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THE IMPLICATIONS OF EXTERNAL SHOCKS ON INVESTMENT DIVERSIFICATION DECISIONS - THE CASE OF ESTONIAN PENSION FUNDS

Bachelor's Thesis

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I have written this bachelor's thesis independently. Any ideas or data taken from other authors or other sources have been fully referenced.

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Introduction

The concept of diversifying investments might sound like a complex topic for those unfamiliar with the field, however, to a certain extent the idea is self-explanatory: investing in assets with different properties. Diversification can be considered an investment management technique that reduces risk by allocating funds to different asset classes and sectors to avoid severe losses if the returns of a specific financial instrument drop (OECD, 2021; Lioudis, 2022). At the same time, diversification enables one to generate greater returns without taking on higher risks (Wagner & Lau, 1970). However, not only the economic cycles play a role in investment portfolio diversification decisions. According to Amariei (2020), Moerman (2008), and Griffin (1998), diversification decisions may also be impacted by policy changes, financial and/or global shocks. In addition to shocks, global trends such as the increasing importance of sustainability and corporate social responsibility play a role in investment decisions.

During different phases of economic cycles, the returns of financial instruments tend to act differently. In times of recession, cash and gold gain popularity, whereas equity investments are on a downward trend. On the contrary, during the expansionary (early-cycle) phase, equity investments are in high demand and yield superior returns (Emsbo-Mattingly et al., 2021). However, to reduce the volatility of returns of any investment funds, it is important for the portfolios to be diversified.

There are varying approaches to portfolio diversification, such as asset-class-based diversification, increasing the number of securities in the portfolio, correlation-based, and geographical diversification (Emsbo-Mattingly et al., 2021). Each technique has its supporters, critics, benefits, and shortcomings. Meanwhile, it is common for several techniques to be used simultaneously to maximize returns and minimize risks.

With numerous different investment possibilities and investment funds available, however, one of the most widespread investment choices in the developed world is pension funds. In Estonia, there are options to create voluntary II and III pillar pension funds, from which money could be retrieved earlier than the pension age or paid out in installments during retirement. Yet pension fund returns, like the returns of other types of investment funds, are affected by the situation in the financial markets. According to Lõvi (2022), all Estonian II pillar pension funds earned negative returns in the first six months of 2022, while only a third of the pension funds earned a negative return in the past three years.

OECD (2021) discovered that the investments of Estonian pension funds in 2020 shifted 9% more towards equity investments and 8% away from fixed-income investments,

while the world experienced an inverse trend. The shift was attributed to the change in regulatory changes in pension management. Griffin (1998) suggests that pension funds' international diversification is dependent on trade regulations. Emsbo-Mattingly et al. (2021) discovered general trends in the returns of different equity investment sectors and asset classes during business cycles. However, besides the study made by OECD (2021) on world pension funds, the available scholarly work lacks the associations between shifts in the investments of Estonian pension funds and external triggers.

The aim of this bachelor thesis is to clarify the implications of external shocks on the portfolio diversification of the Estonian II pillar pension funds. There are many external shocks Estonian pension funds have experienced during the past few years, such as a global pandemic, the Russo-Ukrainian war, significant reform changes to II pillar pension funds, and the rapidly increasing key interest rates, which influenced the author's decision to focus on external shocks instead of trends. Due to the time proximity of these shocks, this thesis studies a timeframe ranging from January 2019 to December 2022. All these events can be presumed to have had an impact on the financial market, thus, having an influence on the returns and investment decisions of pension funds.

The author formulated the following research tasks, which completion is necessary to achieve the aim of the thesis:

- to introduce the importance of diversification in investment management;
- to discuss the different approaches to portfolio diversification;
- to give an overview of the effects of external implications on portfolio diversification decisions (focusing on pension funds) based on previous scholarly work;
- to collect data from reports on asset allocation of LHV, Swedbank, Luminor, and SEB's II pillar pension funds from 2019 to 2022, and sectoral and structural changes in the equity and fixed-income investment of LHV and Swedbank;
- to synthesize the results of the analysis of the reports;
- to conduct interviews with pension fund managers and to discuss the results.

The first chapter of the thesis will give a theoretical overview of the core ideas behind portfolio diversification, its importance, and the different approaches to asset diversification. In addition, related academic literature on external implications and their effects on the decisions behind portfolio diversification will be explored.

The second chapter of the thesis gives a general overview of the investment diversification situation in the II pillar pension funds in Estonia and will describe the data and methodology of this study and its results. To put these into context, interviews with pension fund managers will be conducted to gain their perspectives on the importance of portfolio diversification and their strategy for their managed funds for the predicted upcoming recession. Due to the limited scope of the bachelor's thesis and varying reporting standards of Estonian pension funds, only 16 out of the existing 26 Estonian II pillar pension funds are analysed against the backdrop of changes in the investment diversification decisions resulting from external shocks.

Keywords: Estonian pension funds, diversification, implications of external shocks.

1. Theoretical foundations of investment portfolio diversification

1.1. Importance of diversification in investment management

There are different types of investors on the market - individual and institutional investors, such as banks, pension funds, insurance companies, etc. Even though their approaches to investing often differ from one another, the basis remains the same – generating capital gains (returns earned on their investments). However, to earn a return, one must take risks by facing the unpredictability of future returns. Chang and Thomas (1989) argue that the risks of a company are dependent on the number, size, and properties of the industries in which it operates. Crucially, these risks can be reduced by portfolio diversification.

Diversification is closely intertwined with an asset's risk level. It is a risk-management technique used to reduce the severity and potential of losses when an individual asset fails. It is also called the "free lunch" of the economic world, as the loss in returns is only slightly diminished while the risk is significantly reduced. The safeguard against losses comes from the different properties of the remaining assets in the portfolio. Yet, diversification lacks a single concise definition and a way of calculation. Rather, its properties are discussed, and many different measurements have been introduced. (Koumou, 2020; Parmentier, 2018; Ilmanen & Kizer, 2012)

The mathematical groundwork for diversification was laid by Harry Markowitz (1952) when he introduced the "Modern Portfolio Theory". In his paper, he proposed to measure risk through volatility of asset returns measured by standard deviation and the assumption that an investor is risk-averse, and hence wants to minimize the volatility while still earning the highest possible expected return. Even to this day, the formula developed by Markowitz continues to be one of the most popular measurements of portfolio risk (Markowitz, 1952):

$$\sigma_p = \sqrt{\sum_{i=1}^{m} w_i^2 \sigma_i^2 + \sum_{i=1}^{m} \sum_{j=1}^{m} w_i w_j \rho_{ij} \sigma_i \sigma_j} \tag{1}$$

where

σ_p – the volatility of the portfolio

w_i – the weight of an asset *i* in the portfolio ($i = 1 \ldots m$)

w_j – the weight of an asset *j* in the portfolio ($j = 1 \ldots m$)

σ_i – the volatility of an asset *i*

σ_j – the volatility of an asset *j*

ρ_{ij} – correlation of returns for assets *i* and *j*

In Markowitz's formula, the effect of the correlation of asset returns to portfolio risk is clearly visible, as the correlation directly impacts portfolio volatility (portfolio risk). Hence, the smaller the correlation between asset returns, the smaller the portfolio risk (volatility of returns), and the greater the benefit from portfolio diversification. The potential for diversification only comes when the correlation coefficient (ρ) between asset returns is less than 1. An even higher effect is achieved when the correlation coefficient is negative. A correlation coefficient of -1 suggests the strongest negative correlation between the returns of two assets there may be, as the correlation coefficient of returns ranges from -1 to 1. However, it is important to keep in mind that "the rate of return on a well diversified low risk portfolios is indeed significantly lower than the return of well diversified higher risk portfolios" (Wagner & Lau, 1971, p. 48).

In addition to the correlation coefficient, the other factor worth looking at in Markowitz's model is the standard deviation/volatility of single assets. Since the volatility of returns on assets is calculated using the historic returns of the asset, it does not represent a fair outcome of the expected returns for the future and has led multiple scholars like Wander and D'Vari (2003) and Statman and Scheid (2008), amongst others, to question the accuracy of using standard deviation as a tool for measuring portfolio risks. Nevertheless, Wander and D'Vari (2003) admit that Markowitz's model is a useful portfolio management tool when applied appropriately and acknowledging its limitations.

Choosing assets for a portfolio with low correlation is the basis for reducing one of the risks an asset portfolio faces – the unsystematic, otherwise known as the company-specific risk. Yet, investors must deal with another type of risk – the systematic or market risk expressed as the beta coefficient (β).

β is the quotient of the covariance of returns of an asset and the market divided by the variance of returns of the market (standard deviation squared). It is found in the Capital Asset Pricing Model which is generally used to express an asset's required rate of return:

$$\mathrm{E}\,(R_i) = R_f + \beta\,[\mathrm{E}\,(R_m) - R_f] \qquad (2)$$

where

$E(R_i)$ – the required rate of return on the asset

β – beta coefficient (a measure of systematic risk)

$E(R_m)$ – the expected rate of return of the market

R_f – the risk-free rate of return

The beta coefficient measures the volatility of the asset compared to that of the market. (Sharpe, 1964; Lintner, 1965) An example of the workings of the beta coefficient is as follows: if β = -0.5, it means that if the returns of the market go up by 1 percentage point the returns of the asset fall by 0.5 percentage points. The total risk of the portfolio is the sum of the systematic and unsystematic risk components. (Iyiola et al., 2012; Elbannan, 2015).

Composing a portfolio considering the systematic and unsystematic risks is not an easy task and not just any portfolio is efficient. According to Fabozzi and Markowitz (2002), efficient portfolios are considered to "provide largest possible expected return for given levels of risk" (Fabozzi & Markowitz, 2002, p.18) and optimal portfolios are efficient portfolios that coincide with the level of risk an investor is willing to take. Therefore, it can be said that all optimal portfolios are efficient ones, but not all efficient portfolios are optimal.

As discussed, portfolio diversification already works when the correlation of returns of two assets is less than 1. However, diversification might be achieved to a higher degree with extensive resources, as composing a portfolio of assets with the lowest possible correlations leads to assets with prices fluctuating from cents to tens of thousands of dollars, thereby putting individual investors at a disadvantage compared to institutional investors. Institutional investors often manage thousands of single assets which might make basing investment decisions on asset correlations time-consuming and costly. This is one of the reasons for applying other diversification approaches than simply correlation reduction.

An example of using different approaches to diversify a portfolio (and of how extensively portfolio diversification is used) is the Norwegian oil fund which manages the assets of the Norwegian Pension Fund Global worth over $1.4 trillion and is the largest single owner of all the shares listed worldwide. In January 2023, the fund had invested in over 9300 different companies in over 70 countries, as well as four investment areas such as stock, bonds, real estate, and infrastructure for renewable energy. (Norges Bank Investment Management, n.d.)

1.2. Approaches to investment diversification

To provide a better overview of some of the most widespread approaches to diversification in investment management, the author has developed a model that depicts the approaches to portfolio diversification (Figure 1).

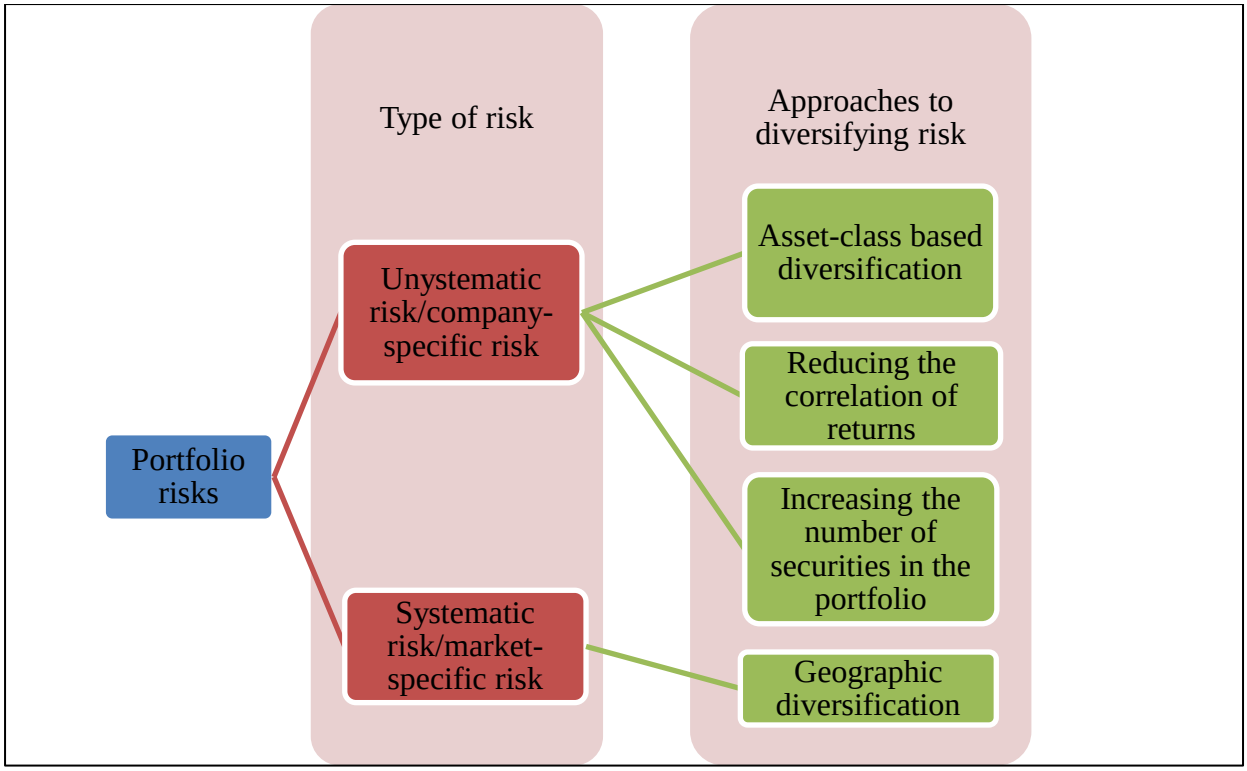

Figure 1. Different approaches to portfolio diversification

Source: Compiled by the author

From the theory and model of Markowitz (1952), it can be derived that the smaller the correlation or covariance of the returns of assets, the smaller the standard deviation and hence the smaller the risk. By investing in different regions or sectors it is possible to reduce the correlation of asset returns. There are different ways to categorize stocks by sectors, however, one of the most common ways for sectoral division is based on the division of S&P500 stocks. The S&P500 index divides its stocks into 126 industries and 11 sectors: information technology, healthcare, financials, consumer discretionary, communication services, industrials, consumer staples, energy, utilities, real estate, and materials. (CFI Team, 2023; Fossung et al., 2021)

Moerman (2008) concluded, that "investing in industry indices gave much more diversification opportunities than a pure country investment strategy" (Moerman, 2008, p. 1126) in terms of stocks. The results are backed by Balli and Balli (2011) who showed that "after the start of EMU, the gains from creating a portfolio including Euro sector equity indices is still more efficient than the portfolio including Euro national equity indices" (Balli & Balli, p. 105).

The division of bonds into categories is not as straightforward. Bonds may be divided into groups by their maturity, their ratings of financial health, sectors, etc. (Fidelity Learning

Center, n.d.; CFI Team, 2022). However, one of the main distinctions is drawn between government and corporate bonds. Since governments cannot issue stocks, borrowing money from the financial market is only possible through issuing bonds, making it an important noteworthy aspect of categorizing bonds.

Another approach to diversification is how the number of assets in the portfolio affects the weight of each asset. Combining numerous assets into a portfolio also helps reduce the unsystematic risk, leading to decreased portfolio volatility (standard deviation). However, the rate of return of the portfolio is not affected by the increase in the number of investments. Wagner and Lau (1970) and Zaimovic et al. (2021) considered 37 studies on the topic of the optimal number of stocks in portfolios to reduce risk. The authors arrived at the conclusion that there is not a single number that represents a well-diversified portfolio due to factors such as "the investment universe (size, asset classes, features of the asset classes); the investor's characteristics: the change over time of asset features; the model adopted to measure diversification" (Zaimovic et al., 2021, p. 21), amongst others. Still, it can be generalized that about 10-20 different stocks diversify around 85-90% of the company-specific (unsystematic) risk.

The authors also pointed out that the number of stocks required varies depending on the market the investor operates (an emerging market vs. a developed market) and the condition of the market (volatile or calm). As well as that the number of stocks needed to achieve a higher level of diversification has increased over time potentially due to the reduction of trading costs. (Zaimovic et al., 2021)

Nevertheless, diversification cannot remove all risks, as it affects mainly the unsystematic risk with the systematic risk component remaining mostly unchanged. Yet, the systematic risk may be further diversified by investing in domestic and in international markets.

Like any other financial theory, international portfolio diversification is not without its critics. Srihari Krishna (2013) researched the correlation patterns between FTSE100 (a share index of the 100 largest market capitalization companies listed on the London Stock Exchange, now called the UK 100 Index) and the S&P500 (a share index featuring 500 U.S. publicly traded companies with the largest market capitalization) as well as FTSE100 and Nikkei225 (an index comprised of 225 Japan's publicly listed companies with the largest market capitalization) focusing on the 2008 financial crisis. The correlation values between the indexes of different markets were chosen to demonstrate the degree of interconnectedness between different markets.

Srihari Krishna (2013) concluded that diversification is ineffective in times of bear markets due to the increasing integration of financial markets and the higher correlation of returns between asset classes and leading equity markets. The claim of the author is also supported by Ilmanen and Kizer (2012) agreeing that "virtually all long-only asset classes, other than high-quality sovereign debt, moved in the same direction (down) (Ilmanen & Kizer, 2012, p. 15) as well as by Kovács, et al. (2011) whose results corroborated that the correlation coefficients of asset returns have a peculiarity of changing over time and experiencing high correlation in times of economic crises. Volskis (2012) agreed with the statements as he proclaimed that the Baltic countries' pension funds' significant international diversification led the II and III pillar pension accounts to be more vulnerable during the financial crisis of 2008. The contagion of the financial markets during declines is the result of investors in search of low-correlation assets in the international markets to diversify their portfolios. In contrast, during bull markets, diversification fulfils its aim of providing greater returns with mitigated risk and steadier returns. (Srihari Krishna, 2013). Ilmanen and Kizer (2012) agree that during the financial crisis of 2008 almost all asset classes experienced a fall but argue that claiming that diversification is dead is an exaggeration, attributing the loss in returns during the crisis to "user error" rather than the death of diversification.

Besides the factors discussed above (choosing assets with low correlation, having a larger number of assets in a portfolio, and investing in international markets to achieve higher diversification), it is possible to reduce risks by investing in different asset classes and securities. In their work, Alestalo and Puttonen (2005) discussed pension funds' asset and liability management, concentrating on Finland. The liability management of pension funds considers the risks associated with pension fund management, like investment risk, wage growth/inflation risk, political risk, actuarial risk, and pension financing risk (Kleynen, n.d.). Alestalo and Puttonen's (2005) results indicate a relationship between liability structure and pension fund asset allocation. The liability structure determines how much risk a pension fund should take, hence the choices for different asset classes. To achieve a higher expected rate of return, equity investments should have a higher weight in the portfolio. Yet, if the goal is stability, fixed-income assets like bonds should have the highest importance in the portfolio. However, real estate investments for pension funds are a good way to diversify inflation risk. (Alestalo & Puttonen, 2005)

Other results of Alestalo & Puttonen (2005) show that pension funds with a younger audience are more prone to hold riskier assets like equities rather than bonds. Volskis (2012) supported this notion. He claimed that until the significant reform changes to Estonian

pension funds in 2008, when the allowed investment strategies changed (Table 1), the most frequently opted pension fund investment strategy had the highest allowed equity proportion, and that of the 75% who opted for the dynamic strategy, 70% were under the age of 40, which could have been one of the reasons for the popularity of the dynamic pension fund investment strategy.

Table 1

The investment strategies allowed for pension funds before the reform in 2008

Type	Investment strategies	Maximum equity investment exposure allowed	Pension fund holders' choices for investment strategies
	Conservative	0%*	10%
	Balanced	25%	15%
	Dynamic	50%	75%

Note: * 0% allowed equity investments means that only bonds were allowed

Source: Volskis (2012)

The study of Brinson et al. (1991) on 82 large U.S. pension plans from the years 1977-87 determined that asset allocation policies accounted for 91.5% of the variation in quarterly returns. However, according to Alestalo and Puttonen (2005), due to the diverse nature and number of different factors affecting the optimal asset allocation of pension funds, it is difficult to compose clear rules for asset allocation. This leads to the conclusion that specific rules for asset allocation are hard to determine, yet asset allocation decisions account for a significant proportion of total portfolio returns.

According to Brinson et al. (1991), the average asset class weights of the 82 U.S. large pension plans from 1977-1987 were as follows: equity 53%, bonds 24.5%, cash 12.1%, and others 10.5%. By the end of 1995, the asset allocation of U.S. pension funds was 55.3% equities, 33.8% bonds, 7.8% real estate, and 3.1% cash. In contrast, the asset allocation of pension funds in Estonia's neighbouring country Sweden, was 29.5% equities and 70.6% bonds. (Griffin, 1998)

Alestalo and Puttonen (2005) determined that the value-weighted asset allocation for Finnish pension funds was 20% equities compared to fixed-income assets proportion of 44%, 19% of cash/money market instruments, and real estate's 13%. The 20% equity proportion was the lowest among the countries analysed (including Canada, Japan, the US, and others) and the cash/money market instruments and real estate ones were the highest.

Volskis (2012) found that, by 2012, net assets were geographically allocated among Estonia's defined benefit pension plans as follows: 3.33% in the USA, 18.13% in

Luxembourg, 21.25% in Estonia, 46.65% in the EU, and 10.64% in other countries. By asset classes, it was 63.61% in equities, 23.53% in government bonds, 11.25% in demand and term deposits, and 1.61% in other assets. Based on the work of Volskis (2012) it can be concluded that the Baltic pension funds have opted for several diversification approaches such as geographical diversification and asset-class-based diversification, similarly to the Norwegian oil fund. The research of OECD (2021) found that the asset allocation for Estonian pension funds in 2020 was around 50% in equities, 45% in bonds and bills, and the rest in cash and deposits.

From the studies of Volskis (2012) and OECD (2021), conflicting results arise, and it could be observed that (Estonian) pension plans experienced a decrease in equity dependence between 2012 and 2020. However, it is important to note that Volskis' data (2012) is based on defined benefit pension plans (a fixed sum paid out monthly during retirement) and the results of the OECD (2021) are based on the whole capital invested by pension funds not only on the former. However, Defau & De Moor (2020) hypothesized that when in search of higher diversification, pension funds turn to investments in alternative assets (such as real estate, private equity funds, etc.), and equity investments have suffered mainly because of this shift, whereas the proportion of bond investments has remained rather fixed. The results of Defau & De Moor (2020) also suggested that pension funds have grown to invest more into alternative assets in the past couple of decades. Nevertheless, based on the results of Brinson et al. (1991), Alestalo and Puttonen (2005), Volskis (2012), Defau & De Moor (2020), and OECD (2021) it may be generalized that over time the world pension funds have experienced a shift toward higher dependence on equity investments as well as alternative investments while the reliance on fixed-income investments has remained at a similar level or decreased.

It may be said that the most widely used investment portfolio diversification techniques for reducing unsystematic risk are asset-class-based diversification, reducing the correlation of returns, and increasing the number of securities in the portfolio, while for reducing market-based risk, regional diversification is used. However, due to globalization and the resulting higher correlation of returns, investment portfolio diversification is dimmed, and several techniques should be applied at once for the portfolios to withstand events such as financial crises and earn the highest possible return whilst bearing the least amount of risk.

1.3. External shocks and investment diversification decisions

In 2010 the Deepwater Horizon oil spill occurred in the Gulf of Mexico. As a result, the stock prices of British Petroleum dropped by nearly 55% in less than two months. (Fodor

& Stowe, 2012) The effects of this catastrophe unfolded in the stock market over several months. Naturally, the companies associated with this accident suffered a loss in stock market returns, but the event also had a spill-over effect on other companies in the industry. This catastrophe led to a temporary suspension of deep-water drilling, which affected the stock prices of gas and oil drilling firms and gas equipment and services firms. (Humphrey et al., 2016).

This example demonstrates how the securities markets are affected by outside implications such as government restrictions or the actions of a single firm. As it happened, the accident for which a handful of companies were responsible, led to a temporary decline in the whole industry, and undiversified oil company investors would have been fully exposed to the decrease in returns following such an event. Markowitz (1952) also suggests that "it is generally more likely for firms within the same industry to do poorly at the same time than for firms in dissimilar industries" (Markowitz, 1952, p. 89). Yet Markowitz's notion is directed more at market movements than the effect of external shocks.

To demonstrate, what previous authors have written in relation to the implications of external shocks on diversification decisions, the author has gathered the data in Table 2, where the core results of six different studies on the researched topic are presented.

Table 2

The implications of external shocks on investment diversification decisions

Source	Type of external implication	Effects
Amariei (2020)	Financial crisis of 2008 Pension reforms	Since 2008, pension funds have shifted toward a higher proportion of equity and alternative investments. Pension reforms could bring more capital into equity markets in countries with low retirement savings and higher international diversification, which may lead to higher proportion of equity investments.
Vermeulen (2013)	Financial crisis of 2008	„International investors actively rebalance their portfolio towards low correlated markets during the crisis" (Vermeulen, 2013, p. 122).
Emsbo-Mattingly et al. (2021)	Changes in business cycles	Stocks outperform other asset classes during the early cycle phase and underperform during recession. Bonds experience the trend vice versa, while cash demonstrate a rather constant trend of return throughout all the phases. Financials, real estate, technology, industrials, materials, and consumer discretionary show the strongest performance during the early cycle, while

Source	Type of external implication	Effects
		health care, energy, and utilities peak at the same time and show a strong performance in the late phase or recession. Financials, real estate, technology, and materials peak in the recession phase.
Griffin (1998)	Regulatory changes to trade	It could be concluded that the higher the level of international trade (imports and exports) in the country, the higher the degree of international equity diversification in pension funds. However, the statement does not hold true for bonds, as bond portfolio diversification has a rather constant diversification trend.
Moerman (2008)	Structural changes Changes in the market	A portfolio in the Euro area, where geographical diversification is already applied, could reap more benefits if it was additionally diversified with sector indices, which is more important than international diversification.
Defau & De Moor (2020)	Changes in interest rates	When interest rates rise, pension funds invest less in equities and partly shift their investments into equities. However, contrary to previous studies, the authors concluded that in times of high interest rates, pension funds expanded their investments into alternative assets.
OECD (2021)	COVID-19 Reform changes	Generally, fixed-income assets were preferred by pension funds in 2020. Yet, the asset allocation saw a less than 5 percentage point decrease in equity investments compared to that of 2019. Estonia “reduced their exposure to bonds by 8 percentage points and increased their exposure to equities by 9 percentage points between end-2019 and end-2020“ (p. 33).

Source: Compiled by the author

The works of Amariei (2020) and Vermeulen (2013) both focused on the effects of the 2008 financial crisis (starting with the collapse of the Lehman Brothers financial company) on investors’ portfolio decisions (Table 2). Vermeulen (2013) studied the issue from a regular investor’s viewpoint, whereas Amariei (2020) focused on the impacts of the financial crisis on the diversification decisions of pension funds. The findings demonstrate that investors seek to diversify their holdings to low-correlated markets during times of crisis, and are willing to forgo up to 2.9% of their returns to switch from a passive to an actively managed portfolio in order to benefit from an actively rebalanced portfolio's utility gain. Accordingly, in times of financial instability or even in the loom of a financial crisis, pension

funds would also experience higher rebalancing of assets between asset classes, sectoral and geographical distribution.

However, relying on the results of Amariei (2020), in the aftermath of a crisis, pension funds would experience a higher reliance on equity and alternative investments than during the crisis. The previous results also coincide with the study of Emsbo-Mattingly et al. (2021). The authors claimed that equity (stocks) outperform other asset classes during the early business cycle phase, supporting a heavier reliance on equity investments.

Yet, during a recession, pandemic, or rising interest rates, stocks tend to underperform compared to fixed-income assets, and instruments like bonds and alternative investments gain higher weight in a portfolio than earlier (Defau & De Moor, 2020; OECD, 2021; Emsbo-Mattingly et al., 2021). The report of OECD (2021) found that even though in 2020 the preferred asset class for pension funds was fixed-income assets (bonds), the equity proportion of investments saw only a slight decrease of less than 5% in most of the OECD countries compared to the previous year. The decrease in equity dependence coincided with the beginning of the COVID-19 pandemic in 2020, which explains the shift.

On the contrary, Estonia "reduced their exposure to bonds by 8 percentage points and increased their exposure to equities by 9 percentage points between end-2019 and end-2020" (OECD, 2021, p. 33). Yet, the shift from bonds to equity exposure has been associated with reform/policy changes instead of the effects of the COVID-19 pandemic. As of September 2019, the maximum allowed equity exposure in Estonian II pillar pension funds rose from 75% to total equity exposure. This also led to the creation of a completely new pension fund consisting of 100% equity investments, among the general decrease in bonds and rise in equity exposure. (OECD, 2021) The research of Amariei (2020) supports the results of OECD (2021), and further adds that (pension) reforms could bring more capital into equity markets and higher international diversification which in general could lead to higher proportion of equity investments.

The effects of regulatory changes were also researched by Griffin (1998) who concluded that the higher the level of international trade (imports and exports) in the country, the higher the degree of international equity diversification in pension funds. Higher international trade implies to free cash flows between countries and the absence of restrictions on cash flows. The importance of decreased restrictions is also brought out by Vermeulen (2013) who suggested that financial institutions only gain from decreased restrictions to international diversification.

Moerman (2008) suggests that the integration of the European countries starting from the introduction of the Euro and the hype of the IT sector in the 90s, has made sectoral diversification more important than international diversification. The author added that investors should consider sectoral diversification when international diversification has already been applied to a portfolio.

The behaviour of varying sectors during the business cycles is discussed by Emsbo-Mattingly et al. (2021). The authors' research focused on the returns of different sectors over the course of 58 years. They concluded that real estate, industrials, and consumer discretionary, followed by financials, technology, and materials sectors show higher relative performance during the early cycle phase. At the same time, the healthcare, energy, and utilities sectors demonstrate lower performance. Inversely, the sectors of utilities, healthcare, and consumer staples bloom during the recession phase, whereas the returns of financials, real estate, technology, and industrials drop. The energy sector shows higher relative performance during the late cycle, while consumer discretionary is at its lowest. (Emsbo-Mattingly et al., 2021)

From the literature review, numerous conclusions can be drawn and expectations for the results of the empirical analysis made. However, the main ideas being:

- In the loom of a financial crisis, pension funds would experience higher rebalancing of assets between asset classes, and sectoral and geographical diversification.
- The pension funds noticeably reduced their proportion of fixed-income assets and increased equity investments because of pension reforms.
- Since the interest rates have been on an increasing trend since only the second half of 2022 (European Central Bank, n.d.), a clear hypothesis about the weight of alternative assets in pension funds' asset allocation cannot be made, yet it might be predicted that alternative investments have increased their weight in pension funds' portfolios and will continue to do so.
- Imposing restrictions (on trade) leads to reduced international diversification.
- After the recession, the investments should shift towards industrials, real estate, consumer discretionary, financials, and technology, moving away from the reliance on utilities, healthcare, and consumer staples.

Based on the previous scholarly work on the effect of regulatory changes, financial crises, structural changes, etc., it is possible to make assumptions about possible trends seen

in the following empirical part of the thesis. However, the world has not experienced a healthcare crisis such as the COVID pandemic in more than a hundred years, making it difficult to predict which trends in investment diversification decisions will be found in Estonian pension funds.

2. The implications of external shocks on investment diversification decisions of Estonian II pillar pension funds

2.1. Methodology and data

In the present subchapter, the author explains in detail the methodology chosen for the empirical analysis as well as the data selection and analysis process. Additionally, the limitations and the potential issues of the reliability of the analysis are discussed.

The empirical part of this thesis consists of two parts:

1. The first part consists of the analysis of reports. The asset class weight changes will be analysed for Estonian II pillar pension funds alongside the sectoral and/or geographical distribution changes in equity and/or bond investments, depending on the available quantitative data. The changes observed will be compared with significant external events in the endeavour of detecting a cause-and-effect relationship between external events/shocks and Estonian II pillar pension funds asset diversification decisions.
2. The second part is conducting interviews and synthesizing the results. Interviews will be conducted with LHV, Luminor, and SEB pension fund managers to support the thesis's quantitative results and provide insight into potential upcoming diversification changes in Estonian pension funds. An interview with any of the fund managers of Swedbank pension funds could not be conducted due to the lack of interest from the pension fund managers' side.

The steps taken to fulfill the aim of the thesis are depicted in Figure 2.

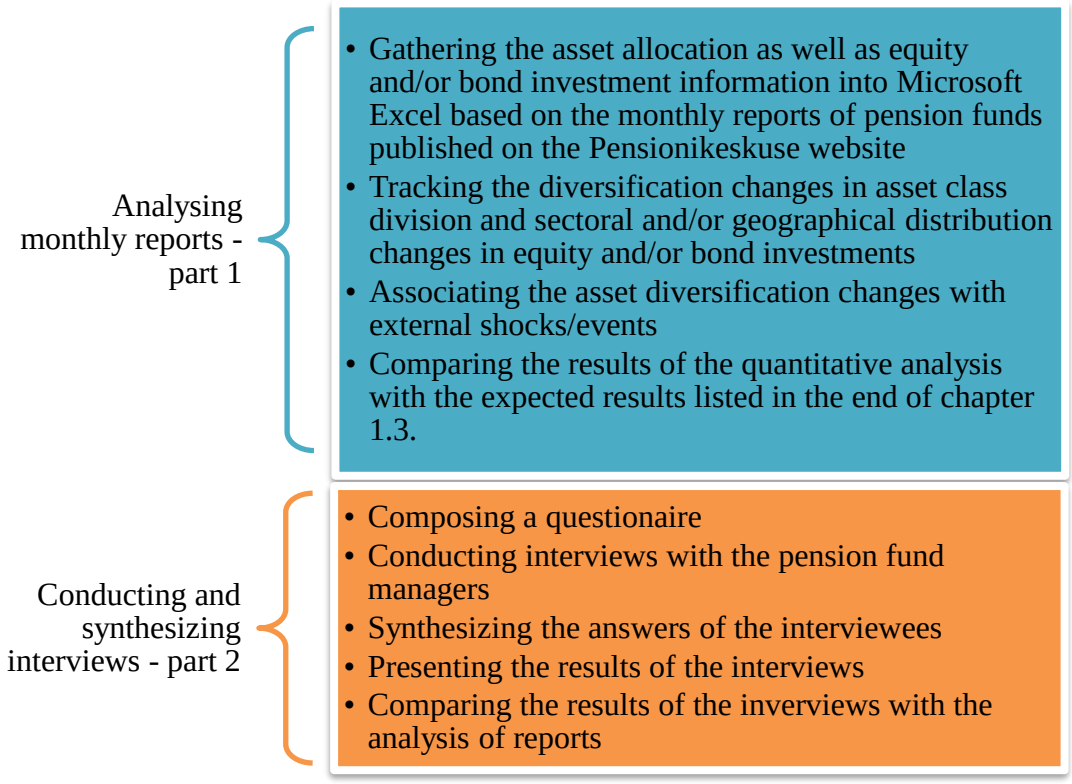

Figure 2. The research steps taken in the empirical analysis

Source: Compiled by the author

As of December of 2022, there are 26 options for II pillar pension funds in Estonia (Appendix A). These pension funds belong to the asset management companies AS LHV Varahaldus, Swedbank Investeerimisfondid AS, AS SEB Varahaldus, and Luminor Pensions Estonia AS which, in their turn, belong to banking corporations and asset management companies like Tuleva Fondid AS. Hereinafter, the asset management companies are simply referred to as LHV, Swedbank, SEB, and Luminor. In the thesis, the asset allocation and/or sectoral and/or geographical distribution changes in the pension funds' equity or fixed-income asset will be analysed for funds that have a maturity longer than the analysed time frame, that have invested into three or more different asset classes and/or for which detailed information on the distribution of securities is available. As a result of these restrictions, ten pension funds are disregarded for analysis (see Appendix A for the list).

The available data varies for different institutions and pension funds, resulting in some funds having a more thorough analysis of the implications of external shocks to portfolio diversification decisions than others. The restrictions to the analysed pension funds are set to avoid funds that invest in only two different asset classes or have no available detailed information on their equity and/or fixed-income investments, as the author believes

that analysing these funds does not add any substantial value to the thesis. Since the analysed four-year-long time frame experiences external shocks throughout the whole period, the author chose not to analyse pension funds that were created after January 2019.

The data used in this thesis to conduct analysis is gathered from the Pensionikeskus website, where all the relevant information regarding the Estonian II pillar pension funds is published, as well as the respective websites of the financial institutions. The author of this thesis believes that the monthly reports published by pension funds give the most comprehensive and detailed information on the pension funds' investments and are hence used as a basis for the analysis. The time frame analysed is January 2019 (as of December 31, 2018) to December 31, 2022. In the analysis, the monthly reports of the selected II pillar pension funds are used to conduct analysis of the implications of external shocks on portfolio diversification decisions such as:

- if and how have the asset class weights changed;
- if and how has the sectoral and geographical distribution of single equity and fixed-income assets changed.

Microsoft Excel is the chosen tool for the analysis, and the changes are observed on a quarterly basis, similar to the work of Brinson et al. (1991).

In order to analyse the data, the available information on the pension funds asset allocation as well as the sectoral, and regional distribution of investments had to be gathered in MS Excel document, which the author did manually. In the case of Luminor, Swedbank, and SEB reports, the author had to only collect the data from the monthly reports and insert it into the MS Excel document. However, to be able to analyse the changes in the geographical and sectoral distribution of single stocks and bonds of LHV pension funds, the author had to take the following steps:

1. To convert the PDF files of monthly reports into MS Excel format.
2. To calculate the geographical-based weights of fixed-income and equity instruments.
3. To manually assign every single stock and bond their sectoral allocation.
4. To categorize investments into groups based on their sectoral allocation.
5. To add the data from monthly reports into a cumulative MS Excel document to compare different time periods.

However, with the author having to manually assign the operating sector for the single stock investments of LHV, there is an issue of internal reliability. Internal reliability

issues result from businesses often operating in multiple sectors and from under which sectors they are categorized. For assigning a sector to the single stock investments in LHV, the author used Yahoo Finance and if the sector was not provided by Yahoo Finance or Google, websites such as E-Krediidiinfo or the equivalents of the website for other countries were used. For analysing the changes in the sectoral division of LHV single stocks, the investments were divided into 11 sectors[1] that are also used by the S&P500 index for grouping stocks (CFI Team, 2023). The sectors were assigned in the timeframe of January-February of 2023 before the restructuring of the S&P sectors took place (Wang, 2023).

A different approach is used to observe the implications of external shock on the sectoral division of bonds. The author of the thesis decided to divide bonds into two large categories: corporate and government (government and municipal) bonds. Corporate bonds are in turn divided into financial and non-financial bonds. Such categorization was chosen since LHV fixed-income investments are mostly in corporate (more specifically financial) bonds and government bonds.

In the case of all pension funds, when the sectoral/and or geographical distribution of securities is analysed, the weight of the respective asset in the portfolio is considered. Hence, for calculating the change in sectoral/and or geographical distribution of securities compared to the previous period, the following formula has been used (in all of the cases it has been denoted by "weighted"):

$$\Delta\%_t = \frac{d_t}{w_t} - \frac{d_{t-1}}{w_{t-1}} \quad (3)$$

where

$\Delta\%_t$ – percentage change in the sectoral or geographical distribution of securities compared to the previous period

d – regional or sectoral weight of a specific region or sector in the portfolio

w – the weight of the respective asset class (to which *d* belongs to) in the portfolio

t, t–1 – current date and previous date

For example, if the weight of IT sector single stocks in March 2020 was 3% and in December 2019 it had made up 2.5% of the total portfolio, and the total weight of single stocks in the portfolio was 24% in March 2020 and had been 25% in December 2019, then the formula would look as follows:

[1] The 11 S&P sectors are communication services, consumer discretionary (consumer cyclical), consumer staples (consumer defensive), energy, financials, healthcare, industrials, IT, materials, real estate, and utilities.

$$\Delta\%_t = \frac{3\%}{24\%} - \frac{2.5\%}{25\%}$$

$$\Delta\%_t = 2.5\%.$$

Meaning that, according to the example, by March 2020 the weight of IT sector single stocks in the portfolio had increased by 2.5% compared to the previous period.

The qualitative part of the thesis consists of conducting three interviews altogether, synthesizing the interviewees' answers, and comparing the results with the quantitative results of the thesis. The author attempted to interview a pension fund manager from each asset management company, whose pension funds are analysed. The interviews aim to support the quantitative analysis results and confirm both that the conclusions drawn in the quantitative analysis are correct and that the trends detected should be attributed to external shock rather than internal decisions or global trends, etc.

The author believes that solely conducting interviews with pension fund managers would provide the opinions of the pension fund managers on the diversification decisions they have made which might not always turn out to be completely correct nor fairly represent the complete scope of their decisions. Additionally, in the framework of this thesis, the author might ask questions that are categorized as confidential, which pension fund managers are therefore not allowed to answer. However, only conducting analysis based on the monthly reports will not demonstrate whether the changes in investment decisions were subconscious or whether the fund managers knowingly changed the diversification approaches of the funds they manage, whereas interviews combined with previously analysed monthly reports of the respective funds will give the most comprehensive results and help the author achieve its aim for the thesis. For additional value, the interviews will try to provide insight into which diversification trends in pension fund asset management might be expected in the near future, following the financial and political turmoil of 2022.

Notwithstanding, it is important to acknowledge that the quantitative results of this study still need to be considered in the context of its limitations. Readers might question the methodology applied and have concerns about the reliability of the data due to several reasons, such as:

- Pension funds’ equity investments are not only in single securities but also in index funds. Nevertheless, in the framework of this thesis, only the sectoral and/or geographical changes in the single securities investments are analysed. In the case of indexes, it cannot be monitored how the indexes’ investments have changed,

and the country of origin of the index does not necessarily mean that the single assets of indexes belong only to that specific region.

- The origin of the issuer of securities is noted in the reports, however, the sector where the issuer operates is not disclosed. Hence, to analyse the sectoral changes, the author has manually assigned a sector to the securities using Yahoo Finance as the platform presents a rather detailed overview of tradable assets. Nevertheless, companies often operate in more than one industry, and assigning just one industry to a company might bias the results.

Hence, more detailed results in the analysis of reports could be reached if investments in index funds were considered. However, due to the limited scope of the thesis and the difficulty of allocating index funds' investments into regions and sectors the index fund investments are not incorporated.

2.2. Analysis of reports

Altogether, 272 monthly reports were analysed for 16 different pension funds. For each fund, 17 reports were analysed on a quarterly basis, starting from December 2018 (as the period under analysis in this thesis starts from January 2019) up to December 2022. The analysed data is presented in 44 tables in the External Appendix. Tables A1-A44 use a colour schematic to make the results more comprehensive and more easily readable. The pink/red colours represent drops in investments in certain categories compared to its previous period; the darker the colour, the more severe the change. The green/light green colours represent the opposite trend, i.e., the increase in certain investments in specific categories compared to the previous period, following the same gradation pattern. Values of 0 and near 0 are white or slightly tinted white, depending on the type/direction of the change.

Some of the most significant external shocks that took place during the analysed time frame, potentially affecting the investment diversification decisions of pension funds are the following:

1. Lifting the maximum allowed equity investments limit in pension funds. From September 2019, pension funds were allowed to have total equity exposure in their portfolios. Afterwards also referred to as "the first pension reform".
2. The beginning of the worldwide COVID-19 pandemic in March 2020 and the following global financial and regulatory turmoil.
3. On January 1st 2021 it was definitively decided that from September 2021 II pillar pension reforms are no longer mandatory and from that point on, II pillar pension fund owners were allowed to take their money out of the pension

funds three times a year. In September 2021, the first payments out of the pension funds were made for those who decided to leave the II pillar pension system. Hereinafter referred to as "the second pension reform".

4. In February 2022, Russia invaded Ukraine, escalating the Russo-Ukrainian war.
5. From July 2022, for the first time since 2014, the European Central Bank increased its key interest rates in the euro area, leading the key interest rates to increase by 3.5 percentage points by March 2023, which could be considered an external shock (European Central Bank, n.d.).

In the following pages, the author analyses the asset allocation as well as the sectoral and/or regional distribution of 16 Estonian pension funds' equity and/or bond portfolios. They additionally present in the form of tables the most significant fluctuations in each fund during the analysed time frame. The 16 pension funds under analysis belong to the following four asset management companies: AS LHV Varahaldus, Swedbank Investeerimisfondid AS, AS SEB Varahaldus, and Luminor Pensions Estonia AS. Each asset management company's pension funds are analysed separately, however, the results are compared with those of other asset management companies.

Luminor pension funds.[2] In the case of all the analysed pension funds of Luminor Pensions Estonia AS (Pension Funds A, A Plus, B, and C), one of the starkest shifts in asset allocation during the analysed time frame took place in the first quarter of 2020. This shift corresponds to the worldwide COVID pandemic and subsequent lockdowns in many parts of the world. The investment strategies of Luminor's pension funds seemed to prioritize the safest (least volatile) asset class they had invested in, namely cash and money market fund, while shifting away from riskier and more volatile assets, such as stocks and, in some cases, bonds (Table 3).

Table 3

The most significant changes in Luminor pension funds' asset allocation

Pension Fund	Period of the change	The magnitude of the change*	Plausible explanation (association with an external shock)
Luminor Pension Fund A	December 2019	9.5% decrease in bonds; 11.5% increase in stocks.	The first pension reform

[2] In External Appendix see Tables A1-A4.

Pension Fund	Period of the change	The magnitude of the change*	Plausible explanation (association with an external shock)
Luminor Pension Fund A Plus	December 2019	25% drop in bonds; 27.9% increase in stocks.	The first pension reform.
Luminor Pension Fund A	March 2020	14.4% decrease in bonds and stocks; 13.9% increase in cash and money market funds	The Covid-19 pandemic
Luminor Pension Fund A Plus	March 2020	18.9% decrease in stocks; 16.7% increase in cash and money market funds.	The Covid-19 pandemic
Luminor Pension Fund B	March 2020	15.7% decrease in bonds and stocks; 17.5% increase in cash and money market funds.	The Covid-19 pandemic
Luminor Pension Fund C	March 2020	7% decrease in bonds and stocks; 7% increase in cash and money market funds.	The Covid-19 pandemic
Luminor Pension Fund A Plus	September 2020	8.7% drop in bonds, 5.7% increase in stocks, and 3.4% increase in cash and money market funds.	Instability caused by the Covid-19 pandemic
Luminor Pension Fund B	September 2020	9.1% drop in bonds; 9.2% increase in cash and money market funds.	Instability caused by the Covid-19 pandemic
Luminor Pension C	September 2020	12.9% drop in bonds; 12.8% increase in cash and money market funds.	Instability caused by the Covid-19 pandemic
Luminor Pension Fund C	December 2022	7% drop in bonds.	Rapidly increasing interest rates

Note: * Percentages expressed represent changes in percentage points

Source: Compiled by the author

In March 2020, all Luminor pension funds experienced drops in their stock and bond portfolios and increased their cash and money market funds. These fluctuations seen in March 2020, and those of the following months could be associated with the worldwide turmoil caused by the COVID pandemic and the fluctuating market prices of most tradable assets. By June 2020, all funds had increased their bond and stock portfolios by using the liquid assets acquired from the previous period by selling riskier investments. However, in September 2020, pension funds experienced once again a significant decrease in the proportion of bonds in the pension funds, with Luminor Pension Fund C undergoing the highest drop.

Even before the COVID pandemic affected Luminor pension funds' asset allocation in March 2020, all the pension funds experienced a shift in asset allocation from bonds to stocks, with some funds experiencing more noticeable changes than others. The highest drops in the bond portfolio occurred in Luminor Pension Funds A and A Plus. Pension Funds B and C also shifted their asset allocation from bonds to stocks, although the increases in the stock portfolio remained at 7% or less. This trend coincided with the first changes in Estonian pension fund legislation in September 2019, which increased the maximum allowed investments in equities in pension fund portfolios from 75% to full equity exposure.

The last most noticeable trend in the asset allocation of Luminor's pension funds during the analysed timeframe took place in December 2022, when all four funds experienced a drop in bond allocation. The drops varied between 3%-7%. Unlike the implications of the COVID pandemic, which were visible in pension funds asset allocation rather quickly, the decrease in bond investments in pension funds could be attributed to a series of decisions by the European Central Bank regarding key interest rates in the euro area.

SEB pension funds.[3] The author further examines the asset allocation trends of three SEB pension funds: Progressive, Optimal, and Energetic Pension Funds. The most significant fluctuations in the asset allocation of the aforementioned funds are presented in Table 4. The results suggest that the pension funds followed similar asset allocation patterns, with variations observed in the magnitude of fluctuations. Specifically, the Energetic Pension Fund appeared to be the most stable regarding asset allocation changes. The most significant fluctuation in the Energetic Pension Fund's asset allocation occurred in June 2019. However, when considering the overall weight of bonds in the portfolio, the 11% increase in bonds was not necessarily the result of a shock, but rather a result of a tactical decision or certain bonds reaching their maturity date.

Table 4

The most significant changes in SEB pension funds' asset allocation

Pension Fund	Period of the change	The magnitude of the change*	Plausible explanation (association with an external shock)
SEB Energetic Pension Fund	March & June 2019	7% decrease in bonds followed by 11% increase in bonds; 6% increase in stocks 6 followed by an equal drop.	Tactical decisions

[3] In External Appendix see Tables A5-A7.

SEB Optimal Pension Fund	March & June 2019	10% drop in bonds, followed by 15% increase in bonds; 8% in stocks in June 2019.	Tactical decisions
SEB Optimal Pension Fund	September 2021	10% drop in stocks; 6% increase in bonds.	The second pension reform – the first round of payouts
SEB Optimal Pension Fund	December 2021	10% decrease in bonds; 6% increase in stocks.	The second pension reform/tactical decisions
SEB Progressive Pension Fund	December 2021	10% decrease in bonds; 6% increase in stocks.	The second pension reform/tactical decisions
SEB Optimal Pension Fund	December 2022	8% decrease in bonds; 9% increase in cash.	Increasing interest rates
SEB Progressive Pension Fund	December 2022	7% decrease in bonds; 9% increase in cash.	Increasing interest rates

Note: * Percentages expressed represent changes in percentage points

Source: Compiled by the author

Similar fluctuations in the bond portfolios of SEB pension funds were observed in the first half of 2019 in the Progressive Pension Fund and even more severely in the Optimal Pension Fund. External shocks such as the first pension reform of the analysed period and the COVID pandemic do not appear to have significantly affected asset allocation of SEB pension funds. The effects of the COVID pandemic, if any, are barely visible in the asset allocation of SEB pension funds.

The next most noticeable asset allocation fluctuations in SEB pension funds occurred in September 2021. The Energetic and Progressive Pension Funds experienced only small fluctuations between asset classes (less than 5%), while in the Optimal Pension Fund, the proportion of stocks decreased by 10%. These changes coincided with the second pension fund reform and first round of payouts. During the following period, the Optimal and Progressive Pension Funds both experienced a 10% decrease in bonds and 6% increase in stocks.

Similarly to Luminor pension funds, SEB pension funds also experienced a drop in bond portfolios and increase in cash in December 2022. These effects could also be attributed to the effects of the increasing interest rates, which negatively affect the bond market due to the inverse relationship between interest rates and bond prices.

The monthly reports issued by SEB pension funds incorporate a specific type of segmentation for bonds. SEB's bond division strategy comprises a combination of geographical and sectoral distribution, in addition to bond investment quality and maturity.

The SEB Optimal Pension Fund owns the most comprehensive and detailed variety of bonds, with fixed-income investments classified into various categories such as Central and Eastern European bonds, developing market bonds, government bonds, high yield bonds, investment grade bonds, and investment grade bonds with a maturity between 1-5 years. However, the categorization of bond investments by SEB differs greatly from that of LHV and Swedbank. Consequently, the implications of external shocks to the investment decisions of SEB pension funds' bond portfolios are not assessed.

Swedbank pension funds.[4] From the four Swedbank pension funds under analysis (Generation 1960-69, Generation 1970-79, Generation 1980-89, and Conservative), Pension Fund Generation 1960-69 and Generation 1970-79 experience the closest asset allocation trend changes, despite having significantly different proportions of asset classes. Some of the most noticeable changes in the respective pension funds took place in June 2020 (Table 5), when both funds experienced an increase in stock allocation. This trend is consistent with Luminor pension funds, indicating a shared reason for the shift: economic instability resulting from the COVID-19 pandemic.

Table 5

The most significant changes in Swedbank pension funds' asset allocation

Pension Fund	Period of the change	The magnitude of the change*	Plausible explanation (association with an external shock)
Swedbank Pension Fund Generation 1960-69	June 2022	8.8% decrease in bonds; 7.2% increase in stocks.	Increase in key interest rates/tactical decisions
Swedbank Pension Fund Generation 1970-79	June 2020	6.8% decrease in stocks.	Instability caused by the Covid-19 pandemic
Swedbank Pension Fund Generation 1970-79	June 2022	14.3% decrease in bonds and 13.4% increase in stocks.	Increase in key interest rates/tactical decisions
Swedbank Pension Fund Generation 1980-89	June 2020	12.9% decrease in bonds and an equal increase in stocks.	Instability caused by the Covid-19 pandemic
Swedbank Conservative Pension Fund	March and June 2020	11.8% drop in bonds followed by a 12.6% increase; 11.7% increase in cash and deposits followed by a 12.2% drop.	The Covid-19 pandemic and its aftermath

[4] In External Appendix see Tables A8-A20.

Swedbank Conservative Pension Fund	December 2020	6.4% increase in bonds; 6.7% decrease in cash and deposits	Tactical or strategic decisions

Note: * Percentages expressed represent changes in percentage points

Source: Compiled by the author

The other most drastic changes in the asset allocation of these funds happened in June 2022, which could be associated with the key interest rates being raised in July 2022 for the first time since 2008. However, generally, Pension Funds Generation 1960-69, Generation 1970-79, and Generation 1980-89 experienced a long-term bond portfolio decline trend, which seems to be the result of strategic decisions in the funds, partly attributed to the first pension reform in the analysed period. Pension Fund Generation 1980-89 seems to be the most responsive to this reform, and as of June 2020, the stock portfolio proportion of the fund passed the previously allowed 75% equity investments limit.

In contrast, Swedbank Pension Fund Conservative exhibited different asset allocation changes compared to the other Swedbank pension funds under investigation. The Conservative Fund began investing in real estate as an asset class only in December 2019, while other funds owned real estate investments even before that. The addition of real estate investments in the pension fund coincides with first pension reform. Unlike other Swedbank pension funds, the effects of the COVID pandemic seem to be visible already from March 2020, while other funds reacted later (in June 2020) by also selling their fixed-income investments. The Conservative Pension fund, like Luminor pension funds, opted to restore its bond proportion in June 2020 by using the available cash reserves.

In December 2020, it seems that the Conservative fund decided to decrease its cash reserves due to some internal decisions. However, since that period the cash reserves of that fund have not reached their previous level and have remained under 5% compared to its previous above 10% level.

The regional changes in the stock and bond portfolios of Pension Fund Generation 1960-69 and Pension Fund Generation 1970-79 share similarities like the asset allocation and its fluctuations (Table 6). The most noticeable regional changes (exceeding 10%) in the pension funds bond portfolios coincided with the onset of the COVID pandemic. In September 2021, when the first payments out of the pension funds took place, Pension Fund Generation 1960-69 saw a decline of 18% in the weight of European stocks in the equities portfolio, with a corresponding increase in US stocks. A similar effect was observed in Pension Fund Generation 1970-79, albeit to a lesser extent.

Table 6

The most significant regional changes in Swedbank pension funds' bond and equities portfolios

Pension Fund	Period of the change	The magnitude and location of the change*	Plausible explanation (association with an external shock)
Swedbank Pension Fund Generation 1960-69	June 2020	12.4% shift from Baltic bonds to European bonds	Instability caused by the Covid-19 pandemic
Swedbank Pension Fund Generation 1960-69	September 2021	18% drop in European stocks and 14.1% increase in the US stocks	The second pension reform – the first round of payouts
Swedbank Pension Fund Generation 1960-69	June 2022	34.9% decrease in European bonds; 33.6% increase in the US bonds	Increase in key interest rates/tactical decisions
Swedbank Pension Fund Generation 1960-69	June 2022	11.8% decrease in European stocks; 6.7% decrease in the US stocks	Increase in key interest rates/tactical decisions
Swedbank Pension Fund Generation 1970-79	March and June 2020	10.5% decrease in European bonds, followed by a 14.6% increase in European bonds and a 15.8% drop in Baltic bonds	The Covid-19 pandemic and its aftermath
Swedbank Pension Fund Generation 1970-79	June 2022	48% decrease in European bonds, 27.3% increase in the US, and 13.8% increase in Baltic bonds.	Increase in key interest rates/tactical decisions
Swedbank Conservative Pension Fund	June 2020	19.1% increase in European bonds; 19.4% decrease in Baltic bonds	Instability caused by the Covid-19 pandemic
Swedbank Conservative Pension Fund	June 2022	31.6% decrease in European bonds and a matching increase in the US bonds	Increase in key interest rates/tactical decisions

Note: * Percentages expressed represent changes in percentage points

Source: Compiled by the author

However, the biggest fluctuations in the regional distribution of both pension funds occurred in June 2022, with the bond portfolios experiencing drastic shifts while the equities portfolios were affected to a lesser degree. These regional shifts coincide with significant asset allocation changes in the same pension funds, of which could be caused by the increasing interest rates or be the result of tactical decisions.

Swedbank Pension Fund Generation 1980-89 did not experience any changes exceeding 7,5% in their stock portfolio during the analysed period. Nevertheless, the regional allocation of the bond portfolio exhibited considerable volatility during the whole timeframe. However, since June 2020, the weight of bonds in the pension funds dropped below 10% and continued to decline to 2% by the end of the analysed period. Consequently, any small regional changes had a significant impact in the total regional distribution of the bond portfolio. Due to the low proportion of fixed-income assets in the portfolio, the monthly reports of Pension Fund Generation 1980-89 stopped reporting the regional distribution of the bond portfolio in the third quarter of 2021.

The Conservative Pension Fund experienced a year-long trend of shifting away from European bonds and increasing the weight of Baltic bonds at the beginning of the analysed period. However, in June 2020, the weight of Baltic bonds dropped like in other Swedbank pension funds. With the continuing worldwide turmoil, the Conservative fund increased the weight of their European fixed-income investments, shifting away from the Baltic fixed-income investments. The starkest regional change in the Conservative Fund's bond portfolio occurred in June 2022, like that of Pension Fund Generation 1960-69 and Pension Fund Generation 1970-79, with the Conservative Pension Fund shifting away from European investments and moving to the US market.

LHV.[5] The broadest scope of analysis in the framework of this thesis is conducted for LHV, due to their reporting standards. Although, it is mandatory for all pension funds to reveal their detailed investments report, for most pension funds only the latest detailed report is available; not the previous ones. In the case of LHV pension funds, the synoptic overview as well as detailed reports are available on the Pensionikeskus website from September 2019 onwards. The detailed reporting allowed the author also to analyse its single stock and bond portfolio sectoral division.

The asset class proportions of LHV pension funds XS and S (Tables A21-A22) are similar and grew nearly identical by the end of the analysed time frame. The biggest asset allocation changes in Pension Fund XS took place in December 2019, corresponding to the first pension reform (Table 7). The second noticeable shift occurred in March 2021. However, this trend does not overlap with a significant outside event like the drop in the bond portfolio of Pension Fund S in December 2021. From March 2022, Pension Funds XS and S have been expanding their scope of investment to stocks and real estate. However, in terms of

[5] In External Appendix see Tables A21-A44.

actual asset classes, they are not entirely novel as investments in real estate had been made before through bonds.

Table 7

The most significant changes in LHV pension funds' asset allocation

Pension Fund	Period of the change	The magnitude of the change*	Plausible explanation (association with an external shock)
LHV Pension Fund XS	December 2019	11% increase in bonds and an equal decrease in cash and equivalents	The first pension reform
LHV Pension Fund XS	March 2021	11% increase in bonds and an equal drop in cash and equivalents	Tactical decisions
LHV Pension Fund S	December 2021	9% drop in bonds; 7% increase in cash and cash equivalents	Tactical decisions
LHV Pension Fund M	September 2022	7.4% drop in bonds; 7.5% increase in cash and cash equivalents	Tactical decisions
LHV Pension Fund L	March 2020	13.4% decrease in bonds; 12.7% aggregate increase in stocks	The Covid-19 pandemic
LHV Pension Fund L	September 2021	15% decrease in bonds	The second pension reform – the first round of payouts
LHV Pension Fund XL	March 2020	24.8% decrease in bonds; 24% aggregate increase in stocks	The Covid-19 pandemic
LHV Pension Fund XL	September 2020	8.6% increase in bonds; 6.3% aggregate decrease in stocks	Instability caused by the Covid-19 pandemic
LHV Pension Fund XL	September 2021	12.9% decrease in bonds	The second pension reform – the first round of payouts
LHV Pension Fund XL	September 2022	10.2% decrease in bonds	Tactical decisions

Note: * Percentages expressed represent changes in percentage points

Source: Compiled by the author

In the asset allocation of Pension Fund M (Table A23), the most significant change in asset allocation occurred in September 2022. Nevertheless, before September 2022, there was already a long-term trend of decreasing the weight of bonds. This trend started in March 2020, which means that it could be associated with the COVID pandemic, however, since the

decreases are gradual it stands to reason that the phenomenon could also be the result of tactical decisions or fluctuating market prices.

LHV Pension Funds L and XL (Tables A24-A25) are similar in their asset allocation nature and investments. The funds experience similar trends to varying extents. However, Pension Funds L and XL are the most affected by external shocks. The beginning of the COVID pandemic in March 2020 brought upon a stark fall in bond investments in both funds. However, this trend contradicts the asset allocation decisions of Luminor and SEB pension funds, which decreased their equity investments in the period but is similar to the reaction of Swedbank Pension Fund Generation 1980-1989 (yet this fund appeared to react to the shock induced by COVID-19 in the following period more severely). Out of all LHV Pension Funds, the L and XL funds' asset allocations also experienced the second pension reform and payments out of the fund most severely. In September 2021, both funds sold a noteworthy amount of their bond investments.

In LHV Pension Funds XS and S, the regional distribution of the bond portfolios follows similar trends (Tables A26-A27). Nevertheless, neither of the pension funds' bond portfolios experienced very significant (over 10% or higher) changes in the regional distribution. However, there is a general trend from the end of 2021 in the respective funds towards a higher weight of Baltic fixed-income investments in the portfolio. Similar regional trends are also detectable in Pension Funds M, L, and XL (Tables A28-A30), especially towards the end of the analysed timeframe.

However, like Pension Funds XS and S, Pension Fund M (Table A28) does not experience over 10% fluctuations in the regional distribution of its bond portfolio either. Close to 10% fluctuations can be detected in the second half of 2022, which could be contributed to tactical decisions. In contrast, Pension Fund L and XL (Tables A29-A30) experience noteworthy fluctuations several times during the analysed time frame that correlate with external shocks but with different magnitudes (Appendix C). Like Pension Fund M, Pension Funds L and XL experience fluctuations in the regional distribution of bonds at the end of 2022 contributable to tactical changes. It is necessary to note, though, that in analysing the regional and sectoral distributions of the bond and stock portfolios, the actual weights of the regions/sectors in the portfolio should be considered since fluctuations that might initially be perceived as grand, but are not as noteworthy in the whole portfolio.

In the regional changes of LHV pension funds' single stock portfolios (Tables A31-A33), detecting more long-term trends rather than severe fluctuations is possible. The visible long-term trends in the single stock regional distribution of LHV Pension Funds M, L, and

XL occurred from the second half of 2020 when the weight of European single stocks increased in the single stock portfolios until September/December 2021 when it started to decrease and that of Baltics and North America started to increase. When looking at the percentages of the single stock investments compared to the whole portfolio, it is visible that the percentage changes are not as drastic as it could be thought, despite of that. Still, the regional distribution of single stock portfolios of Pension Funds M, L, and XL react to the COVID pandemic in March 2020, when in the single stock portfolios of all three funds the weight of North American single stocks increased by more than 12% (Tables A31-A33).

The sectoral changes in the single stock portfolios of LHV Pension Funds M, L, and XL (Tables A37-A39) experience similar long-term trends rather than high volatility, just like the regional distribution of their single stock portfolios (Tables A31-A33). The first sectoral trend that the single stock portfolios of Pension Funds L and XL (Tables A32-A33) experience is the increase in the weight of the materials sector from September 2019 to March 2020. The trend corresponds to the first pension reform of the analysed time frame. The second sectoral trend observed lasted from March 2020 (the beginning of the COVID pandemic) for a one-year period when the weight of financial sector stocks increased in all three pension funds, while the third trend started in June 2021, from which point on the weight of the energy sector stocks in the portfolio increased until June 2022, possibly as a response to the rising inflation rates worldwide. Finally, the fourth trend started in September 2021 and lasted for over a year, comprising of the fall of the weight of financial sector stocks in the single stock portfolios of Pension Funds M, L, and XL and corresponding to the second pension reform of the period and the first payments out of the pension funds.

LHV Pension Funds S and M follow almost identical trends in the sectoral distribution of their bond portfolios (Tables A41-A42). Pension Fund XS experiences some of the same major sectoral fluctuations as other LHV pension funds but does not generally follow the same sectoral trends in its bond portfolio (Table A40). The significant fluctuations in the sectoral distribution of LHV Pension Fund XS' bond portfolio occurred in December 2019 and September 2022 (Appendix C). These trends seem to result from tactical decisions or certain bonds reaching maturity. In September 2022, a decrease of around 10% or more in the weight of government bonds was observed in all other examined LHV pension funds as well (Tables A40-A44).

In the sectoral distribution of Pension Funds S and M bonds, there is a visible trend of the weight of non-financial bonds falling (September 2019-June/September 2020) and government bonds increasing (March 2020-March/June 2021). The observed trend can be

linked to the COVID and the preparations being made for the second pension reform. In Pension Funds L and XL, the weight of government bonds in the sectoral division of the bond portfolio increased from March 2020 (COVID-19) until September 2021 (the first payments made due to the second pension reform).

Upon conducting an analysis of 16 Estonian II pillar pension funds, the following main conclusions can be drawn:

- The changes in investment diversification decisions of the analysed pension funds of the same asset management companies and/or those of similar level of risk share more similarities between one another than pension funds of different asset management companies.
- The investment diversification decisions of all pension funds were affected by at least one external shock. However, the reactions and the magnitudes generally differed greatly.
- The first pension reform had an effect on the asset allocation of several pension funds. The reduction of fixed-income assets in pension fund portfolio due to the first pension fund reform was visible in pension funds like Luminor Pension Fund A Plus, Swedbank Pension Fund Generation 1960-69, Swedbank Pension Fund Generation 1970-79, and Swedbank Pension Fund Generation 1980-89. However, the trend was visible over a longer period of time rather than as an immediate change.
- The biggest fluctuations in Estonian II pillar pension fund investment diversification decisions were caused by the COVID-19 pandemic (March 2020-September 2020) and the II pillar pension reform in September 2021.
- Generally, the Estonian II pillar pension funds have shifted to a lower proportion of fixed-income holdings and higher proportion of equity investments in their portfolios than before and have expanded their investment into alternative assets. These findings corroborate the presumptions made by the author based on the previous scholarly work in Section 1.3.

At times, the author encountered challenges in identifying a relationship between fluctuations in investment diversification decisions and specific external shocks. Therefore, it is reasonable to infer that these changes were likely the result of strategic or tactical decisions made by pension fund managers that entail different reasonings and motivations that the ones that get focused on within the scope of this thesis.

2.3. Results of interviews

The thesis framework involved conducting interviews with pension fund managers whose banks are analysed. Interviews were conducted with Vahur Madisson (Luminor pension fund manager), Endriko Võrklaev (SEB pension fund manager), and a joint interview with Kristo Oidermaa and Romet Enok (LHV pension fund managers). Due to several reasons, the author did not succeed in conducting an interview with any of the Swedbank pension funds managers.

It is worth noting that a pilot interview was not conducted for the following two reasons. Firstly, the aim of the interviews is to support the quantitative results discussed in the previous subchapter, rather than to contribute fundamentally to the results. Secondly, a considerable portion of the interview questions are related to the quantitative data analysed. Consequently, conducting a pilot interview was deemed unnecessary by the author of this thesis in consultation with their supervisor.

The interview questions are divided into the three categories outlined in Appendix B. Firstly, general questions were asked about the interviewee and pension fund management and the reports. The second part consisted of questions about pension fund investment diversification decisions, while the third part of the questions focused on the implications of external shocks on pension fund investment diversification decisions. As the interviews are conducted in Estonian (the native language of the interviewees), Appendix B comprises both English and Estonian versions of the questions. However, some interview questions are modified based on the results of the quantitative analysis and the respective asset management companies' reporting standards.

In what follows, the five generalisable points of interest covered in the interviews will be outlined, as well as the collective conclusions drawn from the obtained answers.

The main influencers to changes in investment diversification decisions. Based on the answers of the pension fund managers, it is possible to generalize that there are some main aspects that need to be considered when analysing the asset allocation as well as the sectoral, or regional changes in the pension fund assets. These include whether the observed trends result from strategic decisions, tactical decisions, external shocks, global trends, or fluctuations in asset market prices.

Strategic decisions such as significant long-term changes in the asset allocation of certain pension funds are taken once or twice a year at pension fund management meetings. Generally, the asset allocation of pension funds should not vary too severely unless it has been decided that the fund's strategic asset allocation will be changed.

Tactical decisions such as which specific assets should be sold or bought are sometimes visible if the asset(s) acquired/disposed of make up a significant percentage of the total assets or if the asset itself has a high weight in the portfolio. However, pension fund managers were at times unable to disclose detailed information regarding tactical decisions due to confidentiality agreements. Nevertheless, they were at most times able to confirm whether an observed trend resulted from tactical decisions or external shocks.

Pension funds are also affected by global trends. The interviews revealed that the most noteworthy global trends of the past years that have affected pension funds are ESG and sustainability. The asset management companies that are in charge of the pension funds' investment decisions have adapted to this trend differently. E. Võrklaev stated, that SEB pension funds chose to make their pension fund investments greener and more sustainable. Võrklaev also said that:

"If we invest less in energy/oil production and those "dirty" investment branches, then from time to time we might lose some returns. For example, the Russo-Ukrainian war brought upon a huge stock price increase of energy carriers and energy companies, etc. And many Estonian funds, including us, were somewhat less invested in the energy sector due to trying to move to greener investments, and potentially we lost some returns." (Võrklaev, 2023)

On the contrary, LHV opted to create a completely new sustainable pension fund rather than changing the investment strategies of the rest of its pension funds. LHV Pension Fund Green was created in March 2020 in response to the ESG trend.

The fluctuation of assets' market prices also creates small fluctuations in the asset allocation of pension funds. Hence, not necessarily all small fluctuations or even big ones in their full scope are caused only by changes in diversification or tactical decisions.

The importance and approaches to portfolio diversification. The author gathered from the interviews that since pension funds are already rather diversified (numerous single investments in different asset classes), it is not additional and the highest possible diversification that the pension funds usually seek but rather higher return earning opportunities. This mentality can mostly be attributed to the pension funds of LHV, where K.Oidermaa stated that:

"*Diversification for us is a secondary or tertiary issue." (Oidermaa & Enok, 2023)*

Nevertheless, the importance of investing in multiple asset classes is not disregarded in LHV pension fund management, and the approach of putting all eggs in one highest return earning basket is not adopted, whereas the interview with V. Madisson revealed that in

addition to asset class allocation, and sectoral and regional diversification, Luminor pension fund managers consider currencies to some extent when making their diversification decisions.

Sectoral diversification. Moerman (2008) concluded that a portfolio in the euro area, where geographical diversification is already applied, could reap more benefits if it was additionally diversified with sector indices, which is more important than international diversification. From the analysis of reports and the interviews, it seemed to the author that sectoral diversification is not as important to pension funds as it could be. However, the interviews showed that sectoral considerations are currently gaining importance in response to the rapidly increasing interest rates and high inflation. LHV stated that all financial sector companies will win from the increasing interest rates and in times of high inflation, the energy and materials sectors tend to perform well. V. Madisson added that in response to the rising interest rates, Luminor pension funds have invested more in defensive sectors, such as the utilities and consumer staples sectors which partly supports the findings of Emsbo-Mattingly et al. (2021).

The effects of the II pillar pension reform. Gathering from an interview with the SEB pension fund manager, the second pension reform (making the existing II pillar pension funds voluntary) has changed the investment outlooks of SEB pension funds. E. Võrklaev stated that due to the pension reform, pension funds have to be more liquid than before (as people have the right to withdraw their investments thrice a year). Being forced to have more liquidity means that the pension funds cannot invest in domestic (the Baltic) markets as much as before since they are not as liquid as, for example, European bonds and bills. Additionally, due to the higher need for liquidity, pension funds have lost, what E. Võrklaev called the "liquidity premium". With this term, he referenced that before the reform, pension funds were able to earn higher returns from less liquid assets and asset classes like real estate. However, now the opportunity to do so is reduced; hence, in the grand scheme of things, it might lead to lower long-term returns.

LHV pension fund managers stated that they made preparations well in advance for the first pension fund payouts in September 2021, considering a longer time perspective. R. Enok and K. Oidermaa mentioned, that due to the previously negative interest rates, pension funds had to pay a fine for cash reserves on their bank account higher than 2%. As a result, LHV pension funds invested for a longer time in highly liquid German and French government bonds to have enough liquidity when it was time for the first payments, which was confirmed by findings in Tables A42-A44. Nevertheless, the author of the thesis would

have expected to see a higher shift towards cash in September 2021 in Luminor and Swedbank pension funds. However, Swedbank pension funds experienced noticeable fluctuations in their asset allocation in June 2022, what perhaps could be contributed to the II pillar pension fund reform, yet it cannot be confirmed due to the interview with Swedbank pension fund managers not taking place.

The effects of the Russo-Ukrainian war. After Russia's invasion to Ukraine in 2022, trade restrictions were imposed on Russia, which means that pension funds were forced to sell their Russian investments. However, based on the monthly reports and interviews with pension fund managers, the pension funds' investments were not significantly changed as the proportion of Russian and Belarusian investments were already minuscule or non-existent. However, LHV pension fund managers confirmed that after the events of February 2022, they sold their remaining investments in Eastern European index funds. This situation confirms one of the conclusions drawn by the author based on the previous scholarly work, that imposing restrictions on trade leads to decreased international diversification.

Russia's actions additionally led to increased energy prices, which affected the investments of pension funds even more severely. As a result of the invasion, oil prices increased by 40% within the first two weeks and gas prices by 180% (Adolfsen et al., 2022), which created an opportunity to earn higher returns for pension funds that had not opted to follow the ESG trend. V. Madisson stated that:

"*In our sectoral outlook or equity strategies, we positioned ourselves in the energy sector." (Madisson, 2023)*

However, as discussed before, this was something that the SEB pension funds were not able to do, as they had adopted a greener investment strategy.

The discussion of analysis of reports. All the pension fund managers interviewed agreed that external shocks such as the COVID pandemic, the second pension reform, and the interest rates shock have affected the pension funds' diversification decisions, but in different pension funds to varying extents. Generally, the pension fund managers confirmed the author's findings from the analysis of their monthly reports. Nevertheless, certain changes in the diversification decisions that the author associated with external shocks were actually tactical decisions or contradicted the strategies that the pension fund managers claimed to be following. One of such examples is the fourth trend detected in LHV pension funds' single stocks sectoral distribution. According to Tables A37-A39, the financial sector has experienced a drop in its weight in the portfolio that the author associated with the second

pension reform. However, according to Romet Enok and Kristo Oidermaa the trend should be vice versa and is a response to the rapidly increasing interest rates.

Based on the interviews with the pension fund managers, several conclusions can be drawn. The author finds the key ideas to be:

- The pension funds' view and portfolio risk tolerance affect the investment diversification decisions.
- Drastic changes in pension funds' asset allocation and/or sectoral distribution of investments should generally not occur unless external shocks take place or strategic decisions have been taken by the pension funds management boards that affect the pension funds' asset allocation in the long run.
- When analysing the pension funds' monthly reports, it is necessary to consider whether the observed changes result from the fluctuation of the market prices, tactical decisions, strategic decisions, external shocks, or long-term trends.
- The investment decisions of pension funds following an external shock were found to be affected by the position of the pension funds' portfolio in the market prior to the shock and their previous asset allocation.
- Generally, the author accurately linked the changes in pension funds' investment decisions to external shocks in their analysis of reports.

To conclude the interviews and look in the future rather than focusing solely on the past, the author asked about potential near-future trends the pension funds might experience. All the pension fund managers declared that due to high interest rates, the outlook on fixed-income investments has bettered and their weight might increase in the portfolios in the near future. However, LHV also stated, that due to their currently high liquidity levels resulting from asset sales at the end of 2022, they are ready to react to any interesting turn of events the market may experience.

Conclusion

Investment management and portfolio diversification go hand in hand. Diversification would not be necessary if the correlation of all asset returns would be +1. Portfolio diversification is an investment management tool that distributes portfolio investments between asset classes, sectors, and different regions to reduce the volatility of the portfolio and provide a safeguard in case an asset's returns drop. The mathematical groundwork for portfolio diversification was developed by Markowitz (1952) when he proposed to measure portfolio risk using standard deviation representing the volatility of returns. Different

approaches are used to diversify the systematic and unsystematic risks involved in investing, such as asset-class-based, sectoral, and international diversification, alongside with changing the weights of single assets or asset classes in the portfolio. These approaches may be used separately or together as each approach has its benefit and its critics. Literature and pension funds' monthly reports show that Estonian pension funds have also opted for several diversification techniques such as changing the weights of different asset classes in their portfolios and international diversification. For Estonian pension funds, the general trend in asset allocation has been towards heavier equity and alternative assets dependence like that of the world.

Previous scholarly work shows that external shocks such as a financial crises, pandemics, reform/regulatory changes, and other factors influence portfolio diversification. In the aftermath of financial crisis, equity investments are more heavily relied upon, while international diversification is sought during crises. During a pandemic, pension funds have shifted their assets towards fixed-income assets like bills and bonds, unless more significant factors have affected investment decisions like reform/regulation changes. Further analysis was conducted to understand better how external shocks such as the COVID-19 pandemic, pension reforms, rapidly increasing interest rates, and Russia's invasion to Ukraine have shaped the investment diversification decisions of Estonian II pillar pension funds.

The author conducted a quarterly analysis of 16 Estonian II pillar pension funds' asset allocation as well as the sectoral, and/or regional distribution between 2019 and 2022. This consisted of inserting the data from 272 pension funds' monthly reports into cumulative tables. To be able to analyse the sectoral distribution of LHV pension funds' bond and single stock investments, the author manually assigned each bond and single stock investment a sector. LHV pension fund bond investments were categorized into government, financial, and non-financial bonds, whereas the stock sectors were assigned following the S&P index fund's sectoral division structure. To confirm the findings and the conclusions drawn from the reports, the author managed to interview three out of four respective asset management companies' pension fund managers.

The analysis of reports showed that all pension funds were affected by at least one external shock. However, the reaction and their magnitude varied partly due to the different investment strategies of the pension funds. Additionally, the interviews with pension fund managers from Luminor, SEB, and LHV revealed that tactical decisions, strategic decisions, and global trends such as ESG and sustainability affect Estonian II pillar pension fund investment diversification decisions. Some of the biggest fluctuations in the pension funds'

asset class as well as the sectoral, and regional distribution took place as a response to the COVID pandemic and the II pillar pension reform which made holding a II pillar pension fund optional instead of mandatory. Generally, the interviews confirmed the results and conclusions drawn by the author based on the analysis of results with minor variations.

Nonetheless, the author faced several limitations in conducting their analysis, mostly because of the varying available data on the pension funds' investments, pension funds' investments in index funds, and the limited scope of the thesis. For expanding the research regarding the investment diversification decisions of Estonian II pillar pension funds and the implications external shocks have had on them, the author suggests incorporating a method that additionally considers the investments in index funds and how they affect the sectoral and regional investment levels. Avenues for potential directions for continuing research on the related topic could be firstly analysing the implications of external shocks on III pillar pension funds and, secondly, studying in depth the effect of long-term trends on pension funds' investment portfolio diversification decisions.

As a combination of the quantitative and qualitative methodologies chosen in the thesis, the author was able to fulfil the aim of the thesis and clarify how different external shocks have affected the investment diversification decisions of 16 different Estonian II pillar pension funds. As an extra value, small glimpses into the possible near-future investment strategies of the pension funds were given based on the answers of the pension fund managers.

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APPENDIX A

The 26 Estonian II Pillar Pension Funds and Their Eligibility for Quantitative Analysis

Financial institution	Pension fund	Data available	Eligibility for analysis	Changes that will be observed
LHV	Pension Fund Index	Asset class allocation	No*	
LHV	Pension Fund L	Asset class allocation Detailed information on single equity and fixed-income investments	Yes	Asset class allocation Sectoral and geographical changes in single equity and fixed-income investments
LHV	Pension fund M	Asset class allocation Detailed information on single equity and fixed-income investments	Yes	Asset class allocation Sectoral and geographical changes in single equity and fixed-income investments
LHV	Pension Fund Green	Asset class allocation Detailed information on single equity investments	No**	
LHV	Pension Fund S	Asset class allocation Detailed information on fixed-income investments	Yes	Asset class allocation Sectoral and geographical changes in fixed-income investments
LHV	Pension Fund XL	Asset class allocation Detailed information on single equity investments	Yes	Sectoral and geographical changes in single equity investments
LHV	Pension Fund XS	Asset class allocation Detailed information on fixed-income investments	Yes	Asset class allocation Sectoral and geographical changes in fixed-income investments
Luminor	Pension Fund A	Asset class allocation	Yes	Asset class allocation
Luminor	Pension Fund A Plus	Asset class allocation	Yes	Asset class allocation
Luminor	Pension Fund B	Asset class allocation	Yes	Asset class allocation
Luminor	Pension Fund C	Asset class allocation	Yes	Asset class allocation
Luminor	Pension fund “Sustainable Future” Index	Asset class allocation	No*	
SEB	Conservative Pension Fund	Asset class allocation SEB’s distribution of fixed-income investments	No*	
SEB	Energetic	Asset class distribution	Yes	Asset class allocation

	Pension Fund			
SEB	Optimal Pension fund	Asset class allocation Sectoral distribution of fixed-income investments	Yes	Asset class allocation Sectoral distribution of fixed-income investments
SEB	Pension Fund 100	Asset class allocation	No*	
SEB	Pension Fund Index 100	Asset class allocation	No*	
SEB	Progressive Pension Fund	Asset class allocation	Yes	Asset class allocation
Swedbank	Conservative Pension Fund	Asset class allocation Fixed-income investments' geographical distribution Information on the distribution of the top 10 holdings	Yes	Asset class allocation Fixed-income investments' geographical distribution
Swedbank	Pension Fund Generation 1960-69	Asset class allocation Fixed-income and equity investments' geographical distribution Information on the distribution of the top 10 holdings	Yes	Asset class allocation Fixed-income and equity investments' geographical distribution
Swedbank	Pension Fund Generation 1970-79	Asset class allocation Fixed-income and equity investments' geographical distribution Information on the distribution of the top 10 holdings	Yes	Asset class allocation Fixed-income and equity investments' geographical distribution
Swedbank	Pension Fund Generation 1980-89	Asset class allocation Fixed-income and equity investments' geographical distribution Information on the distribution of the top 10 holdings	Yes	Asset class allocation Fixed-income and equity investments' geographical distribution
Swedbank	Pension Fund Generation 1990-99 Index	No detailed information available besides the annual report, prospectus, and rules of the fund	No*	
Swedbank	Pension Fund Index	No detailed information available besides the	No*	

		annual report, prospectus, and rules of the fund	
Tuleva	World Bonds Pension Fund	Asset class distribution	No*
Tuleva	World Stocks Pension Fund	Asset class distribution	No*

Note: * The pension fund is not eligible for analysis as the fund has invested into 3 or less different asset classes and/or detailed information on the distribution of securities is not available

Note: ** The pension fund is disregarded for the analysis as it was created in March 2020

Source: Compiled by the author

APPENDIX B

Interview questions in English and Estonian

I General questions	
1. What has been your role in the pension fund management - and for how long? 2. How is pension fund management organized? (is there a general committee for pension funds, how many fund managers does each fund have, etc.) 3. In the pension fund monthly reports, the aggregate sum of asset classes is often over 100% and the amount over 100% is written off as obligations of the fund. However, this sum differs from one period to another, often in tens of thousands of euros. Could you please explain the reason behind this?*	1. Milline on olnud teie roll (rollid) pensionifondide juhtimises ja kui kaua olete seda täitnud? 2. Kuidas on korraldatud pensionifondi juhtimine? (Kas on olemas üleüldine komitee, kui palju fondijuhte on igal fondil, jne.) 3. Pensionifondide kuuaruannetes ületab varaklasside kombineeritud summa tihtilugu 100% ning üle 100% olev summa arvestatakse maha kui fondi kohustused. Kuid see summa erineb iga kuu (kümneid) tuhandeid eurosid. Millised on sellise aruandluse tagamaad?
II The investment diversification decisions of the pension funds	
4. Do the investment portfolio diversification decisions differ for pension funds from general investment portfolio diversification decisions (single investors/equity funds)? If so then how? 5. Which portfolio diversification approaches are used in your respective asset management company's pension fund management? 6. Which diversification approach do you deem the most important and why? 7. How have these diversification approaches been selected – are the diversification requirements set in the general guidelines? Or chosen by a committee, respective pension fund manager? 8. If and how are risk and diversification decisions/approaches connected in pension funds?	4. Kas pensionifondide portfellide diversifitseerimise otsused erinevad teiste fondide või portfellide diversifitseerimise otsustest? Kui jah, siis kuidas? 5. Millistele varade diversifitseerimise dimensioonidele tuginetakse Teie hallatavate pensionifondide juhtimises lisaks sektoripõhine hajutatus, varaklasside hajutatus, geograafiline hajutatuse? Ja kas need on? 6. Milline varade diversifitseerimise dimensioon - geograafiline, sektoraalne, varaklassiline vmt - on Teie arvates kõige olulisem? 7. Kuidas pannakse paika varade diversifitseerimise dimensioonid? 8. Kuidas on seotud Teie pensionifondide riskitase ja nende varade diversifitseeritus?
III The implications of external shocks on pension fund asset diversification decisions	
9. Which external events/shocks (e.g. policy changes, inflation, war, etc.) have most influenced pension fund investment/portfolio management in	9. Millised välised sündmused/tegurid on enim mõjutanud pensionifondide investeerimisotsuseid viimase nelja aasta jooksul?

the past 4 years? Why? 10. How have these events influenced pension fund investment diversification decisions? 11. The results of my analysis of [asset management company/pension fund] have detected [x] trend/relationship between [external shock/event] and changes in portfolio diversification decisions/approaches. Can you confirm these relationships or can these trends be associated with another external factor? 12. Were these changes in investment portfolio diversification discussed in the previous question made knowingly or intuitively? 13. Which investment portfolio diversification changes might we see in the next six months? Are they a result of some recent external shocks/events or follow general economic trends?	10. Kuidas need sündmused on mõjutanud pensionifondide varade diversifitseerimisotsuseid? 11. Teie pensionifondide varade diversifitseerimisotsuse analüüs tuvastas [x] trendi/suhet [välise šoki/sündmuse] ja [varade] mitmekesistamise otsuste vahel. Kas te kinnitate sellist suhet või saab selliseid muutuseid seortada mõne muu välise või sisemise teguriga? 12. Kas eelpoolmainitud muutused portfellivarade diversifitseerimiel olid tehtud kõik teadlikult või intuitiivselt põhinedes kogemusele? 13. Milliseid pensionifondi varade diversifitseerimistrende võib näha järgmise kuue kuu jooksul? Kas need muutused tulenevad hiljutistest välistest sündmustest või järgivad üldiseid majandustrende?

Note: *This question was asked from Luminor and LHV pension fund managers

Source: Compiled by the author

APPENDIX C

The most significant regional and sectoral changes in LHV pension funds' bond and stock portfolios

Pension Fund	Period of the change	The magnitude and location of the change*	Plausible explanation (association with an external shock)
LHV Pension Fund L	September 2020	13.1% increase in European bonds	The aftermath of the Covid-19 pandemic
LHV Pension Fund L	March 2020	15.2% increase in North American stocks	The Covid-19 pandemic
LHV Pension Fund L	September 2021	25.5% decrease in European bonds	The second pension reform – the first round of payouts
LHV Pension Fund XL	March 2020	12.5% increase in North American stocks	The Covid-19 pandemic
LHV Pension Fund XL	March 2020	22.9% drop in North American bonds	The Covid-19 pandemic
LHV Pension Fund XL	September 2020	18% decrease in European bonds	The aftermath of the Covid-19 pandemic
LHV Pension Fund XL	September 2021	22% decrease in European bonds	The second pension reform – the first round of payouts
LHV Pension Fund XS	December 2019	12.8% increase in the financial bonds	Tactical decisions
LHV Pension Fund XS	September 2022	13.1% decrease in government bonds	Tactical decisions
LHV Pension Fund S	September 2022	15% decrease in government bonds	Tactical decisions
LHV Pension Fund M	September 2022	9.9% decrease in government bonds	Tactical decisions
LHV Pension Fund L	September 2021	27.1% decrease in government bonds	The second pension reform – the first round of payouts
LHV Pension Fund XL	September 2021	23.9% decrease in government bonds	The second pension reform – the first round of payouts
LHV Pension Fund XL	September 2022	13% decrease in government bonds	Tactical decisions

Note: * Percentages expressed represent changes in percentage points

Source: Compiled by the author

EXTERNAL APPENDIX

Excel file: Liisa-Marie Pajumägi_Bachelor Thesis Data_2023. The file includes Tables A1-A44.

The Asset Allocation of Luminor Pension Funds

1. Table A1: Luminor Pension Fund A
2. Table A2: Luminor Pension Fund A Plus
3. Table A3: Luminor Pension Fund B
4. Table A4: Luminor Pension Fund C

The Asset Allocation of SEB Pension Funds

5. Table A5: SEB Energetic Pension Fund
6. Table A6: SEB Optimal Pension Fund
7. Table A7: SEB Progressive Pension Fund

The Asset Allocation of Swedbank Pension Funds

8. Table A8: Swedbank Pension Fund Generation 1960-69
9. Table A9: Swedbank Pension Fund Generation 1970-79
10. Table A10: Swedbank Pension Fund Generation 1980-89
11. Table A11: Swedbank Conservative Pension Fund

The Regional Distribution of Swedbank Pension Funds' Bond Portfolios

12. Table A12: Swedbank Pension Fund Generation 1960-69
13. Table A13: Swedbank Pension Fund Generation 1970-79
14. Table A14: Swedbank Pension Fund Generation 1980-89
15. Table A15: Swedbank Conservative Pension Fund

The Regional Distribution of Swedbank Pension Funds' Stock Portfolios

16. Table A16: Swedbank Pension Fund Generation 1960-69
17. Table A17: Swedbank Pension Fund Generation 1970-79
18. Table A18: Swedbank Pension Fund Generation 1980-89

The Aggregate Regional Changes in the Distribution of Swedbank Pension Funds' Stock and Bond Portfolios

19. Table A19: Swedbank Pension Fund Generation 1960-69
20. Table A20: Swedbank Pension Fund Generation 1970-79

The Asset Allocation of LHV Pension Funds

21. Table A21: LHV Pension Fund XS
22. Table A22: LHV Pension Fund S
23. Table A23: LHV Pension Fund M

Resümee

Väliste šokkide implikatsioonid investeeringute varahajutamisotsustele – Eesti pensionifondide uuring

Liisa-Marie Pajumägi

Viimase kolme aasta jooksul on maailm kogenud turbulentsi millest jätkub aastakümneteks. COVID-19 pandeemia, Vene-Ukraina sõda, hüppeliselt tõusvad intressimäärad ja kasvav inflatsioon on vaid mõned šokid, mis on mõjutanud nii üksikisikute kui korporatiivseid investeerimisstateegiaid. Eesti pensionifondid on üle elanud lisaks eelpool mainitud välistele šokkidele ka kaks regulatiivset muudatust. Aktsiate ülempiiri kaotamine pensionifondides 2019. aastal ning 2021. aastal II samba vabatahtlikuks muutmise. Kõige tulemusena teenisid kõik Eesti pensionifondid 2022.a esimesel poolel negatiivset tootlust. Selleks, et olla vähem mõjutatud majandustrendidest ja ka välistest šokkidest on oluline pöörata tähelepanu varade hajutamisele.

Diversifitseerimine ehk teisisõnu varade hajutamine on investeeringute juhtimise tehnika mis põhineb investeeringute hajutamisel varaklasside vahel ning ka näiteks erinevate sektorite ja regioonide vahel. Varade diversifitseerimine annab võimaluse vähendada kaotuste suurust, kui kindel varaklass või investeering satub löögi alla ning annab võimaluse teenida kõrgemat tootlust lisariske juurde võtmata. Markowitzi (1952) loodud modernse portfelliteooria kohaselt võib võrdlustada riski tootluse volatiilsusega, mida on võimalik vähendada valides portfelli varasid, mille tootlused korreleeruvad võimalikult vähe. Kuna varaklassid käituvad majandusolukordades erinevalt, aitab varade diversifitseerimine vähendada portfelli volatiilsust ehk vähendada riske.

Erinevatel diversifitseerimismeetoditel on oma plussid, kuid leidub ka kriitikuid. Eesti pensionifondides on põhiliselt näha varade hajutamist varaklasside vahel, kuid ka regionaalset ja sektoraalset hajutatust. Et saada paremat ülevaadet sellest, kas ja kuidas välised šokid on mõjutanud Eesti teise samba pensionifondide diversifitseerimisotsuseid, analüüsis töö autor 16 Eesti pensionifondidi poolt avaldatud igakuiseid raporteid iga kvartali tagant perioodil 1.jaanuar 2019 (31.detsember 2018 seisuga)-31.detsember 2022. Raportitest kogus autor kokku andmed varaklasside jaotuse kohta ning kus võimalik, info regionaalse või sektoraalse jaotuse kohta. Luminori, SEB ning Swedbanki pensionifondide raportitest sai kätte info algkujul. LHV pensionifondide võlakirjade ja üksikaktsiate sektoraalse hajutatuse analüüsimiseks, määras töö autor käsitsi igale investeeringule sektori. Võlakirjad jaotati riiklikuteks ja kohalike omavalitsuse võlakirjadeks, finantssektori ja mitte finantssektori

võlakirjadeks. Üksikaktsiate sektoraalne hajutatus põhines S&P indeksfondi sektoraalsel jaotusel, mille põhjal jaotati üksikaktsaite investeeringud 11 varaklassi.

Raportite analüüsist selgus, et kõiki pensionifonde mõjutas vähemalt üks väline šokk, kui mitte kõik. Väliste šokkide mõju mastaap erineb pensionifonditi ning on osaliselt mõjutatud pensionifondide investeerimisstrateegiatest. Võib öelda, et enim mõjutasid pensionifondide varade hajutamisotsuseid COVID-19 pandeemia ning sellele järgnev majanduslik ebastabiilsus ning II samba pensionireform. Kuid diversifitseerimisotsustele avaldasid mõju ka intressimäärade järsk tõus ja mõnevõrra ka Vene-Ukraina sõda.

Et saada kinnitust raportite analüüsi tulemustele ning kinnitust nähtud välistest šokkidest tulenevatele trendidele, intervjueeris töö autor ka LHV, SEB ja Luminori pensionifondide juhte. Intervjuudest selgust, et lisaks välistele šokkidele mõjutab diversifitseerimisotsuseid ka jooksvad taktikalised otsused, pikaajalisemat mõju avaldavad strateegilised otsused ning globaalsed trendid, nagu näiteks jätkusuutlikkus, millele pensionifondid lähenenud erinevalt. Pensionifondide juhtidega tehtud intervjuud enamuses toetasid autori leide ja raportitest tehtud järeldusi. Lisaks sellele, pakkusid intervjuud lisaväärtust pilguheitega potentsiaalsetesse investeerimisotsustesse/suundadesse lähitulevikus. Fondijuhid vihjasid, et tõusvate intressimääradest tulenevalt võib oodata rohkem võlakirja- ja finantssektori investeeringuid ning vastukaaluks inflatsioonile uusi investeeringuid energiasektorisse.

Intervjuud ja raportite analüüs osaliselt toetasid varasema kirjanduse põhjal püstitatud hüpoteese töö teoreetilises osas, kuid mitte kõik hüpoteesid ei leidund kinnitust. Teema edasiseks uurimiseks soovitab autor raportite analüüsi kaasata meetodi, mis võimaldab ka indeksfondide investeeringute sektoraalset ja regionaalset osakaalu arvesse võtta ning anda laialdasemaid analüüsitulemusi.

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9/05/2023