-French-Carharti mudeli analüüsi, et mõista, mis pensionifondide tootlust enim mõjutas. Mitmeteguriline analüüs näitas, et Luminor A Plussi ja SEB Energiline pensionifondide peamine ajend oli turutegur. Muud tegurid ei omandanud põhimõtteliselt statistilist tähtsust. Lisaks turuteguri ajendile oli pensionifondide Swedbank K100 ja LHV XL portfellidel positiivne ja statistiliselt oluline kasumlikkuse tegur. Autor saab väita, et nende kahe Eesti teise samba fondi tootlust mõjutasid positiivselt tugeva tegevuskasumlikkusega ettevõtted. Lisaks investeerisid Swedbank K100 ja LHV XL suure tõenäosusega ka kõrge bilansi ja turuväärtusega ettevõtetesse kuna nende fondide mõne mitmetegurilise mudeli puhul oli väärtustegur positiivne ja statistiliselt oluline. Viimase 10 ja 5 aasta keskmine väärtusteguri tootlus oli aga negatiivne, mistõttu suure tõenäosusega avaldasid turuväärtusest kõrgema bilansilise väärtusega ettevõtted üldiselt negatiivset mõju ka Swedbank K100 ja LHV XL tootlusele.

Lisaks turu mõjule oli Euroopa pensionifondide peamiseks tootluse teguriks kasumlikkuse tegur, mille koefitsient oli positiivne ja statistiliselt oluline kolme puhul, neljast fondist (Keva, Alecta Optimal 60 ja AMF Småbolag). Lisaks näitas mitmeteguriline analüüs, et suure tõenäosusega kasutavad välismaised pensionifondid palju aktiivsemalt Fama-French tegurite investeerimisstrateegiat, kui seda Eesti teise samba fondid, kuigi suuruse, väärtuse ja investeerimistegurid viimase 10 aasta jooksul olid negatiivse tootlusega. Lisaks eelnimetatud turu- ja tasuvustegurile oli väärtusteguri koefitsient statistiliselt oluline kõigi analüüsitud välismaa fondide puhul. Suurustegur avaldas statistiliselt olulist mõju kolmele leiule (Keva, Alecta Optimal 60 ja GPFN fondid). Lisaks oli investeerimistegur AMF Småbolagi tootluse selgitamise puhul statistiliselt oluline. Kinnitust selle kohta, et välismaa fondid kasutavad oma investeerimisstrateegias tõenäoliselt aktiivsemalt Fama-French tegurid kui Eesti fondid, leiab teguriga korrigeeritud tootluse aruannetest Folketrygdfondetilt (2020) ja Norges Bank Investment Managementilt (2020), kes juhivad Norra Valitsuse Pensionifondi ja Norra Valitsuse Pensionifond Global.

Toetudes antud lõputöö tulemustele võib järeldada, et viimase 10 aasta jooksul ei suutnud Eesti II samba pensionifondid agressiivse või progressiivse strateegiaga mõistliku riskitaseme juures kõrget tootlust saavutada. Kui aktiivselt juhitud fondi peamiseks tootluseks on turg ja ei saa need fondid süstemaatilise riskiga korrigeerituna turgu ületada, siis võiks investorile hea valikuvõimalus olla passiivselt juhitud ja madalamate halduskuludega pensionifond.

Investorid soovitasid vältida investeerimist agressiivsetesse pensionifondidesse, kui pensionini on jäänud vähem kui 15 aastat. LHV XL riskitaset vaadates tundub aga, et selline fond võiks olla sobiv valik ka üle 49-aastastele investoritele, kui pensionifond jätkab sama riskiga korrigeeritud tootluse taseme pakkumist.

Eesti pensioniturg on veel suhteliselt varajases järgus ning on veel küllaltki ruumi edasi areneda ja paraneda. Arvestades ülaltoodud järeldusi, teeb autor ettepaneku, et Eesti teise samba fondijuhid võiksid oma investeerimisstrateegias aktiivsemalt kasutada erinevaid riskitegureid. Kui fondijuhid ei suuda pakkuda investoritele kõrgemat tootlust, võiksid nad otsida võimalusi fondiriskide vähendamiseks. Näiteks alternatiivsed investeeringud võiksid olla üks võimalus, kuidas pakkuda paremat hajutamist, mis vähendaks volatiilsust ja fondiriske.
Veel paar aastat tagasi ei saanud teise samba fondid 100% aktsiaturule investeerida. Tänapäeval lubavad agressiivsed pensionifondid, et kuni 100% fondi varast saab investeerida aktsiariskiga instrumentidesse. Seega on tulevikus huvitav hinnata agressiivsete pensionifondide tootlust ja näha, kas nad suudavad pakkuda riskiga korrigeeritud tootlust kõrgema võetud riskiga.

LIST OF REFERENCES

Alecta pension fund. Retrieved from https://www.alecta.se/en/, 1 November 2021.

AMF pension fund. Retrieved from https://www.amf.se/in-english/, 1 November 2021.

Ang, A., Goetzmann, W.N., Schaefer, S.M. (2009). Evaluation of Active Management of the Norwegian Government Pension Fund – Global. Report to the Norwegian Ministry of Finance. Accessible: https://www0.gsb.columbia.edu/faculty/aang/papers/report%20Norway.pdf, 30 October 2021.

Aragon, G.O., Ferson, W.E. (2006). Portfolio performance evaluation. – *Foundatioms and Trends in Finance*, Vol. 2, No. 2, 83-190

Bacon, C. R. (2013). Practical Risk-Adjusted Performance Measurement. *Chichester: John Wiley & Sons Ltd.*

Baltes, N., Dragoe, A. (2015). Study regarding the Markowitz model of portfolio selection. – *Revista Economica 67: Supplement*, Vol. 67, No. 2.

Bender, J., Briand, R., Melas, D., Subramanian, R.A. (2013). Foundations of Factor Investing. – *MSCI Inc.* Accessible: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2543990

Bernoulli, D. (1738). Exposition of a New Theory on the Measurement of Risk. – *Econometrica*, Vol. 22, No. 1, 23-36.

Blitz, D. (2020). Factor Performance 2010–2019: A Lost Decade? – *The Journal of Index Investing*, Vol. 11, No. 2, 57-65

Blitz, D., Hanauer, M. X., Vidojevic, M., Van Vliet, P. (2018). Five concerns with the five-factor model. – *The Journal of Portfolio Management*, Vol. 44, No. 4, 71-78.

Bohl, M.T., Lischewski, J., Voronkova, S. (2011). Pension Funds' Performance in Strongly Regulated Industries in Central Europe: Evidence from Poland and Hungary. *Emerging Markets Finance and Trade*, Vol. 47, No. 3, 80-94.

Carhart, M. (1997). On Persistence in Mutual Fund Performance. – *Journal of Finance*, Vol. 52, No. 1, 57-82.

Christpherson, J. A., Carino, D.R, Ferson, W.E. (2009). Portfolio Performance Measurement and Benchmarking. *New York: McGraw-Hill Education.*

Cornuejols, G., Tütüncü, R. (2006). Optimization Methods in Finance. – *Cambridge University Press.*

Donaldson, J., Ingram, M. A. (2014). Applying Multi-Factor Models of Stock Returns: Student Exercises and Applications. – *Journal of Financial Education*, Vol. 40, No. 3/4, 1-21.

Dopierala, L., Mosionek-Schweda, M. (2021). Pension Fund Management, Investment Performance, and Herding in the Context of Regulatory Changes: New Evidence from the Polish Pension System. – Risks, Vol. 9, No. 1. Accessible: https://www.mdpi.com/2227-9091/9/1/6, 30 October 2021.

Estonian Funded Pension Registry. Accessible: https://www.pensionikeskus.ee, 2 September 2021.

Fabozzi, F.J., Gupta, F., Markowitz, H.M. (2002). The Legacy of Modern Portfolio Theory. – *The Journal of Investing*, Vol. 11, No. 3, 7-22.

Fabozzi, F.J., Markowitz, H.M., Gupta, F. (2008). Portfolio Selection. – *Handbook of Finance*, Vol. 2, Chapter 1, 3-14.

Fama, E., French, K. (1992). The cross-section of expected stock returns. – *Journal of Finance*, Vol. 47, 427-465.

Fama, E., French, K. (1993). Common risk factors in the returns on stocks and bonds. – *Journal of Financial Economics*, Vol. 33, 3-56.

Fama, E. F., French, K. R. (2015). A five-factor asset pricing model. - *Journal of financial economics*, Vol. 116, No. 1, 1-22.

Fama, E. F., French, K. R. (2018). Choosing factors. - *Journal of Financial Economics*, Vol. 128, 234–252.

Ferson, W.E. (2010). Investment Performance Evaluation. - *Annual Review of Financial Economics*, Vol. 2, 207-234.

Folketrygdfondet (2020). Government Pension Fund Norway. Risk-adjusted return. Accessible: https://www.folketrygdfondet.no/getfile.php/133723-1618999151/Nedlastingssenter/Risikojustert%20avkastning%20over%20tid/Risikojustert%20avkastning%20over%20tid%202020.pdf, 1 November 2021.

Francis, J. C., Kim, D. (2013). Modern Portfolio Theory: Foundations, Analysis, and New Developments. *New Jersey: John Wiley & Sons Inc.*

Global top 300 pension funds. A Thinking Ahead Institute and Pensions & Investments joint study. (2021). - *Thinking Ahead Institute.* Accessible: https://www.thinkingaheadinstitute.org/research-papers/the-worlds-largest-pension-funds-2021/, 20 November, 2021.

Gruber, M. (1996). Another Puzzle: The Growth in Actively Managed Mutual Funds. – *Journal* *of Finance,* Vol. 52, 783-810.

Hoepner, A. G., Schopohl, L. (2018). On the price of morals in markets: An empirical study of the Swedish AP-Funds and the Norwegian Government Pension Fund. - *Journal of Business Ethics,* Vol. 151, No. 3, 665-692.

Ingersoll, J., Spiegel, M., Goetzmann, W., Welch, I. (2007). Portfolio Performance Manipulation and Manipulation-Proof Performance Measures. – *Review of Financial Studies,* Vol. 20, No. 5, 1503-1546.

Jensen, M.C. (1968). The Performance of Mutual Funds in the Period 1945–1964. – *Journal of Finance,* Vol. 23, No. 2, 389-416.

Jensen M.C. (1972). Optimal utilization of market forecasts and the evaluation of investment performance. In: G.P. Szego, K. Shell (Eds.), Mathematical Methods in Finance. New York, USA: North-Holland.

Jones, R.C., Wermers, R. (2011). Active Management in Mostly Efficient Markets. – *Financial Analysts Journal,* Vol. 67, No. 6, 29-45.

Kenneth French data library. Retrieved from: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html, 30 October 2021.

Keva pension fund. Retrieved from https://www.keva.fi/en/this-is-keva/keva/, 1 November 2021.

King, B. F. (1966). Market and Industry Factors in Stock Price Behavior. – *Journal of Business,* 139-190.

Lakonishok, J., Shleifer, A., Vishny, R. W., Hart, O., Perry, G. L. (1992). The structure and performance of the money management industry. - *Brookings Papers on Economic Activity. Microeconomics,* 339-391.

Lieksnis, R. (2011). Momentum in the Baltic Stock Market. – *Economics and Management,* Vol. 16, 1164-1169.

Maniušis, V., Urba, M. (2007). Short Run Momentum and Stock Market Efficiency. Case Study of the Baltic States. - *SSE Riga Working Papers,* Vol. 5, No. 92. Accessible: https://www.sseriga.edu/sites/default/files/researchPapers/maniusis_urba.pdf, 1 November 2021.

Markowitz, H. M. (1952). Portfolio selection. – *The Journal of Finance,* Vol. 7, No. 1, 77-91.

Markowitz, H. M. (1959). Portfolio Selection: Efficient Diversification of Investments. – *Cowles Foundation Monograph 16.* New York: John Wiley & Sons.

Markowitz, H. M. (1991). Foundations of Portfolio Theory. – *The Journal of Finance,* Vol. 46, No. 2, 469-477.

Merton, R.C. (1972). An Analytic Derivation of the Efficient Portfolio Frontier. – *The Journal of Financial and Quantitative Analysis,* Vol. 7, No. 4, 1851-1872.

Modigliani, F., Modigliani, L. (1997). Risk-adjusted performance: how to measure it and why. – *Journal of Portfolio Management,* Vol. 23, 45-54.

Mok, W., Bender, J., Hammond, P. B. (2014). Can Alpha be Captured by Risk Premia*?* – *Journal of Portfolio Management,* Vol. 40, No. 2, 18-29.

Norges Bank Investment Management. (2020). Factor and risk-adjusted return. Accessible: https://www.nbim.no/contentassets/fd871d2a4e2d4c1ab9d3d66c98fa6ba1/factor-and-risk-adjusted-return.pdf, 1 November 2021.

Roll, R. (1992). A Mean/Variance Analysis of Tracking Error. – *The Journal of Portfolio Management*, Vol. 18, No. 4, 13-22.

Rosenberg, B. (1974). Extra-Market Components of Covariance in Security Returns. – *Journal of Financial and Quantitative Analysis,* 263-274.

Ross, S. A. (1976). The Arbitrage Theory of Capital Asset Pricing. – *Journal of Economic Theory,* 343-362.

Rubinstein, M. (2002). Markowitz's "Portfolio Selection": A Fifty-Year Retrospective. – *The Journal of Finance,* Vol. 57, No. 3 (June 2002), 1041-1045.

Sharpe, W.F. (1964). Capital asset prices: a theory of market equilibrium under conditions of risk. – *The Journal of Finance,* Vol. 19, No. 3, 425-442.

Sharpe, W.F. (1966). Mutual Fund Performance. – *The Journal of Business,* Vol. 39, No. 1, 119-138.

The Government Pension Fund Norway. Accessible: https://www.folketrygdfondet.no/en/?lang=en_GB, 1 November 2021.

Treynor, J.L. (1965). How to Rate Management of Investment Funds. – *Harvard Business Review,* Vol. 43, No. 1, 63-75.

Wermers, R. (2003). Is Money Really 'Smart'? New Evidence on the Relation between Mutual Fund Flows, Manager Behavior, and Performance Persistence. – University of Maryland. Accessible: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=414420, 2 November 2021.

APPENDICES

Appendix 1. Non-exclusive licence

A non-exclusive licence for reproduction and publication of a graduation thesis[11]

I __Roman Lutšit________________________________ (*author's name*)

1. Grant Tallinn University of Technology free licence (non-exclusive licence) for my thesis *Performance evaluation of Estonian second pillar funds. A comparison with selected European pension funds.*

____,

(*title of the graduation thesis*)

supervised by *Karsten Staehr*

____,

(*supervisor's name*)

1.1 to be reproduced for the purposes of preservation and electronic publication of the graduation thesis, incl. to be entered in the digital collection of the library of Tallinn University of Technology until expiry of the term of copyright;

1.2 to be published via the web of Tallinn University of Technology, incl. to be entered in the digital collection of the library of Tallinn University of Technology until expiry of the term of copyright.

2. I am aware that the author also retains the rights specified in clause 1 of the non-exclusive licence.

3. I confirm that granting the non-exclusive licence does not infringe other persons' intellectual property rights, the rights arising from the Personal Data Protection Act or rights arising from other legislation.

04.01.2022

[1] *The non-exclusive licence is not valid during the validity of access restriction indicated in the student's application for restriction on access to the graduation thesis that has been signed by the school's dean, except in case of the university's right to reproduce the thesis for preservation purposes only. If a graduation thesis is based on the joint creative activity of two or more persons and the co-author(s) has/have not granted, by the set deadline, the student defending his/her graduation thesis consent to reproduce and publish the graduation thesis in compliance with clauses 1.1 and 1.2 of the non-exclusive licence, the non-exclusive license shall not be valid for the period.*