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Asset Allocation of Czech Third Pillar Pension System compared to Finnish Autonomous Funds and long-term Effect on Investment Returns

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Declaration:

I hereby declare, that I have written this master thesis on topic **"Asset Allocation of Czech Third Pillar Pension System compared to Finnish Autonomous Funds and long-term Effect on Investment Returns"** by myself and referenced all used literature and other sources in the attached list at the end of this work.

In Prague on 28th May 2014 Martin Vandas

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Anotace:

Diplomová práce se zabývá analýzou alokace aktiv třetího pilíře Českého penzijního systému a jejich investiční výnosnosti v porovnání s penzijním systémem Finska. První část práce detailně analyzuje Český penzijní systém a jeho základní parametry, zejména regulatorní limity vztahující se k alokaci aktiv, vše s ohledem na reformu penzijního systému účinnou od 1. ledna 2013. Druhá část práce poskytuje srovnatelná data a informace k Finskému penzijnímu systému a dotváří tak kvalitativní porovnání obou zemí. Pro potvrzení kvalitativní analýzy a dojmů nabitých při prvním pohledu na dostupná data je v poslední části práce aplikováno několik statistických modelů hodnotících investiční výkonnost penzijních fondů za období od roku 2002 do roku 2012. Ve stejném období je také zkoumán vliv alokace aktiv v systému na jeho celkovou výnosnost.

Klíčová slova:

Penzijní fondy, alokace aktiv, regulace investičních limitů, dlouhodobá výnosnost

Annotation:

The diploma thesis provides an analysis of Czech third pillar pension system asset allocation and resulting investment performance compared to pension system in Finland. The first part provides a detailed analysis of pension system in The Czech Republic and its key parameters with focus on investment regulatory limits, all in context of reform of the system effective as of 1st January 2013. The second part of this work provides comparable data and information of Finnish pension system and provides qualitative comparison of both pension systems. To support the qualitative analysis and first sight assessments, the third part of this work forms several statistical models evaluating investment performance of pension funds between years 2002-2012. An impact of individual asset groups to investment returns of both funds is evaluated for the same time period.

Key words:

Pension funds, asset allocation, asset allocation regulative limits, long-term investment performance.

Introduction

Pension funds are in general an important element of securing the social and income stability of those who retire all over the developed world. The currently worsening demographic development in western countries and the growing amount of invested assets in various types of pension instruments invokes an important question, whether the pension systems are capable of fulfilling their obligations on a constant basis.

This work compares the recently reformed Czech pension system, its' regulatory requirements and economic performance with that of the Finnish pension system. While the government in The Czech Republic has just a year ago cancelled the funds' obligation to comply with the so-called black-zero obligatory returns and effectively allowed the funds' managers to consider asset allocation outside of bonds and money-market instruments, the Finnish management companies are obliged to maximize the returns of contributors at an acceptable risk level over a long-term horizon.

The comparison is therefore performed from a dynamic perspective as to where the Czech pension system might be directed, and the advantages and disadvantages of such development. The goal of this work is to provide with key factors affecting asset allocation and consequent investment performance. I shall focus on the economic explanation of the topic, however it will be important to bear in mind that as much as economic factors, the asset allocation, is affected by social and psychological factors.

The first chapter provides an introduction to the Czech pension system and key factors affecting the resulting asset allocation. Special attention is paid to the regulative limits reducing the maximum interests held by pension funds in individual asset groups, regulations of economic loss the funds are allowed to perform and role of banks as (mostly) mother companies of the funds..

The second part compares the gained information with comparable data for the Finnish market and provides interesting significant differences in both systems' approaches. While the investment regulative limits are approximately the same in both countries (a bit more limiting in the case of allocation to shares in Finland), the actual allocation indicates that the funds in The Czech Republic hold one of the least diversified portfolios among all OECD countries. Contrary to that, the Fins already have a developed diversification of their assets through different asset groups both, domestic and international.

The statistical measurement of investment returns provided in chapter three over the period of the last 12 years presented in the last part of this work shows that even though the Finnish

pension system is achieving higher investment returns in the long-term, the volatility invoked by the returns is several times higher than that in the case of Czech funds. A simple Sharpe ratio is calculated to provide a firstlook at the return/risk performance of both systems accompanied with the calculation of Jensen's alpha measuring the ability of the pension funds' managers to provide their contributors with higher returns than the accepted risk.

The final statistical model aims to provide an explanation of how individual asset groups (shares, bonds, money-market instruments or real-estate investments) contribute to the resulting investment returns.

Introduction to pension systems

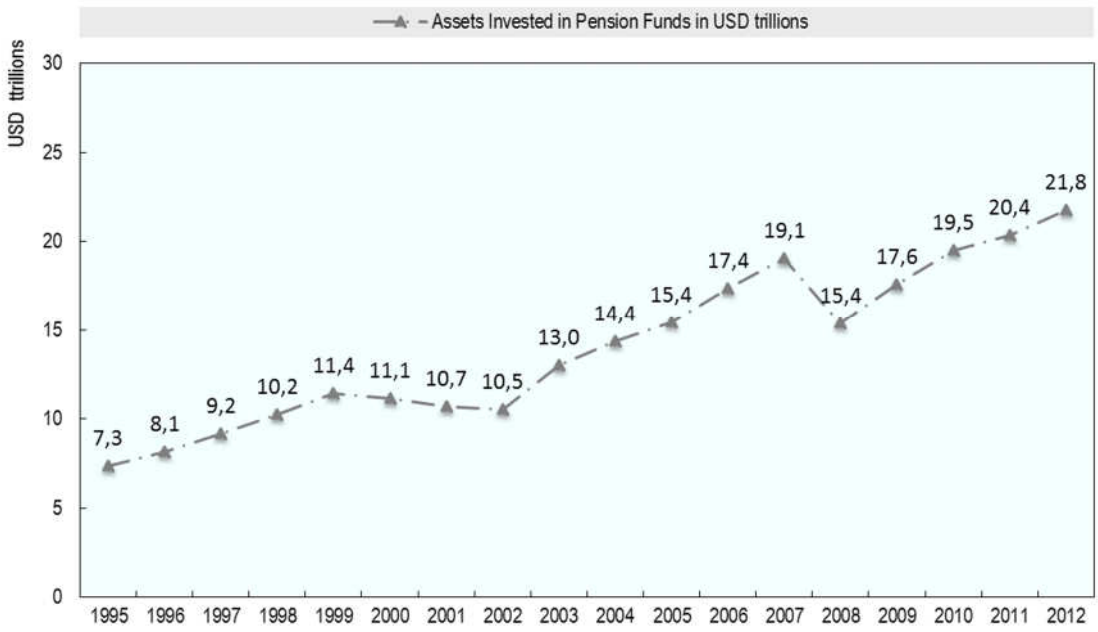
Pension systems were created to cover financial needs of economically inactive population, being usually formed by both, public and private pension plans – usually in cooperative combination. Various studies show that private pension plans will play an important role in solutions of various demographic problems.

"In 2012, private pension systems in the OECD accumulated USD32.1 trillion, comprising pension funds USD21.8 trillion (67.9%), banks and investment companies (18.5%), insurance companies (12.8%) and employers´ book reserves (0.8%)"[1]. Pension funds also play an important role on the market of institutional investors overall with 28% of the market share.

The value of allocated assets in pension funds overall has been constantly growing (not considering year 2008), in 2011 the assets allocated solely in pension funds in OECD countries were worth USD20.6 trillion representing on average 73.8% of GDP of the respective countries.

Graph 1: Total Assets Invested in Pension Funds in OECD countries (in USD trillions) in years 1995-2012

1 Pension Markets in Focus: 2013 [online]. 2013 [quoted 2014-02-24], page 7 Available at: http://www.oecd.org/pensions/PensionMarketsInFocus2013.pdf.



Data source: Pension Markets in Focus: 2013 [online]. 2013. Available at: http://www.oecd.org/pensions/PensionMarketsInFocus2013.pdf. Authors' adjustments.

The Czech Republic pension system solely accumulated assets worth USD14,019m representing 6.5% of the countrys´ GDP, ranking the country as having the 13th lowest asset value per GDP indicator of 34 OECD countries where data are available.[2]

Pension systems in general are defined under variety of options reflecting the intensity of state involvement, portion of risk carried by an individual contributor, form of participation or funds management. Such characteristics define the resulting asset allocation in the pension system, this chapter shall therefore define the basic characteristics of the systems.

Pension Plan Types

Pension plan types differ by the characteristics of pension contributions and security of paid-off benefits. There are two major types of pension funds: (i) defined contribution plan, (ii) defined benefit plan[3].

In OECD classification and glossary the defined benefit plans (in all its forms) form a group of so called occupational plans and defined contribution plans can be included either in the group of occupational plans or personal pension plans.

2 Based on data available at: OECD (2013), Pensions at a Glance 2013: OECD and G20 Indicators, OECD Publishing. Available at: http://dx.doi.org/10.1787/pension_glance-2013-en, page 195. Ranking was calculated by author of this thesis.

3 The design of individual systems differ in each country, there are therefore also combined systems of the above mentioned – so called hybrid systems, or systems based on contributions in a form of stocks provided by employer based on years of employment with the company or its profits. Source: MUSÍLEK, Petr. Trhy cenných papírů. 2., aktualiz. a rozš. vyd. Praha: Ekopress, 2011, 520 s. ISBN 978-80-86929-70-5.

Occupational pension plans are defined as plans linked to an employment or professional relationship between the plan member and the entity that establishes the plan, whether it is an employer, association or union. Contrary to occupational plans the personal pension plans are not linked to a professional relationship and are contributors are fully independent to choose from any of the competitors placing his product on the pension market[4].

It is important to note that in some countries (The Czech Republic including), the pension system is separated to more than just one pillar, where each may be organized in a different form.

Defined Contribution Plan

Pension fund with defined contribution is a system where the contributor accumulates the assets in predefined contributions, usually on individual account opened with the pension fund company. The value of accumulated wealth at the end of pension agreement is evidenced as the sum of contributions plus potential (not secured) return. The investment risk is therefore carried by the individual contributors.

The system is not linked to an employment relationship, the plans are founded by private usually financial institutions. Nevertheless employers are allowed to contribute to the personal accounts of their employees as a form of benefit. In The Czech Republic such contributions are considered up to some limits as taxable costs.

In the pure version of this system, the resulting wealth is tight with ability of the chosen fund manager to secure the desired return of invested assets. This system is currently setup in The Czech Republic after the Pension reform came effective on 1st January 2013 (as described later). Prior to the reform the Czech pension system was also institutionally organized as with defined contribution plan, however the regulation limited returns of contributors to a minimum of a zero – so called Black-zero System. It will be shown in the following chapters how such regulation limited the decision making of the fund asset managers.

Disadvantage of such systems are negative potential incomes to the contributors which can significantly influence the final value of accumulated wealth, especially in cases when the market drops down just before the pension agreement is terminated. For this reason the asset allocation and returns tend to be tightly limited by the regulation as it shall be shown in the following sections.

4 Information source: Private pensions: OECD classification and glossary = Les pensions privées : classification et glossaire de l'OCDE [online]. Paris, France, c2005, 102 p. ISBN 978-926-4016-996.

Defined Benefit Plan

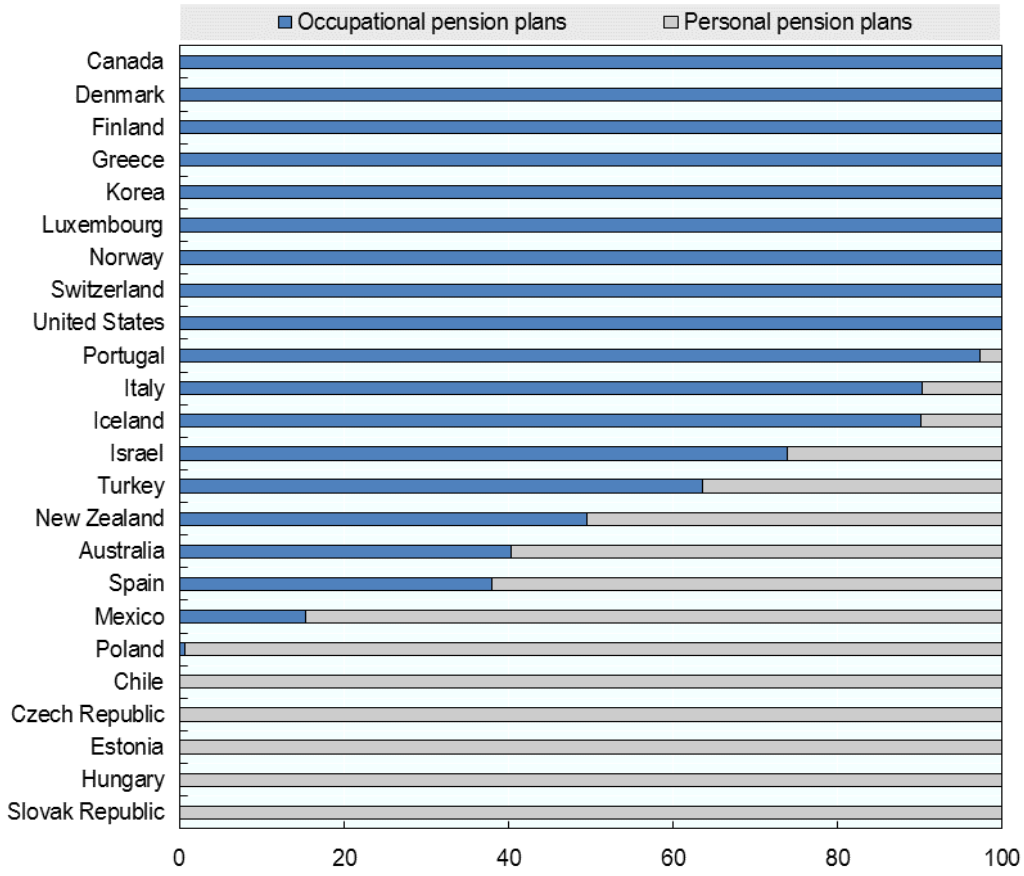
The defined benefit plan is an opposite to the defined contribution plan. At the beginning of the pension agreement the contributor and the pension fund define an accurate required benefit to be benefitted to the contributor. In the same moments the parties agree on the regular (monthly, quarterly or annual) contribution to be paid by the contributor during the life-time of the contract.

The investment risk is therefore carried by the pension fund, not the contributor as in the case of defined contribution plan. Age of contributor, his health and expected life-length are calculated by the pension fund to evaluate the requested regular contribution. Such pension funds in their structure and calculations close to pension/retirement insurance contracts.

The advantage of defined benefit plans is that the investment risk is carried by the pension fund that is more likely to be able to afford paying consultants and specialists to assess the investment decisions. The disadvantages are that the contracts are problematic to evaluated during its' life-time and therefore their transfer to a different pension fund might be problematic.

The defined benefit plans tend to be used in a form, where employer of the contributor is providing the contribution based on year of employment and the fund is kept and managed by the employer (or a company in the same group). There is a risk that the asset allocation in such portfolio is focused on buying stocks within the same group and in case the group goes bankrupt, the employee loses both – secured current income and pension plans.

Graph 2: Pension Funds' Assets by Pension Plan Type in Selected OECD Countries



Source: Pension Markets in Focus: 2013 [online]. 2013, page 21. Available at: http://www.oecd.org/pensions/PensionMarketsInFocus2013.pdf .
Note that the data relate to 2012 apart from Spain and Mexico relating to June 2012 and New Zealand and Australia relating to 2011[5].

Specifics of the pension funds structure have a serious impact on the final asset allocation in the fund. If regulation was not involved, the defined benefit plan would lead to more aggressive asset allocation due to the fact, that any excessive return of the portfolio would be accounted as the funds' income.

Financing of Pension Systems

Pension systems operations are based on long-term allocating of assets invested by the contributors and then based on individual conditions set in pension plans' conditions providing pension payments. Definition of the pension payments shall be omitted in this paper as its impact on the final asset allocation and pension funds' performance is limited if any at all. Nevertheless the sources of such payments can be of two types, either invested funds of other contributors under the pay-as-you-go (later only "PAYGO") system or a system based on creating individual accounts (or funds) for each individual contributor of the system.

[5] Pension Markets in Focus: 2013 [online]. 2013, page 21. Available at: http://www.oecd.org/pensions/PensionMarketsInFocus2013.pdf

In OECD glossary the PAYGO system is defined as "Unfunded pension plans"[6] and its' main difference against Funded pension system is the approach to current benefit payouts. In PAYGO systems these are distributed from the current contributors' payments and the systems don't create any individual funds. The systems therefore create less reserves and are involved in less long-term investing than the opposite Funded pension plans.

The Funded pension plans create individual funds for its contributors. Most of the pension funds however account the liability against contributors in the exact time when the contributors are exiting the plan. Nevertheless the pension plans tend to be much more involved in long-term investing than the PAYGO systems.

[6] Private pensions: OECD classification and glossary = Les pensions privées : classification et glossaire de l'OCDE [online]. Paris, France, c2005, 102 p. ISBN 978-926-4016-996. Available at: http://www.oecd.org/finance/private-pensions/2496718.pdf

Czech Pension Scheme (third pillar)

Czech pension system consisted of two parts: (i) public pension scheme and (ii) private voluntary scheme. The public pension scheme is a PAYGO scheme based on a basic benefit plus benefit linked to average earnings over life-time of the contributor. There is no active asset allocation in the Czech public pension system, therefore the further pages shall focus on the third pillar – private voluntary system formed by private pension funds.

The system was reformed effective as of 1st January 2013 (as described in chapter "*Third Pillar Reform, Regulation and Legal Background*") and created a second pillar of pension system which attracted only few tens of thousands contributors and as from the share on the whole market is not worth mentioning in the latter parts of this work (partly due to the fact that the current government as of May 2014 is considering of cancelling the second pillar). As such this chapter will analyze pension third pillar in both of the settings, before and after the reform.

After the reform of Czech pension system, the number of Transformed Funds was reduced by one totaling 8 at the end of 2013. The current shareholders' structure is indicated in the following table.

Table 1: Tranformed Funds as of 31st December 2013

	Tranformed Fund	Shareholders structure above 10 %	Number of Active Participants	Accumulated Participants' Contributions (in CZK millions)
1	**AEGON PS**	Conseq Investment Management, a.s.	98 325	5 296
2	**ALLIANZ PS**	Allianz pojišťovna, a.s.	479 472	24 831
3	**AXA PS**	Societe Beaujon	412 568	33 410
4	**ČS PS**	Česká spořitelna, a.s.	994 144	50 151,75
5	**ČSOB PS**	Československá obchodní banka, a. s. 100%	683 944	32 471
6	**ING PS**	ING CONTINENTAL EUROPE HOLDINGS B.V.	386 940	27 378
7	**KB PS**	Komerční banka, a.s. - 100%	537 270	35 765
8	**PS ČP**	CP Strategic Investments - 100%	1 277 511	71 385
	Total		**4 870 174**	**280 688**

Data source: Ekonomické ukazatele v r. 2013 - 4. čtvrtletí. In: Ekonomické ukazatele penzijních fondů APF za rok 2013 [online]. Asociace penzijních společností České republiky, 2013 [quoted 2014-03-01]. Available at: http://www.apfcr.cz/cs/vybrane-ekonomicke-ukazatele/ekonomicke-ukazatele-penzijnich-fondu-apf-cr-za-rok-2013.html. Authors' summary.

The traditional Czech financial institutions took majority of the market share (Pension fund by Česká Pojišťovna, a.s. or Pension fund by Česká Spořitelna, a.s. with over 20% market share each being followed by ČSOB PF Stabilita, a.s and Pension fund by Komerční banka, a.s. both exceeding 10% market share). This information will be important later when considering the risk of forced equity calls due to the Black-zero system as the mother companies (banks) are strictly controlling such equity call risks.

Besides the above mentioned 8 Transformed funds, the system also includes additional 36 New Funds founded and managed by 10 Pension Companies after 1st January 2013 as a reaction to the reform.

Table 2: Participant Funds Overview as of 31 December 2013

	Pension Company	Participants' Fund	Equity (in CZK millions)	Accumulated Assets
1	AEGON PS	PKF	0,00	0,00
2	AEGON PS	Dynamický ÚF	0,00	0,00
3	ALLIANZ PS	PKF	24,70	24,70
4	ALLIANZ PS	Vyvážený ÚF	14,58	14,58
5	ALLIANZ PS	Dynamický ÚF	10,74	10,74
6	ALLIANZ PS	Účastnický fond Selection	6,91	6,91
7	AXA PS	PKF	42,66	43,74
8	AXA PS	Dluhopisový ÚF	14,56	15,05
9	AXA PS	Smíšený UF	6,36	7,03
10	CONSEQ PS	PKF	0,06	0,06
11	CONSEQ PS	Dluhopisový ÚF	1,31	1,40
12	CONSEQ PS	Státních dluhopisů 2033 ÚF	0,16	0,18
13	CONSEQ PS	Státních dluhopisů 2023 ÚF	0,20	0,21
14	CONSEQ PS	Globální akciový ÚF	4,12	4,34
15	ČS PS	PKF	413,70	427,62
16	ČS PS	Vyvážený ÚF	17,70	18,67
17	ČS PS	Dynamický ÚF	7,80	8,03
18	ČSOB PS	PKF	83,24	86,01
19	ČSOB PS	Vyvážený ÚF	3,08	3,17
20	ČSOB PS	Dynamický ÚF	2,77	2,79
21	ČSOB PS	Garantovaný ÚF	27,00	27,51
22	ING PS	PKF	40,30	40,30
23	ING PS	Penze 2030	2,02	2,02
24	ING PS	Penze 2040	1,79	1,79
25	ING PS	ÚF Světových akcií	5,10	5,10
26	KB PS	PKF	135,73	137,56
27	KB PS	Zajištěný ÚF	5,50	5,53
28	KB PS	Vyvážený ÚF	15,27	15,46
29	KB PS	Dynamický ÚF	15,39	15,60
30	PS ČP	PKF	29,85	30,65
31	PS ČP	Spořicí	255,51	259,60
32	PS ČP	Vyvážený ÚF	41,24	42,16
33	PS ČP	Dynamický ÚF	11,35	11,59
34	Raiffeisen PS	PKF	4,89	5,01
35	Raiffeisen PS	Chráněný ÚF	1,24	1,27
36	Raiffeisen PS	Růstový ÚF	4,00	5,06
	Total		**1 250,85**	**1 281,42**

Data source: Ekonomické ukazatele v r. 2013 - 4. čtvrtletí. In: Ekonomické ukazatele penzijních fondů APF za rok 2013 [online]. Asociace penzijních společností České republiky, 2013. Available at: http://www.apfcr.cz/cs/vybrane-ekonomicke-ukazatele/ekonomicke-ukazatele-penzijnich-fondu-apf-cr-za-rok-2013.html. Authors' summary.

According to relevant data at the end of 2012, the third pillar pension system included 5.150 million participants[7], representing 71.6% of all population at the age between 15-64[8]. It's important to note that any person is eligible to become a contributor to the third pillar pension insurance contract since 18 years old, therefore the group between 15-18 remains uncovered and the real percentage of population covered by the third pillar pension system would be even higher.

In 2013 the number of participants decreased by 189,214 representing decrease of 3.67% on annual basis. More importantly the amount of participants in the new Participants' Funds is only 91,027 as of 31st December 2013. The assets accumulated in them reach CZK1.265bn[9]. In the later parts of this chapter I shall demonstrate the asset allocation in the Transformed funds as of the effectivity day of the reform and the Participants funds asset allocation as of 31st December 2013. Assets in both systems will be allocated similarly.

Prior to that I find important to specify the asset allocation limits on individual assets in both systems and how the reform changed the specifics of such limits.

Third Pillar Reform, Regulation and Legal Background

In the following sub-sections I shall concentrate on acts regulating pension funds´ system and then putting light on the regulation of investments allocations in specific groups of assets.

Historically up to the end of 2012 all pension funds operating in The Czech Republic were regulated by the *Act no.42/1994 Coll. - State-Contributory Supplementary Pension Insurance Act*[10] (later only **"Act 42/1994"**). The Act 42/1994 defined a pension fund as a legal entity, its establishment, requirements concerning Supervisory Board and Board of Directors members, the participant´s payments options and government contributions to them, pension benefit distribution rules, fund´s management and investment rules and regulations. Supervision and regulation over pension funds and all financial institutions has been integrated in CNB since April 2006 by Act No. 57/2006 Coll[11].

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[7] Data source: Vybrane ekonomicke ukazatele. ASOCIACE PENZIJNÍCH SPOLEČNOSTÍ ČESKÉ REPUBLIKY. Asociace penzijních společností ČR [online]. Praha: Asociace penzijních společností ČR, 2009. Available at: http://www.apfcr.cz/cs/vybrane-ekonomicke-ukazatele/, data for 2012.

[8] According to Czech Statistical Office data available from: http://www.czso.cz/csu/redakce.nsf/i/cr_od_roku_1989#01, Tab.01.01.

[9] Information source: KANTOR, Milan. Komentář Asociace penzijních společností ČR k vybraným obchodním a ekonomickým výsledkům za 4. čtvrtletí 2013. In: *Komentář k výsledkům za rok 2013* [online]. 2013 [quoted 2014-03-01]. Available at http://www.apfcr.cz/cs/komentare-dane/komentar-k-vysledkum-za-rok-2013.html

[10] The full document in its electronic English translation is available at: http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/en/legislation/acts/download/act_42_1994.pdf

[11] Integrace dohledu nad finančním trhem - praktické informace - Česká národní banka. *Česká národní banka* [online]. 2003 - 2013 [quoted 2013-04-06]. Available from: http://www.cnb.cz/cs/verejnost/pro_media/tiskove_zpravy_cnb/2006/060328_integrace_prakt_info.html

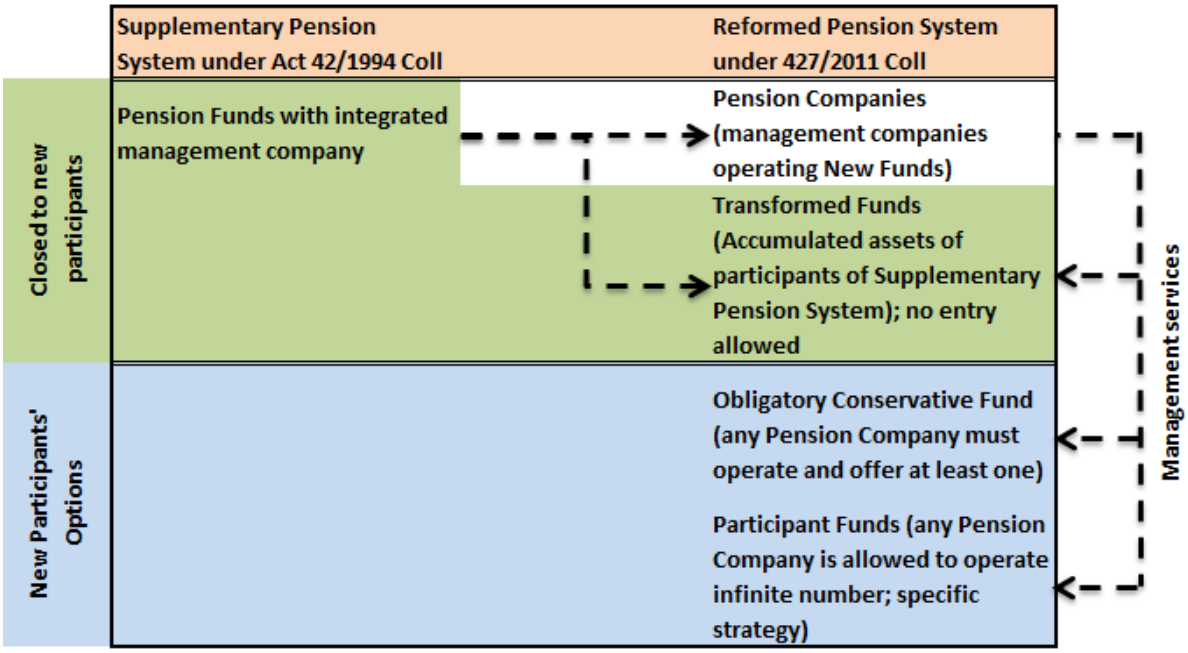
The whole system of pension funds was reformed in 2013 by *Act No. 427/2011 Coll. Supplementary Pension Insurance Act*[12] effective since 1st January 2013 (except for minor paragraphs). One of the major changes in the logical and legal structure of the system is that after the reform, pension funds are separated from their management companies in material perspective. In other way the funds´ accounting, assets and liabilities of participants are separated from accounting, assets and liabilities of the management companies.

As a result the management companies (later as **"Pension Companies"**) can found one or more private pension funds under one brand with one – Obligatory Conservative Fund – being always obligatory, while the other funds are complementary and their formation and strategy is fully on consideration of the management company. The complementary funds are called Participants' Funds.

The funds that were founded under the Old Pension System have been transformed to the New Pension System including their key characteristics and all assets and shall be further called as Transformed Funds. Any individual participant can decide whether he or she wants his/her accumulated assets to be managed under the regime of Transformed Fund or one of the new form of New Funds.

For better understanding see the following graph showing the differences between legal and operation structure between both of the systems.

Graph 3: Summary of Czech Pension Third Pillar before and after the Reform



[12] The full document in its electronic version is available at: http://business.center.cz/business/pravo/zakony/doplnkove-penzijni-sporeni/

Source: Authors' summary based on analysis of Act 42/1994 Coll. and Act 427/2011 Coll.

The Black-zero System

There is one main difference between the two regimes concerning profit/loss distribution. The funds formed under the Act 42/1994 Coll. are obliged to secure the value of invested funds. If the fund recorded a loss it had to utilize its retained earnings from previous years or in extreme cases contributed the loss from shareholders´ equity[13]. The same applied to returns assigned to participants in case the fund had no real returns from its investments[14].

As a result of this regulation the funds´ strategies were strictly conservative to avoid equity contributions (unless specifically desired for marketing purposes as in case of AEGON) and the funds also recorded respective low performance. According to Mr. Hoffmann from Amundia Investment management company managing Penzijní fond Komerční banka, a.s. the strategies were also strictly controlled and evaluated by risk departments of the mother companies of the pension funds. For this rule the system is also called as a "Black-zero System" as the funds profitability usually reached between 0-2% (more about funds historic profitability is specified in Section "Pension Funds' Returns").

The Black-zero System was also transformed to the Transformed Funds regulations under the New system as defined in Act 427/2011 Chapter 13, Section II, §187, but not into the regulations of the New Funds.

Regulative Limits on Individual Asset Classes

As mentioned before the pension funds are strictly regulated to avoid a situation where the individuals would lose their retirement savings. Such regulation includes not only the Black-zero System, but also limitations on individual asset groups reflecting to the final asset allocation. This chapter is devoted to such limits as well as economic consequences of them.

Transformed funds

The Pension Company is according to Section 187 Act 427/2011 obliged to keep the value of invested funds at least on the same level as is its´ nominal value invested by the individual contributor plus the state contributions. This limitation is taken from the Old Pension System which has been closed to new contributors since 30th November 2012. All contributors can

[13] The Czech Republic. Act No. 42/1994 Coll. - State-Contributory Supplementary Pension Insurance Act: on state-contributory supplementary pension insurance and amending certain acts related to its introduction, as amended. 1994, Number 42, 14 Available at: https://www.cnb.cz/miranda2/export/sites/www.cnb.cz/en/legislation/acts/download/act_42_1994.pdf

[14] AEGON penzijni fond, a.s. can be set as an example of such equity contributions assigned to participants after it has entered the market in 2007.

complementarily choose to stay in the Transformed fund or transfer their funds in one of the offered New Funds.

The limitations of investments into individual asset groups are defined under Section 193 of Act 427/2011 referring to Act 42/1994, where the limitations are defined under Sections 33-34. The rules have been examined by OECD survey[15] presented in August 2012 (applicable to December 2011). The regulation defines (i) the quality of investment instruments the funds can invest in (under Section 33 of the Act 427/2011) and (ii) the quantitative limitations of investing within one asset group and limitations within one ownership concern (under Section 34 of the Act 427/2011). The following table summarizes both above mentioned streams of the regulation:

Table 3: Investment Limitations of Transformed Funds

Country	Equity	Real Estate	Bonds	Retail Investment Funds	Private Investment funds	Loans	Bank deposits
Czech Republic	- 70% for equity traded on OECD regulated markets (a common overall limit for securities traded on OECD markets, open-ended mutual funds, movable assets and real estate) (Non-OECD equity can be included in 5% limit for other assets). Min 50% of assets shall be denominated in the currency of the pension funds liabilities to the participants of the scheme	- 10%	- No limit (if issued or guaranteed by OECD member state or its central bank or EIB). EBRD, IBRD or other international financial institution where the Czech Republic is a member. 70% if other than above and traded on OECD regulated markets. In other cases, bonds can be included in 5% limit for other assets. -Min 50% of assets shall be denominated in the currency of the pension funds liabilities to the participants of the scheme	- 70% if open-ended (also see the information in the first column).	- If traded on OECD regulated markets: 70%, if not, they can be included in 5% limit for other assets (also see the information in the first column).	- 0% (not supported)	- Only OECD banks deposits and deposits certificate are allowed. Max 10% for deposits at an individual bank or an equivalent of 20 mil CZK.

Source: *SURVEY OF INVESTMENT REGULATION OF PENSION FUNDS: AUGUST 2012* [online]. OECD, 2012. Available at: http://www.oecd.org/daf/fin/private-pensions/2011SurveyOfInvestmentRegulationsOfPensionFunds.pdf.

Note that the Real Estate investing is limited to 10%, but as it will be examined later, the funds do not invest in Real Estate almost at all (besides AXA Penzijni fond before the transformation). Also see that the funds are forced to invest at least half of their asset value in instruments denominated in the currency it accepts contributions from the participants. There could be an eligible doubt raised whether the market with stocks and equity instruments in CZK is developed enough to provide the funds with sufficient investment opportunities.

[15] *SURVEY OF INVESTMENT REGULATION OF PENSION FUNDS: AUGUST 2012* [online]. OECD, 2012. Available at: http://www.oecd.org/daf/fin/private-pensions/2011SurveyOfInvestmentRegulationsOfPensionFunds.pdf.

Obligatory Conservative Fund

The Obligatory Conservative Fund has strict asset allocation rules set in Section 98 of the Act 427/2011 practically limiting the asset allocation to Czech national bonds or money market products with potentially small portion of corporate bonds of investment graded corporations. Every Pension Company who wants to operate an unlimited number of Pension Funds is obliged to operate at least one separate Obligatory Conservative Fund and automatically offer such fund to its clients[16]. The investment limitations of such fund are as follows:

Table 4: Investment Limitations of Obligatory Conservative Funds

Country	Equity	Real Estate	Bonds	Retail Investment Funds	Private Investment funds	Loans	Bank deposits
Czech Republic A – voluntary conservative scheme (3rd pillar)	not allowed	not allowed	a) EU and OECD and OECD member states bonds and MMI with qualified rating; b) Bonds of international institutions with membership of CR; c) other bonds and MMI with qualified rating Portfolio limits 35% -100%; Concentration limits 5-35%	Money market funds with qualified rating Portfolio limit 30 %; Concentration limit 10%.	not allowed	not allowed	Max 2 years deposits; regulated banks Concentration limit 10%

Source: OECD. Annual Survey of Investment Regulation of Pension Funds: 2013. OECD, 2013, 130 pages. Available at: http://www.oecd.org/finance/private-pensions/annualsurveyofinvestmentregulationofpensionfunds.htm
Note that OECD calls the Obligatory Pension Funds as "voluntary". The discrepancy between OECD and this thesis is caused by the fact, that such funds are voluntary for the contributors, but their foundation is obligatory for the Pension Companies.

As it can be seen from the table, the Obligatory Conservative Fund has strictly limited options of investment opportunities concerning only bonds and money market investments. It is also appropriate to note that the Pension Company is not required to guarantee a positive level of return for the Obligatory Conservative Fund and as such the investment risk is fully carried by the participant.

Participant Fund

The Pension Companies are according to Act 427/2011 allowed to found an infinite number of Participant Funds (after foundation of at least one Obligatory Conservative Fund). The regulation of investments to such funds is less strict than to the Obligatory Conservative Fund and the Pension Company also does not have to guarantee the level of return which as in the case of the Obligatory Conservative Fund can reach a negative level. The regulation for investments of the Participants´ Fund is defined in Sections 99-108 of the Act 427/2011 as follows:

Table 5: Investment Limitations of Participant Funds

[16] As defined under Section 94 of the Act 427/2011.

Country	Equity	Real Estate	Bonds	Retail Investment Funds	Private Investment funds	Loans	Bank deposits
Czech Republic B – other voluntary schemes (3rd pillar)	equity traded on regulated market or MTF verified by CNB. Concentration limit 5%	not allowed	bonds traded on EU regulated market or EU MTF verified by CNB.	UCITS and non-UCITS funds authorized to be publically offered in the CR. Portfolio limit 35%; 5% for non-UCITS. Concentration limit 10%.	not allowed	Borrowings up to 6 month. Leverage not allowed. Portolio limit 5%; Granting loans not allowed	Max 2 years deposits; regulated banks Concentration limit 10%

Source: OECD. Annual Survey of Investment Regulation of Pension Funds: 2013. OECD, 2013, page 7/130. Available at: http://www.oecd.org/finance/private-pensions/annualsurveyofinvestmentregulationofpensionfunds.htm

Note that the Equity, Bonds and Money market instruments must comply with the following definition: "The asset is traded on European regulated market of a Member state or a non-member state if such a state is listed in a specific list evidenced by Czech National Bank"[17]. Interestingly no real estate investments are allowed to the Participants' Funds.

Moreover according to Section 107 of the Act 427/2011 the New Funds can deviate from the above mentioned limits, if mentioned in the statute of the fund. In a limited time of 24 months from issuance of the approval of the funds operations or until the asset value reaches CZK100,000,000.

Czech third Pillar Funds' Asset Allocation

The key difference between Transformed Funds and New Funds are strict asset allocation rules and the Black-zero System applied in the regulation for Transformed Funds. This subchapter shall show the diversification of pension funds in The Czech Republic in both, the New Pension System and the Old Pension system compared to other countries and analyze how much the funds use their opportunities to invest within individual asset groups. The goal is to compare the regulation limits with reality and – potentially – analyze the discrepancies.

Transformed Funds

It is clear from the first view over the pension funds' asset distribution (below) that all of the Transformed pension funds are strictly conservative keeping with long-term tradition of bonds-money market portfolio mix:

Table 6: Transformed Funds' Asset Allocation as of 31.12.2013 in CZK millions

[17] The Czech Republic. Act No. 427/2011 Coll. on Supplementary Pension Savings. In: *427/2011*. 2011, no. 427, 149. Section 100. Available at: http://www.cnb.cz/en/supervision_financial_market/legislation/pension_funds/national_legislation.html

	Tranformed Fund	Number of Active Participants	Accumulated Participants' Contributions	Assets of Transformed Funds in CZK millions																			
				Total Accumulated Assets	Bank and Term Accounts	%	Money market instruments (CZK)	%	Czech National Bonds	%	Bonds OECD countries + IFS	%	Other Bonds	%	Shares incl. Investment Funds Shares	%	Other Mutual Funds	%	Real Estate Properties	%	Other Assets	%
1	AEGON PS	98 325	5 296	5 501	136	2,50	498	9,00	4 024	73,20	82	1,50	725	13,20	0	0,00	0	0,00	0	0,00	35	0,60
2	ALLIANZ PS	479 472	24 831	25 893	940	3,63	0	0,00	21 347	82,44	42	0,16	2 932	11,32	0	0,00	632	2,44	0	0,00	0	0,00
3	AXA PS	412 568	33 410	34 573	3 080	8,91	0	0,00	24 072	69,63	2 446	7,08	1 651	4,77	1 387	4,01	0	0,00	1 656	4,79	280	0,81
4	ČS PS	994 144	50 152	51 204	1 099	2,15	18 698	36,52	22 481	43,90	2 033	3,97	5 960	11,64	0	0,00	498	0,97	0	0,00	435	0,85
5	ČSOB PS	683 944	32 471	34 614	359	1,04	0	0,00	28 556	82,50	619	1,79	4 785	13,82	80	0,23	0	0,00	0	0,00	215	0,62
6	ING PS	386 940	27 378	28 227	1 891	6,70	0	0,00	22 975	81,39	147	0,52	2 994	10,61	0	0,00	0	0,00	0	0,00	221	0,78
7	KB PS	537 270	35 765	38 427	1 550	4,03	0	0,00	28 533	74,25	797	2,07	7 335	19,09	0	0,00	0	0,00	0	0,00	212	0,55
8	PS ČP	1 277 511	71 385	77 351	2 240	2,90	210	0,27	55 159	71,31	2 051	2,65	14 852	19,20	2 057	2,66	0	0,00	0	0,00	781	0,01
	Total	**4 870 174**	**280 688**	**295 790**	**11 296**	**3,8**	**19 406**	**6,6**	**207 147**	**70,0**	**8 217**	**2,8**	**41 234**	**13,9**	**3 525**	**1,2**	**1 130**	**0,4**	**1 656**	**0,6**	**2 180**	**0,7**

Data source: Ekonomické ukazatele v r. 2013 - 4. čtvrtletí. In: Ekonomické ukazatele penzijních fondů APF za rok 2013 [online]. Asociace penzijních společností České republiky, 2013 [quoted 2014-03-01]. Available at: http://www.apfcr.cz/cs/vybrane-ekonomicke-ukazatele/ekonomicke-ukazatele-penzijnich-fondu-apf-cr-za-rok-2013.html. Authors' summary.

Note: Asset group Money market instruments issued by OECD member states or international financial institutions as well as other money market instruments were omitted from the summary as no assets were invested in them.

Few important facts can be read from the table presented above referring to the asset allocation in Transformed Funds:

(i) Pension funds invest 86.8% of all available assets in debt instruments (debentures mainly represented by Bonds and Treasury Bills). This represents 91.4% of all Funds credited to the participants and 86.75% of all accumulated assets in the respective pension funds. Most of assets invested in bonds are invested in Czech National bonds (80.7%) with limited share of financial institutions' bonds and bonds of other OECD countries (3.2%) and other bonds representing mainly corporate bonds (exclusive financial institution bonds) amounting to 16.1%.

(ii) Another 3.8% of the assets is invested in Cash in banks and term deposits and 6.6% in money market instruments with the nominal currency being Czech crown.

(iii) These two groups ((i) + (ii)) of conservative investments therefore represent up to 97.1% of all assets in the funds and exceed the amount of funds credited byt the participants over nearly 2.36%

(iv) It can already be implicated from points (i) – (iii) that investments to shares and real estate in the portfolios is negligible[18]. AXA PF is the most aggressive fund (if classic theorems in the meaning that shares are riskier than bonds are relevant) with 4.01% invested in shares. AXA PF is also the only pension fund, who has invested in real estate amounting to 4.79% of portfolio value. AXA PF in its final audited accounting

[18] 5 pension funds had no active investments in shares at all and the assets allocated to shares in ČSOB PS were practically mitigant with its 0.23% share on the total portfolio value.

statements indicates that the properties are valued by an external valuator and include the value of underlying land plots[19].

The results however show only a static allocation as of 31.12.2013. To explore whether the asset allocation is so conservative in the long-term, the following table indicates asset allocation of pension funds in years 2000-2012.

Table 7: Long-term Asset Allocation within Individual Asset Groups in Czech Third Pillar Pension System (2000-2012)

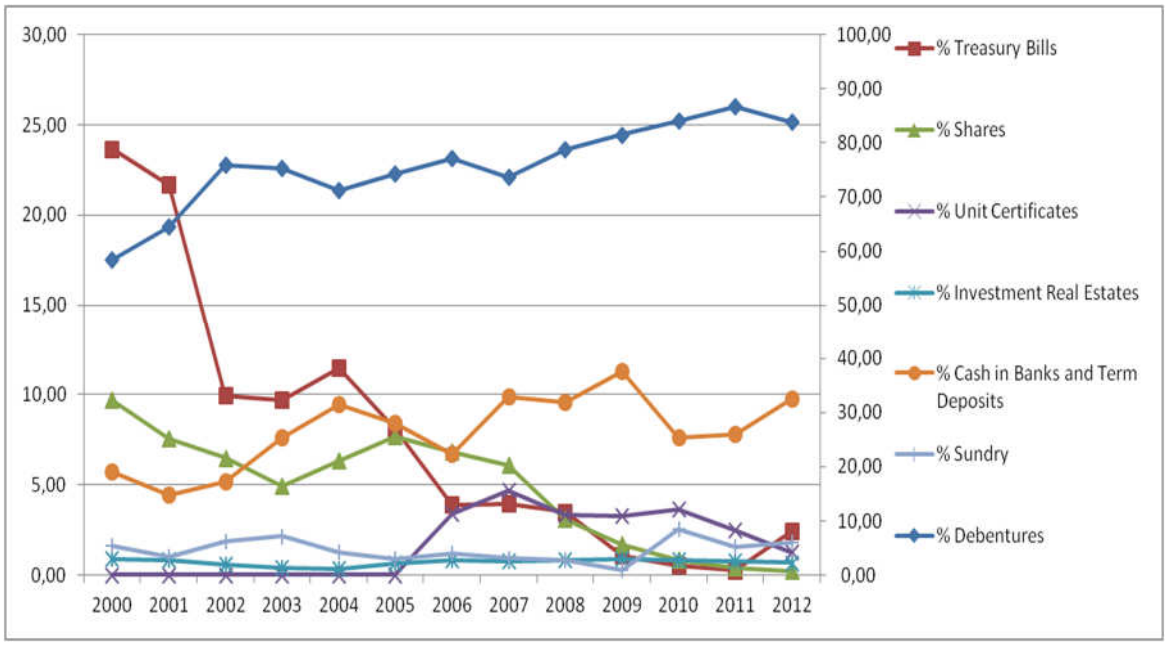
Year	Number of active participants	Funds credited to the participants	Total Assets	Total debentures	%	Treasury bills	%	Shares	%	Unit certificates	%	Investment Real Estate	%	Cash in bank and term deposits	%	Sundry *)	%
2000	2 372 289	40 052	41 705	24 355	58,40	9 869	23,66	4 052	9,72		0,00	369	0,88	2 388	5,73	672	1,61
2001	2 508 264	50 400	52 317	33 749	64,51	11 337	21,67	3 945	7,54		0,00	428	0,82	2 327	4,45	531	1,01
2002	2 597 364	63 424	67 122	50 925	75,87	6 686	9,96	4 351	6,48		0,00	408	0,61	3 483	5,19	1 270	1,89
2003	2 661 362	76 783	80 202	60 330	75,22	7 781	9,70	3 932	4,90		0,00	324	0,40	6 115	7,62	1 721	2,15
2004	2 949 688	93 826	99 706	70 962	71,17	11 421	11,45	6 331	6,35		0,00	320	0,32	9 431	9,46	1 242	1,25
2005	3 284 430	112 646	120 347	89 412	74,29	9 744	8,10	9 231	7,67		0,00	748	0,62	10 132	8,42	1 081	0,90
2006	3 610 920	136 136	142 531	109 969	77,15	5 542	3,89	9 735	6,83	4 819	3,38	1 215	0,85	9 516	6,68	1 735	1,22
2007	3 962 098	162 104	162 053	119 498	73,74	6 400	3,95	9 898	6,11	7 575	4,67	1 211	0,75	15 978	9,86	1 493	0,92
2008	4 295 603	186 119	183 883	144 908	78,80	6 413	3,49	5 731	3,12	6 162	3,35	1 528	0,83	17 568	9,55	1 573	0,86
2009	4 470 178	200 220	210 370	171 520	81,53	2 255	1,07	3 490	1,66	6 916	3,29	1 911	0,91	23 741	11,29	537	0,26
2010	4 595 342	216 112	232 402	195 256	84,02	1 186	0,51	1 906	0,82	8 504	3,66	1 870	0,80	17 729	7,63	5 952	2,56
2011	4 599 209	232 052	246 297	213 600	86,72	612	0,25	1 026	0,42	6 166	2,50	1 854	0,75	19 238	7,81	3 802	1,54
2012	5 150 415	246 594	273 263	229 344	83,93	6 562	2,40	581	0,21	3 367	1,23	1 851	0,68	26 660	9,76	4 897	1,79

*Soundry represents other investment vehicles (ie loans). Note that in 2013 the asset group and its reporting has slightly changed and therefore the data contain only comparable period of 2000 – 2012.
Data source: Vybrane ekonomicke ukazatele. ASOCIACE PENZIJNÍCH SPOLEČNOSTÍ ČESKÉ REPUBLIKY. Asociace penzijních společností ČR [online]. Praha: Asociace penzijních společností ČR, 2009. Available at: http://www.apfcr.cz/cs/vybrane-ekonomicke-ukazatele/. Authors' summary of data available for 2000 - 2012.

Putting the same data in a graph shows the decreasing trend of Equity (shares) in pension funds' portfolios and stable low share of investment real estates. The sum of debentures and treasury bills also remained stable, while it is important to notice that the while the share of debentures as a long-term product has been constantly growing, the share of treasury bills tend to decreasing by time.

Graph 4: Long-term Trends in Asset Allocation of Czech Third Pillar Pension System (in % of total invested asset value) in years 2000-2012.

[19] *VÝROČNÍ ZPRÁVA 2012 ANNUAL REPORT 2012* [online]. Brno: AXA penzijní fond, a.s., 2013, page 62. Available at: https://www.axa.cz/getattachment/a6e41a6f-73d0-4076-844c-580826f1a4d6/Vyrocni-zprava-2012.aspx/



Note: Data applicable as of 31st December 2012. Percentage shares of Debentures (marked with dark blue curve) are linked to the right vertical axis values, percentage shares of all other asset groups are linked to the left vertical axis. Data source: Vybrane ekonomicke ukazatele. ASOCIACE PENZIJNÍCH SPOLEČNOSTÍ ČESKÉ REPUBLIKY. Asociace penzijních společností ČR [online]. Praha: Asociace penzijních společností ČR, 2009. Available at: http://www.apfcr.cz/cs/vybrane-ekonomicke-ukazatele/. Authors' summary.

Conservative Obligatory Funds and Participant Funds

Since the reform became effective on 1st January 2013, the system of Transformed funds is separated from the New Funds. The following section indicates what the New Funds invested the first accumulated assets in.

Table 8: Asset Allocation in Participant Pension Funds at the end of 2013

			Assets of 3rd pillar funds in CZK millions													
	Pension Company	Participants' Fund	Accumulated Assets	Bank and Term accounts	%	Money Market Instruments (Czech)	%	Czech National Bonds	%	Other Bonds	%	Shares incl. Investment Funds Shares	%	Other Assets	%
1	AEGON	PKF	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2	ALLIANZ	PKF	24,70	24,70	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3	AXA	PKF	43,74	43,74	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
4	CONSEQ	PKF	0,06	0,06	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
5	ČS	PKF	427,62	385,58	90,17	0,00	0,00	35,29	8,25	0,00	0,00	0,00	0,00	6,75	1,58
6	ČSOB	PKF	86,01	86,01	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
7	ING	PKF	40,30	18,02	44,72	16,00	39,69	6,29	15,60	0,00	0,00	0,00	0,00	0,00	0,00
8	KB	PKF	137,56	33,93	24,66	0,00	0,00	103,63	0,00	0,00	0,00	0,00	0,00	0,00	0,00
9	ČP	PKF	30,65	15,21	49,62	0,00	0,00	15,37	50,15	0,00	0,00	0,00	0,00	0,07	0,23
10	Raiffeisen	PKF	5,01	4,93	98,54	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,10	0,00
Subtotal Obligatory Conservative Funds			**795,64**	**612,18**	**76,94**	**16,00**	**2,01**	**160,58**	**20,18**	**0,00**	**0,00**	**0,00**	**0,00**	**6,92**	**0,87**
11	AEGON	Dynamický ÚF	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
12	ALLIANZ	Vyvážený ÚF	14,58	14,58	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
13	ALLIANZ	Dynamický ÚF	10,74	10,74	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
14	ALLIANZ	Účastnický fond Selection	6,91	6,91	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
15	AXA	Dluhopisový ÚF	15,05	15,05	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
16	AXA	Smíšený UF	7,03	7,03	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
17	CONSEQ	Dluhopisový ÚF	1,40	1,39	99,93	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
18	CONSEQ	Státních dluhopisů 2033 ÚF	0,18	0,18	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
19	CONSEQ	Státních dluhopisů 2023 ÚF	0,21	0,21	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
20	CONSEQ	Globální akciový ÚF	4,34	0,69	15,85	0,00	0,00	0,00	0,00	0,00	0,00	3,65	84,15	0,00	0,00
21	ČS	Vyvážený ÚF	18,67	17,07	91,43	0,00	0,00	1,01	5,41	0,00	0,00	0,00	0,00	0,59	3,16
22	ČS	Dynamický ÚF	8,03	7,89	98,26	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,14	1,74
23	ČSOB	Vyvážený ÚF	3,17	3,17	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
24	ČSOB	Dynamický ÚF	2,79	2,79	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
25	ČSOB	Garantovaný ÚF	27,51	27,51	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
26	ING	Penze 2030	2,02	1,20	59,72	0,00	0,00	0,81	40,28	0,00	0,00	0,00	0,00	0,00	0,00
27	ING	Penze 2040	1,79	1,23	68,75	0,00	0,00	0,56	31,25	0,00	0,00	0,00	0,00	0,00	0,00
28	ING	ÚF Světových akcií	5,10	2,60	50,98	2,00	39,20	0,50	9,82	0,00	0,00	0,00	0,00	0,00	0,00
29	KB	Zajištěný ÚF	5,53	5,53	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
30	KB	Vyvážený ÚF	15,46	13,50	87,32	0,00	0,00	1,96	0,00	0,00	0,00	0,00	0,00	0,00	0,00
31	KB	Dynamický ÚF	15,60	10,00	64,10	0,00	0,00	5,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00
32	ČP	Spořicí	259,60	55,86	21,52	0,00	0,00	154,89	59,66	48,33	18,62	0,00	0,00	0,52	0,20
33	ČP	Vyvážený ÚF	42,16	17,50	41,51	0,00	0,00	20,68	49,05	0,00	0,00	3,80	9,01	0,18	0,43
34	ČP	Dynamický ÚF	11,59	6,71	57,89	0,00	0,00	3,10	26,75	0,00	0,00	1,74	15,01	0,04	0,35
35	Raiffeisen	Chráněný ÚF	1,27	1,26	99,21	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
36	Raiffeisen	Růstový ÚF	5,06	1,68	33,10	0,00	0,00	0,00	0,00	0,00	0,00	3,34	0,00	0,00	0,00
Subtotal Participants Funds			**485,78**	**232,28**	**47,82**	**2,00**	**0,41**	**189,11**	**38,93**	**48,33**	**9,95**	**12,54**	**2,58**	**1,48**	**0,30**
Total for all New Funds			**1 281,42**	**844,46**	**65,9**	**17,99**	**1,4**	**349,69**	**27,3**	**48,33**	**3,8**	**12,54**	**1,0**	**8,40**	**0,7**

Data source: Vybrane ekonomicke ukazatele. ASOCIACE PENZIJNÍCH SPOLEČNOSTÍ ČESKÉ REPUBLIKY. Asociace penzijních společností ČR [online]. Praha: Asociace penzijních společností ČR, 2009. Available at: http://www.apfcr.cz/cs/vybrane-ekonomicke-ukazatele. Authors' summary.

Due to limited allocated assets in the funds, the Pension Companies are not able to perform the strategies the funds are designed to invest in. This can be in general read from the majority of funds investing in money-market instruments and waiting until they reach a certain amount of funds (defined in statutes of the individual funds). There are few funds which already started investing in shares, however the value of assets invested is not worth analyzing compared to the value all assets invested in the pension system.

According to Mr. Pavel Hoffman from Amundi group providing asset management services to Komercni banka pension fund, there are three key reasons of nearly no asset diversification in the third pillar of Czech Pension System:

(i) The Black-zero system combined with the accounting regulation forcing funds to re-value their assets regularly to fair value and cover potential accounting losses from equity drawdowns. The system causes that portfolio riskiness is strictly controlled by mother companies of the pension funds and the managers themselves are limited in their decision authorities.

(ii) Pension funds' contributors/participants are extremely sensitive to any potential negative return of their portfolio. Researchers in psychology show that most humans are in general more sensitive to negative return of – say – 1% than a loss of a potential positive return of 1%. Such negative return of one pension fund (even though it would be just because of regular market volatility) might result to a loss of contributors and funds to invest. For this rather psychological pattern the New Funds focusing on more aggressive strategies might be struggling to search for their potential customers.

(iii) As vast majority of the assets invested in third pillar pension funds are remaining on the Transformed Funds with the Black-zero rule (with its effect described in (i)), all the pension funds follow a very similar pattern in their asset allocation. Since there is no pension fund pressuring on the others with its excessive returns to the contributors, the market shall remain focused on bonds and money market instruments until the New Funds take over most of the investment assets in the third pillar.

Accounting Impact to Asset Allocation

On an example of two countries with similar asset allocation restrictions, United Kingdom and Netherlands, Griffin (1998) shows an importance of accounting standards application to the value of funds' assets[20].

The accounting differences were also considered in comparison between Czech and Finnish pension funds, but as none of the system is using any of the two above mentioned accounting

[20] Both of the countries have to comply with a rule that the value of invested funds shall not fall under 100% (similar to Black-zero system in the Czech republic), otherwise the pension plan has to be restored by shareholders and additional shareholders' equity must be injected. While the Dutch plan is potentially threated annually via regular re-valuation of the held assets, the UK plan allows its' managers to take a three-year average in the value of the plans and arrive to the value of instruments as discounted value of planned coupons or dividends. The risk of equity call is therefore higher in Dutch plans than in the UK ones.
Despite similar asset allocation limits, the differences in accounting principles were proven to be the key factor of dramatically different asset allocation.

methods (earnings-smoothing and discounting valuation instead of fair value), this factor will not be tested furthermore[21].

Pension Funds' Returns

After analyzing the asset diversification it can be expected that the returns shall be on the level of annual inflation. The comparison can be found in the following table.

Table 9: Pension Funds' Returns Since 1995

[21] Despite the fact that accounting principles will not be tested furthermore, the author of this works finds it important to mention such factor in case readers desire to compare pension systems in different countries than The Czech Republic and Finland.

The Name of the Pension Fur	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*	Average Annual Return	Respecti ve Annual CPI	Annual Difference
AEGON Penzijní fond, a.s.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	4,50	3,50	2,10	2,11	1,60	2,09	0,026	0,028	-0,16%
Allianz penzijní fond, a.s.	-	-	8,90	9,10	6,00	3,80	4,36	3,71	3,00	3,00	3,00	3,11	3,00	3,00	3,10	3,00	2,69	1,49	0,040	0,028	1,19%
AXA penzijní fond, a.s.	12,80	11,45	11,20	10,10	6,50	4,10	4,25	3,41	3,36	3,10	3,70	2,50	2,20	0,00	2,00	1,47	1,47	1,20	0,046	0,041	0,58%
ČSOB Penzijní fond Progres, a.s.	0,00	16,40	8,00	10,90	7,70	5,62	3,90	4,26	4,30	5,30	5,00	2,30	2,40	0,02	1,00	-	-	-	0,054	0,041	1,32%
ČSOB Penzijní fond Stabilita, a.s.	10,40	10,90	10,30	10,02	6,10	4,20	3,20	3,00	2,30	4,30	4,00	2,80	2,40	0,05	1,37	1,49	1,71	1,79	0,044	0,041	0,35%
Generali penzijní fond, a.s.	10,30	10,61	14,60	11,40	5,30	3,60	4,60	4,10	3,00	3,00	3,81	3,74	4,10	2,00	2,40	2,10	0,30	1,07	0,049	0,041	0,87%
ING Penzijní fond, a.s.	12,80	12,10	11,00	9,34	6,00	4,40	4,80	4,00	4,00	2,50	4,20	3,60	2,50	0,04	0,10	2,10	2,10	1,81	0,048	0,041	0,73%
Penzijní fond České pojišťovny, a.s.	10,30	9,20	9,60	9,72	6,60	4,50	3,80	3,20	3,10	3,50	3,80	3,30	2,40	0,20	1,20	2,00	1,50	2,05	0,044	0,041	0,34%
Penzijní fond České spořitelny, a.s.	4,00	8,10	9,05	8,33	4,40	4,20	3,80	3,50	2,64	3,74	4,03	3,04	3,10	0,40	1,28	2,34	2,07	1,51	0,038	0,041	-0,22%
Penzijní fond Komerční banky, a.s.	9,44	8,36	9,10	9,50	7,20	4,89	4,40	4,63	3,40	3,50	4,00	3,00	2,30	0,58	0,24	2,23	2,00	1,53	0,044	0,041	0,36%

Respective CPI index**	9,14	8,84	8,55	10,76	2,13	3,71	4,70	1,92	0,10	2,72	1,94	2,50	2,83	6,36	1,07	1,41	1,91	3,33

Data source: Vybrané ekonomické ukazatele: APF ČR. ASOCIACE PENZIJNÍCH SPOLEČNOSTÍ ČR. Asociace penzijních společností ČR [online]. 2009, 2014. Available at: http://www.apfcr.cz/cs/vybrane-ekonomicke-ukazatele/ and Český Statistický Úřad ČSÚ [online]. 2013. Available from: http://www.czso.cz/

*The returns were illustrative according to known data about asset returns for the funds and respective fee structure. Source: Zhodnocení penzijních fondů za rok 2012: Žádná sláva. Investujeme.cz [online]. 2013. Available from: http://www.investujeme.cz/zhodnoceni-penzijnich-fondu-za-rok-2012-zadna-slava/

Note: the table presents annual return attributed to the participants of the specific pension funds, not the return the pension funds have gained from allocated assets. The author is also aware, that for the individual participants there are also other profits not included in this table – state contribution which is dependent on the amount of participants´ contribution and indirect income caused by reduction of tax base.

The calculation of Average Annual Return was executed on the principal of geometrical average as well as the respective annual CPI over the lifetime of the specific fund according to the following formula:

Formula 1: Annual return calculation

$$i = \sqrt[n]{(1 + a_1) * (1 + a_i) * \dots * (1 + a_n)}$$

where a defines annual return presented by a fund for a specific year, n defines years of existence of such fund. The red marked cells indicate returns that are lower than the inflation in the respective year. It can be noticed from the table, that:

a) Two out of nine operating pension funds have not even attributed average returns equal to the average of inflation in their lifetime – AEGON PF and pension fund operated by Česká Spořitelna, a.s.;
b) Only two of the pension funds have attributed average returns exceeding the average inflation over their lifetime by more than 1% annually – Allianz pension fund and ČSOB PF Progress (consolidated in ČSOB PF Stabilita in 2011 as a reaction to the prepared novelization); and
c) In 2008 when investment results overall were affected by the financial crisis, the funds themselves mostly lowered the attributed returns to their investors, besides AEGON PF, Allianz PF and Generali PF.

Summary

This chapter was devoted to the legal background of pension funds' investment market, regulation and returns in The Czech Republic. The information will be important in the following parts of this work to understand the differences in comparison to other OECD countries, namely Finland. The outcomes of this part are as follows:

(i) Most of the currently active pension insurance contracts between pension funds and participants are regulated under the system of Transformed Funds which were created before 30th November 2012. In The Czech Republic nearly 5.2 million participants have

such contracts. These Transformed Funds include the so called Black-zero System and their asset allocation is focused on debentures and cash/money market instruments.

(ii) The New Funds founded after the pension system reform are separated within two products. One is Obligatory Conservative Fund with strictly limited investment rules and second is a Participants' Fund for which the regulation is less strict and allows the funds to invest in derivatives and equity investments. Important to note is that both of the New Funds don't have their investments secured by Black-zero System as it was in the Old Pension System, however the assets allocated have so far been minor to the assets invested in the Transformed Funds.

Finnish Pension System compared to Czech Pension System

In this chapter I shall demonstrate the impact of different approach to asset allocation in pension funds in Finland on the portfolio return as well as identify the differences of both of the systems. The goal of this chapter is to set a challenging benchmark and rather ask a question "where The Czech Republic should direct its pension system?" than "how bad could it be?".

The chapter shall first describe the Finnish pension system and economic conditions the system is operating in.

Finnish pension system

There are two tiers (pillars) of pension system in Finland. One is the national basic state pension scheme financed as a pay-as-you-go scheme[22] and the other is a private sector formed by company funds and industry-wide funds and pension insurance companies based on earning-related principle[23].

The national pension scheme is a scheme securing a minimal income for nearly anyone residing in Finland and shall not be the subject of examination in the further parts of this chapter. The earning-related scheme separates into private sector employers and public sector employers, where: "In the private sector, pension security is mostly arranged through insurance contracts. Wage earners in the public sector are not insured through insurance contracts. Their pension security is determined directly based on the fact that wage earners working for certain employers are covered by the pension acts of the public sector"[24].

The earnings-related system also includes self-employed and partners in limited companies. "A self-employed person is responsible for arranging his or her own pension security. Self-employment is insured based on the Self-Employed Person's Pensions Act (YEL)"[25]. There are

[22] OECD (2013), Pensions at a Glance 2013: OECD and G20 Indicators, OECD Publishing, page 249. Available at: http://dx.doi.org/10.1787/pension_glance-2013-en

[23] Pension Coverage and Insurance: The Earnings-related Pension Insurance Covers All Earnings from Work. FINNISH CENTRE FOR PENSIONS. *Finnish Centre for Pensions: Exper on earnings-related pension provisions* [online]. Finnish Centre for Pensions, 2014, 2014-03-12 [quoted 2014-03-22]. Available at: http://www.etk.fi/en/service/pension_coverage_and_insurance/1423/pension_coverage_and_insurance

[24] Pension Coverage and Insurance: The Earnings-related Pension Insurance Covers All Earnings from Work. FINNISH CENTRE FOR PENSIONS. *Finnish Centre for Pensions: Exper on earnings-related pension provisions* [online]. Finnish Centre for Pensions, 2014, 2014-03-12 [quoted 2014-03-22]. Available at: http://www.etk.fi/en/service/pension_coverage_and_insurance/1423/pension_coverage_and_insurance

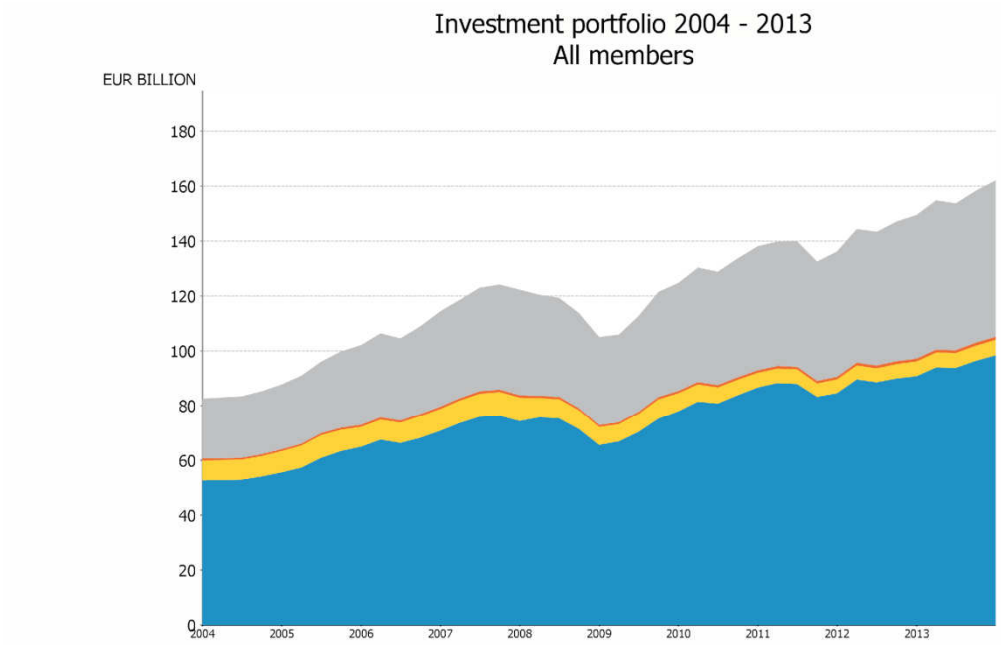
[25] Self-employed: Insurance of the Self-employed is Based on the YEL Income. FINNISH CENTRE FOR PENSIONS. *Finnish Centre for Pensions: Exper on earnings-related pension provisions* [online]. Finnish Centre for Pensions, 2014, 2014-03-12 [quoted 2014-03-22]. Available at: http://www.etk.fi/en/service/pension_coverage_and_insurance/1423/pension_coverage_and_insurance

also other specific professions insured by the earnings-related system like farmers and grant recipients, but these professions are of minor impact reflecting the whole pension system market.

The earnings-related pension funds are represented by private association The Finnish Pension Alliance TELA[26], comparable to the Association of Pension Companies (Asociace penzijních společností ČR) operating in The Czech Republic[27].

The earnings-related pension funds in Finland accumulated EUR162.3billion as of 2013 and represent approximately 79.3% of the national GDP as showed below. The assets in funds covering non-public sector employees form together 64.9% of all assets invested in the Finnish pension portfolio and reached EUR105.2billion[28].

Graph 5: Finnish Pension System Assets by Institution Type 2004-2013



	31.12.2004	31.12.2005	31.12.2006	31.12.2007	31.12.2008	31.12.2009	31.12.2010	31.12.2011	31.12.2012	31.12.2013
Public sector pension institutions	23,8	29,2	34,8	38,5	32,3	39,4	45,1	45,6	52,3	56,9
MEK And MELA	0,7	0,8	0,8	0,9	0,7	0,8	0,9	0,9	1,0	1,1
Company funds and industry-wide funds	7,8	7,2	8,1	8,7	6,5	6,6	5,4	5,0	5,4	5,6
Pension insurance companies	55,6	65,0	70,8	74,4	65,6	78,0	86,7	84,7	90,9	98,5
Total	**87,9**	**102,2**	**114,5**	**122,4**	**105,1**	**124,9**	**138,2**	**136,3**	**149,6**	**162,2**

Source: THE FINNISH PENSION ALLIANCE TELA. *Market Value and Allocation of Assets: By type of pension institution* [online]. The Finnish Pension Alliance TELA, 2014, slide 1 [quoted 2014-03-22]. PPT available at: http://www.tela.fi/en/investments/market_value_and_allocation_of_assets

[26] TELA. *TELA* [online], The Finnish Pension Alliance TELA. Available at: www.tela.fi

[27] THE ASSOCIATION OF PENSION COMPANIES OF THE CZECH REPUBLIC. APF CR [online]. 2009. Available at: http://www.apfcr.cz/en/

[28] THE FINNISH PENSION ALLIANCE TELA. *Market Value and Allocation of Assets: By type of pension institution* [online]. The Finnish Pension Alliance TELA, 2014, [quoted 2014-03-22]. Power Point Presentation available at: http://www.tela.fi/en/investments/market_value_and_allocation_of_assets

It is clear from the graph above and other graphs of the source that the importance of the public sector pension institutions and its share on the sum of pension investment portfolios is constantly growing.

Finland as a benchmark

For the comparison part of this work I have chosen Finland as a benchmark for The Czech Republic. Finland is a country with higher standards of living with one of the most fair and sophisticated social system. From half a year personal experience of living in Finland I personally believe that the Finnish social system is quality enough to be taken as a benchmark, moreover that any country willing to set the system in long-term as it is set in Finland would not act in any harm to its inhabitants.

The further pages point on important similarities and differences that should be taken into account when comparing those two countries.

GPD per Head

The key goal of this section is to compare Czech pension system with forward looking perspective to a country that is more developed than The Czech Republic. I shall use as a measurement of such development the indicator GDP per head being known as one of the basic indicators of economic development.

Table 10: Long-term GPD per Head in The Czech Republic and Finland

Transaction	Gross domestic product (expenditure approach)									
Measure	Per head, US $, constant prices, constant PPPs, OECD base year									
Frequency	Annual									
Time	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Country										
Czech Republic	19 081	19 976	21 268	22 689	23 860	24 347	23 113	23 625	24 102	23 823
Finland	28 838	29 940	30 708	31 939	33 501	33 443	30 441	31 321	32 057	31 584

Data source: *OECD Statistic (GDP, unemployment, income, population, labour, education, trade, finance, prices, health, debt...)*[online]. [quoted 2014-03-15]. Section: National Accounts, Subsections: Annual National Accounts; Main Aggregates: Gross domestic product (GDP), Table: GDP per head. US Dollars, current prices, constant PPPs. Available at: stats.oecd.org. Note that the Purchasing Power Parity (PPP) is a constant as of 2005.

Finnish GDP per head is 32.6% higher than in The Czech Republic. Positively, the gap is decreasing in time, as in 2003 it was more than 50% higher, but still significant enough to consider Finland (as expected) as more developed than The Czech Republic.

Population age distribution and workforce share

Finland has one of the lowest share of working population per pensioner in all OECD countries. The population amounts to 5.41 million as of 2013 out of which 28.33% is formed by inhabitants

above 65 years of age. The population of Finland is approximately half of the population in The Czech Republic, but the share of inhabitants above 65 years of age is higher.[29]

Trend of working population in age between 20-64 per pensioner has been constantly falling since 2000 to current 3.20 workers per pensioners, representing a 21.03% decrease in the respective time period in Finland. The Czech Republic has currently 3.86 workers per pensioner, and the decrease has been much less intensive compared to 2000 with 15.03% fall. The trend of G7 countries was approximately the same as in Czech with 15.88% decrease and 11.75% decrease as for OECD average.[30]

This results in higher public expenditures on pension in Finland reaching the level of 9.9% of the national GDP (data as of 2010 available) and in The Czech Republic 8.3% of the national GDP[31]. Both of the mentioned public pension systems therefore face a worsening demographic problem which from the point of individual inhabitants can particularly be solved by individual pension saving.

Pension system characteristics

The two countries are also similar in private pension system institutional setup, both being mainly organized via autonomous pension funds – in case of The Czech Republic in 100% and in case of Finland in 90.18% (the rest are pension insurance contracts)[32]. Both countries also reach the same share of private expenditures per national GDP amounting to 0.6%[33]. According to the source, the most actual data available for Finland are as of 2010, while for The Czech Republic it is for 2012. Despite the 2-year difference and mainly for the stability of such data, the author considers the time lag as unimportant.

[29] Data source: OECD. *OECD Statistic (GDP, unemployment, income, population, labour, education, trade, finance, prices, health, debt...)*[online]. [quoted 2014-03-15]. Section: Demography and Population, Subsection: Population Statistics, Table: Population, Subject: Population (hist5) All ages, persons (‘000). Available at: stats.oecd.org.

[30] Data source: OECD. *OECD Statistic (GDP, unemployment, income, population, labour, education, trade, finance, prices, health, debt...)*[online]. [quoted 2014-03-15]. Section: Demography and Population, Subsection: Population Statistics, Table: Population, Subject: Working Age (20-64) per Pension Age (+65), persons (‘000). Available at: stats.oecd.org. The percentage change for all OECD countries was calculated as a percentage change between years 2000 and 2011 due to the data for 2012 unavailability. The percentage change was calculated by the author.

[31] Data source: OECD. *Pension Markets in Focus 2013: Accompanying statistical tables* [.xls]. OECD, 2013 [quoted 15.3.2014]. Available at: http://www.oecd.org/finance/private-pensions/pensionmarketsinfocus.htm. Sheet: Data F15.

[32] Data source: OECD. *Pension Markets in Focus 2013: Accompanying statistical tables* [.xls]. OECD, 2013 [quoted 15.3.2014]. Available at: http://www.oecd.org/finance/private-pensions/pensionmarketsinfocus.htm. Sheet: Data F2.

[33] Data source: OECD. *Pension Markets in Focus 2013: Accompanying statistical tables* [.xls]. OECD, 2013 [quoted 15.3.2014]. Available at: http://www.oecd.org/finance/private-pensions/pensionmarketsinfocus.htm. Sheet: Data F15.

Both systems are opposite in terms of the type of system setup, The Czech Republic representing 100% defined contribution system and Finland representing 100% defined benefit system[34][35]. Such difference is interesting discerning sign of the systems, but the author does not expect it to have a significant difference on the resulting asset allocation. Nevertheless the system definition will also be tested on its importance to asset allocation.

Assets Allocated in Pension System and their Share on GDP

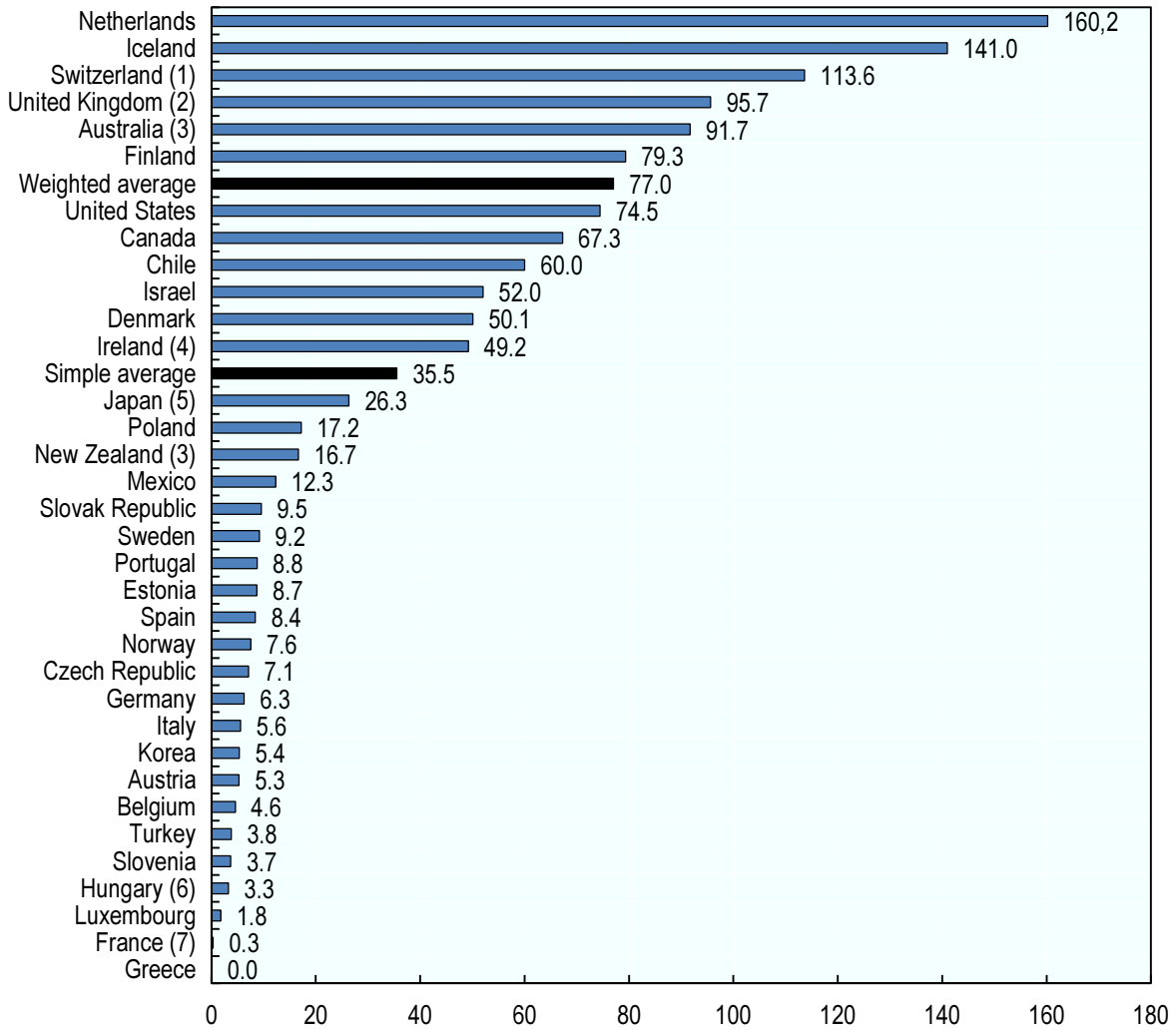
Despite the above mentioned similarities, the two systems have significant differences too. One of the key differences is the pension systems' allocated assets share on national GPD reaching in Finland 79.3%, while in The Czech Republic it is only 7.1% in 2012[36].

Graph 6: Pension Funds Assets as percentage of national GDP in OECD countries as per 2012

[34] Data source: OECD. *Pension Markets in Focus 2013: Accompanying statistical tables* [.xls]. OECD, 2013 [quoted 15.3.2014]. Available at: http://www.oecd.org/finance/private-pensions/pensionmarketsinfocus.htm. Sheet: Data F18.

[35] For comparison of the system setup among other OECD countries, see Graph 2: Pension Funds' Assets by Pension Plan Type in Selected OECD Countries

[36] Data source for the text and following graph: OECD. *Pension Markets in Focus 2013: Accompanying statistical tables* [.xls]. OECD, 2013 [quoted 15.3.2014]. Available at: http://www.oecd.org/finance/private-pensions/pensionmarketsinfocus.htm. Sheet: F3. Assets % GDP (OECD).



Source: the same data used as for the text above (note [36]).

In this case it is also important to note that the GDP in The Czech Republic reached USD289,288mil, while in Finland it has been 26.7% lower than that and reached USD212,010 mil in 2012[37]. To eliminate the effect of different GDP I recalculated the percentages assuming that the GDP of Finland is the same as the GDP of The Czech Republic.

Table 11: Elimination of GDP Difference in the Calculation of Pension Funds Assets % Share of National GDP

Country	Assets as % of national GDP (A)	GDP in USD millions (B)	Funds Assets Value in USD millions (C)	Assets as % of CZ GDP (D)	Assets as % of FIN GDP (E)
Finland	79,3	212 010	168 192	58,1	79,3
Czech Republic	7,1	289 288	20 633	7,1	9,7

Data source: the same data set as notes 33 and 34. Note: the values in D are arrived to as a calculation of C divided by B of The Czech Republic for both countries. The values in E are arrived to as a calculation of C divided by B of Finland for both countries. Note that for the purposes of the calculation FX changes are not included.

[37] Data source: OECD. *OECD Statistic (GDP, unemployment, income, population, labour, education, trade, finance, prices, health, debt...)*[online]. [quoted 2014-03-15]. Section: National Accounts, Subsection: Annual National Account; Main Aggregates; 1. Gross domestic product (GDP), Table: GDP, US USD, current prices, current PPPs, millions, 2012. Available at: stats.oecd.org.

The share of assets allocated in Finnish pension system still reaches 58.1%, being 51 bp higher than in The Czech Republic. This comparison show an important difference of the capital resources of Finnish private pension system and in the later parts of this chapter will be understood as one of the key differences between both of the systems potentially affecting not only the allocation of assets, but also the resulting investment returns of the funds.

Asset Allocation Regulatory Limits

Contrary to the system definition the author expect a significant role of regulatory rules on the resulting asset allocation in the pension systems. On the case of The Czech Republic as shown at the previous chapters of this thesis it is important not only to list down the specific limitations to each individual asset groups, but also to understand such limitations in a complex perspective. In The Czech Republic the limitations themselves are not the biggest obstacle to the fund managers, the biggest obstacle are the Black-zero system combined with accounting rules of immediate asset revaluation in case the value is changing, for example listed equities[38].

First I shall in consistency with chapter "Regulative Limits on Individual Asset Classes" list the specific regulatory limits on assets invested in pension funds so the reader is able to compare such limits to the regulations in The Czech Republic.

Table 12: Asset Allocation Regulatory limits in Finnish voluntary part of pension system as of 2012

Equity	Real Estate	Bonds	Retail Investment Funds	Private Investment Funds	Loans	Bank Deposits
•50% for listed shares •10% for non-listed shares	•40%	•No limit if issued by OECD government, local government or similar institution •50% if issued by companies on regulated OECD markets •10% for other bonds	•No limit	•10% for non-listed funds	•70% if mortgage loans including investment in real estates and buildings •10% if subordinated*	•No limit

*Note: (No limit if a debtor or a guaranto is an EEA State, municipality, municipality authority, a parish located in an EEA State, a deposit bank or an insurance company licenced in an EEA State or a bank or an insurance company comparable to the above mentiond)

Source: OECD. Annual Survey of Investment Regulation of Pension Funds: 2013. OECD, 2013, page 10. Available at: http://www.oecd.org/finance/private-pensions/annualsurveyofinvestmentregulationofpensionfunds.htm

[38] For detailed information see respective sections in chapter "Regulative Limits on Individual Asset Classes" and "Accounting Impact to Asset Allocation".

Interestingly the limits on shares are lower than those implied in The Czech Republic with 50% of the portfolio allowed to be invested in this asset class. However it is important to note that Finnish Pension funds also have an opportunity to invest in non-listed shares. Another interesting asset group are subordinated loans, which in general are riskier assets – the Finnish funds are allowed to invest up to 10% of their portfolio in this asset group.

The regulatory limit on investments in foreign assets is set to 10% to other than OECD countries. For comparison the limit on foreign investments in Czech pension funds is set to 5% of equity investments in case of Transformed Funds. The foreign limit however shall not be an important factor to be considered further on.

Table 13: Concentration Limits on Asset Allocation in Finnish Voluntary Pension System as of 2012

Investment limit in single issuer/issue	Self-investment/conflict of interest	Other quantitative rules	Ownership concentration limits
•Assets should be diversified and decentralized within the diversified groups •Max 25% in one single investment •Max 5% in shares of the same company •Max 15% in real estate regarded as one object	•Max 5% of assets may be invested in the sponsoring employer	•Max 30% in other currencies than euro	•Max 20% of shares (votes) in one company

Source: OECD. Annual Survey of Investment Regulation of Pension Funds: 2013. OECD, 2013, page 77. Available at: http://www.oecd.org/finance/private-pensions/annualsurveyofinvestmentregulationofpensionfunds.htm

As it can be seen from the previously pointed tables, the main difference between regulatory limits in Czech and Finnish pension system are in real estate investments which in The Czech Republic are not allowed at all or limited to 10% in case of the Transformed Funds and forbidden in cases of both types of New Funds.

Finnish and Czech Pension System Asset Allocation in context to other OECD countries

In this part I find it important to point out more than just the two selected countries. The below attached table shows that the Finnish pension funds are on top of OECD countries with their shares of investment in both, equities and real estate investments, while Czech pension funds are one of the most conservative among all the pointed countries. Consider that Czech pension funds have technically higher regulatory limits on equities than Finland

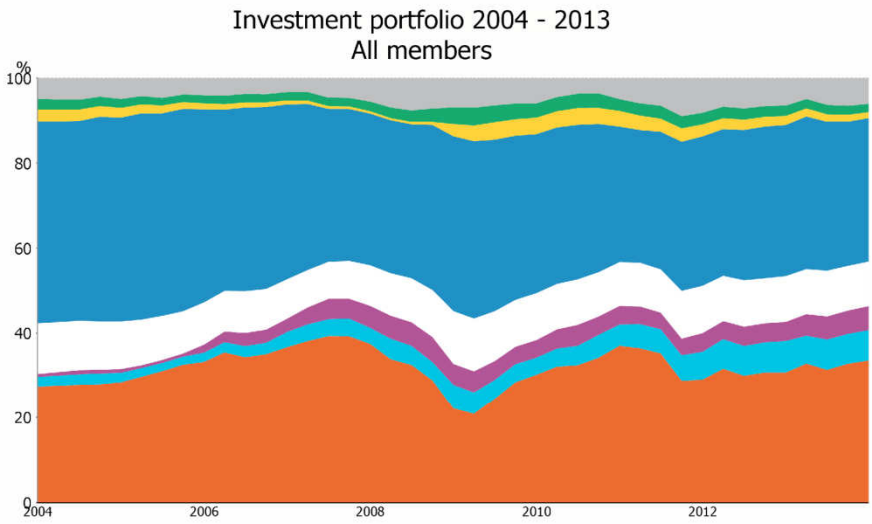
Table 14: Asset Allocation in Foreign Pension Funds in 2012

Pension Plan Type	Total, by pension plan type									
Definition Type	Total, by definition type									
Contract Type	Pension funds (autonomous)									
Indicator	Structure of assets									
Year	2012									
Variable	Cash and Deposits	Bills and bonds issued by public and	Loans	Shares	Land and Buildings	Mutual funds (CIS)	Unallocated insurance contracts	Hedge funds	Private equity funds	Other investments
Country										
Australia	14,038	..	5,848	25,122	5,576	45,937	..	..	..	3,478
Austria	9,236	52,245	1,073	29,569	3,475	..	..	..	..	3,709
Belgium	3,03	11,39	0,744	8,187	0,84	71,374	1,189	..	..	3,244
Canada	2,725	27,569	0,271	24,62	5,54	34,599	..	..	..	4,677
Chile	0,473	45,49	1,135	12,527	..	40,253	..	..	..	0,123
Czech Republic	9,775	84,393	0	0,212	0,674	1,233	..	..	0	1,758
Denmark	0,443	66,14	0,057	12,964	1,048	2,272	..	..	..	17,077
Estonia	16,374	25,622	0	5,204	0	52,483	..	0	..	0,316
Finland	4,163	35,968	4,63	37,133	10,974	..	..	..	..	7,133
Germany	1,363	35,725	18,466	0,177	2,389	39,177	..	0,534	0,318	1,724
Greece	46,355	37,097	..	2,493	0	12,49	..	..	..	1,565
Hungary	3,874	64,917	..	4,72	..	23,249	..	..	..	3,239
Iceland	7,166	50,207	8,31	10,279	0	15,326	..	..	8,687	0,025
Israel	5,231	73,989	2,559	5,357	0,574	3,229	..	0,18	0,093	5,95
Italy	4,233	45,038	..	11,238	2,887	10,304	22,897	..	..	..
Korea	57,842	1,587	0,038	0,005	0	5,851	32,395	0	0	2,281
Luxembourg	4,541	57,413	0	0	0	36,347	..	..	..	1,698
Mexico	0,454	80,931	..	18,222	..	..	..	..	..	0,392
Netherlands	0,918	24,208	2,856	11,374	0,903	49,765	..	..	0,138	9,611
New Zealand	..	..	..	..	..	..	..	..	..	..
Norway	2,664	50,668	1,58	18,074	2,918	22,999	..	..	..	1,096
Poland	8,292	55,795	0	34,818	..	0,279	..	..	..	0,816
Portugal	13,856	38,02	0	8,516	12,243	24,915	0	0	0	-1,578
Slovak Republic	22,704	68,46	..	0,188	..	7,842	..	..	..	0,806
Slovenia	21,016	54,361	2,845	1,1	0	20,596	0	0	0	0,082
Spain	14,602	55,661	0,003	9,07	0,222	9,673	10,039	..	0,616	0,004
Sweden	2,368	58,132	0,291	9,385	2,968	26,711	..	..	..	0,146
Switzerland	7,241	19,867	3,318	13,009	9,707	42,967	..	2,375	1,147	0,368
United Kingdom	2,392	22,14	0,945	17,326	1,91	27,979	6,231	..	..	21,077
United States	0,815	16,287	0,309	38,154	1,735	21,959	3,299	..	..	17,442

Source: OECD. OECD Statistic (GDP, unemployment, income, population, labour, education, trade, finance, prices, health, debt...) available at stats.oecd.org

The asset allocation of Czech funds has already been described in chapter Czech third Pillar Funds' Asset Allocation. Finland is the country with second highest allocation of assets in shares (37.133%) after United States with just one percentage of assets more than in Finland. Finnish pension system is also second in percentage share of assets invested in Buildings and Properties with nearly 11% invested in this category. The portfolio diversification in Finland is much more diversified compared to the portfolios of pension funds in The Czech Republic also in the long-term.

Graph 7: Long-term Trends in Asset Allocation of Finnish Pension Funds (2004 - 2013)



	31.12.2004	31.12.2005	31.12.2006	31.12.2007	31.12.2008	31.12.2009	31.12.2010	31.12.2011	31.12.2012	31.12.2013
MONEY MARKET INVESTMENTS	4,9	4,0	3,3	5,5	6,9	5,9	4,9	8,1	6,4	6,0
INVESTMENT LOANS	2,1	1,9	2,0	2,3	3,9	3,4	2,8	2,7	2,4	1,9
TYEL-LOANS	2,3	1,4	1,0	0,6	2,9	3,9	3,7	2,8	2,1	1,4
BONDS AND CONVERTIBLE BONDS	48,0	45,4	41,1	35,7	41,1	37,4	31,9	35,2	35,6	33,8
REAL ESTATE AND SHARES	11,2	10,0	9,3	9,6	12,5	11,1	10,3	11,2	10,8	10,5
HEDGE FUNDS	0,9	1,9	3,1	5,2	5,0	4,2	4,4	4,4	4,5	5,7
PRIVATE EQUITY AND OTHER ALTERN	2,2	2,2	3,6	3,8	5,6	4,0	5,0	6,6	7,4	7,1
LISTED STOCKS AND EQUITY FUNDS	28,4	33,2	36,7	37,4	22,2	30,2	37,0	29,0	30,7	33,6
Total	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**

Source: THE FINNISH PENSION ALLIANCE TELA. *Market Value and Allocation of Assets: By Asset Class* [online]. The Finnish Pension Alliance TELA, 2014, slide 3 [quoted 2014-03-22]. PPT available at: http://www.tela.fi/en/investments/market_value_and_allocation_of_assets

There are three important trends spotted in the portfolio allocation in Finnish pension funds:

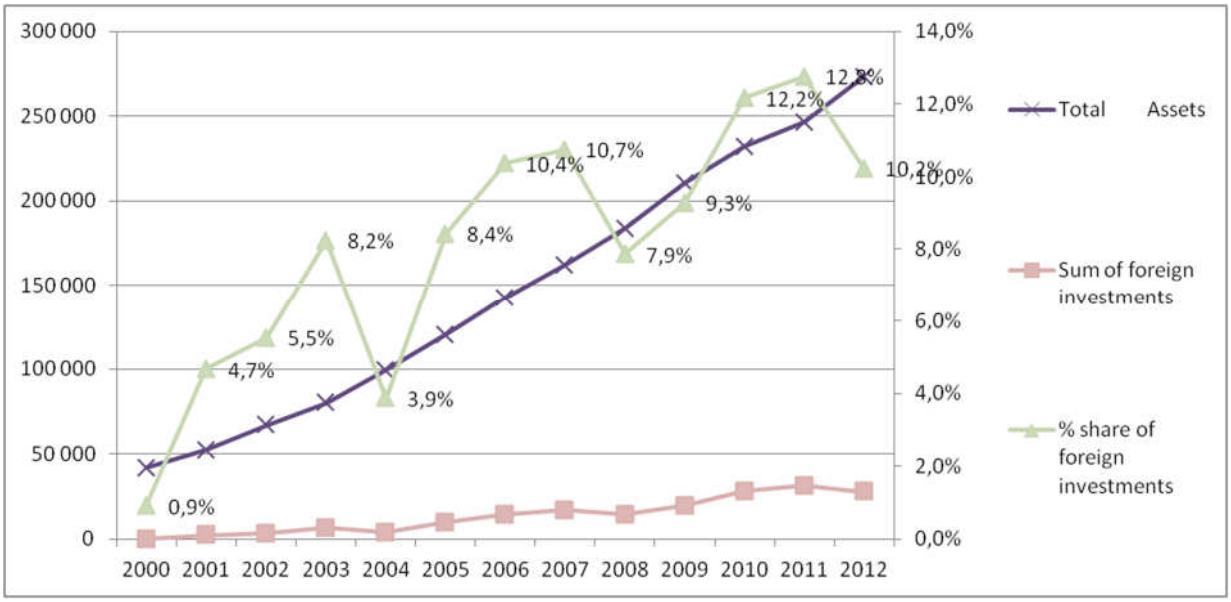
1) the allocation in bonds has been decreasing in the past years from 48% at the end of 2004 to 33.8% at the end of 2013;
2) the share of listed stocks and equity funds has increased only by 4.8 basis points in the same period (from 28.4% at the end of 2004 to 33.6% at the end of 2013 and
3) the share of private equity and other equity alternatives has risen by 4.9 basis points from 2.2% at the end of 2004 to 7.1% at the end of 2013.

It shall be tested later whether such asset allocation leads to higher investment returns or not. In context with the above showed differences in pension funds asset allocation in both countries, it is interesting to notice the approach of TELA to the asset diversification: “Considering the need to generate income at acceptable risk levels, investors of pension assets are obligated to diversify

their investment portfolios"[39], and "By law, pension assets must be invested profitably and securely. An investor of pension assets must earn a return that is as high as possible..."[40].

Last but not least I shall draw the attention to foreign investments in both countries. The long-term trend of foreign investments in Czech funds has been fluctuating around 10% of all assets since 2006 with no significant indication of the trend potential change:

Graph 8: Long-term Foreign Investments of Czech Pension System (2000-2012)



Data source: Data source: Vybrané ekonomické ukazatele. ASOCIACE PENZIJNÍCH SPOLEČNOSTÍ ČR. *Asociace penzijních společností ČR* [online]. 2009 [quoted 2014-03-22]. File Ekonomické ukazatele v r.2010-2012 – 4.čtvrtletí. Available at: http://www.apfcr.cz/cs/vybrane-ekonomicke-ukazatele/

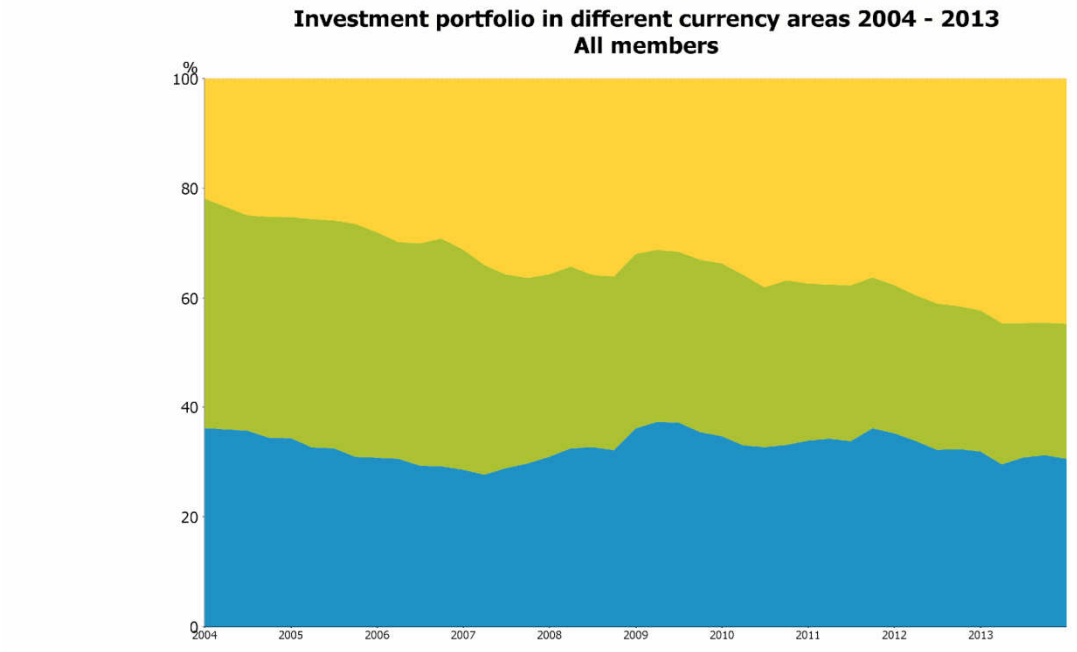
Note: Total Assets and Sumf of Foreign Investments are linked to the left Y axis, the percentage share of foreign investments is linked to the right Y axis.

The foreign investments in Finland were also stagnating, but in contrast to The Czech Republic only within the range of 28.6% - 36.1% share of domestic investments on the whole portfolio. Out of the foreign instruments, the share of instruments with domicile in Euro area has been constantly decreasing since 2006 to the benefit of instruments with domicile out of the Euro are. This indicates that the portfolios are also diversified from the currency risk perspectives.

Graph 9: Finnish Pension Assets according to Currency (2004 - 2013)

[39] THE FINNISH PENSION ALLIANCE TELA. *Principles for Responsible Investment of the Finnish Pension Alliance TELA* [online]. 2008 [quoted 2014-03-22], page 2. Available at: http://www.tela.fi/instancedata/prime_product_julkaisu/tela/embeds/telawwwstructure/14196_130208PrinciplesForResponsibleInvestmentOfTheFinnishPensionAllianceTELA.pdf

[40] THE FINNISH PENSION ALLIANCE TELA. *Principles for Responsible Investment of the Finnish Pension Alliance TELA* [online]. 2008 [quoted 2014-03-22], page 4. Available at: http://www.tela.fi/instancedata/prime_product_julkaisu/tela/embeds/telawwwstructure/14196_130208PrinciplesForResponsibleInvestmentOfTheFinnishPensionAllianceTELA.pdf



	31.12.2004	31.12.2005	31.12.2006	31.12.2007	31.12.2008	31.12.2009	31.12.2010	31.12.2011	31.12.2012	31.12.2013
Rest of the world	25,2	28,0	31,2	35,7	31,9	33,7	37,3	37,6	42,2	44,7
Rest of euro area	40,4	41,2	40,3	33,4	32,0	31,6	28,8	27,2	25,9	24,8
Finland	34,3	30,7	28,6	30,9	36,1	34,7	33,9	35,2	31,9	30,5
Total	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**

Source: THE FINNISH PENSION ALLIANCE TELA. *Market Value and Allocation of Assets: Domestic and foreign investments* [online]. The Finnish Pension Alliance TELA, 2014, slide 3 [quoted 2014-03-22]. PPT available at: http://www.tela.fi/en/investments/market_value_and_allocation_of_assets.

The following summary shall provide a summary of factors, why the author considers Finland as an appropriate benchmark for The Czech Republic:

1) The comparison shall be made as forward looking, therefore a more economically developed country will be required;
2) Finnish GDP per head is approximately 32% higher, than in The Czech Republic. As this thesis is not focused on economic development, this indicators shall be understood as confirming no 1);
3) Share of inhabitants above 65 years is higher in Finland than in The Czech Republic. Both countries have a negative trend of demographic indicators, therefore the benchmark provides a comparison to a country which faced similar deepening problems in the past;
4) The share of assets in pension funds per GDP is incomparably higher in Finland than in The Czech Republic;
5) Despite similarities in asset allocation regulatory limits between the two countries (particularly in case of equity/shares), the actual investment allocation is essentially different.

Statistical comparison

The two previous chapters highlighted key differences between both countries and their pension system setup. The available data of the pension system's investment returns indicate that the pension system in Finland is investing the funds more effectively with higher returns in long-term complemented with higher volatility of returns.

Calculating long-term average investment return via geometrical average would provide a simple comparison between the two countries, but does not take into account different economic conditions in which both of the systems are operating, therefore using such calculation would result in a misleading conclusion.

Methods

The following subchapters shall indicate the methods that will be used to evaluate the investment returns and asset allocation impact on them in both systems. The Sharpe ratio and CAPM model shall both evaluate the return/risk ratio, where Sharpe ratio is a static indicator over the whole measured period using average returns and risks and CAPM model provides with more dynamic approach. The impact of individual asset classes on investment returns will be evaluated by a simple regression model.

Sharpe ratio

The Sharpe ratio was first introduced by William F. Sharpe in 1966 as an indicator of "measure for the performance of mutual funds"[41]. According to Morningstar – a renowned agency providing a wide spread of products across the financial markets (not only in the United Statehs), the Sharpe ratio should be calculated over at least 36-month period on monthly basis[42]. This will come up to a statistical problem further on as the available data set for comparison of pension funds returns is (unfortunately) much smaller than the recommended size.

The ex-post version of the Sharpe ratio "takes into account both the average differential return and the associated variability"[43] as a measure of risk related to the respective return.

The Sharpe ratio is calculated as follow:

Formula 2: Historical Sharpe Ratio

[41] SHARPE, William F. The Sharpe Ratio. *The Journal of Portfolio Management*. Fall 1994. Available at: http://www.stanford.edu/~wfsharpe/art/sr/SR.htm#fn3

[42] Sharpe Ratio. *Morningstar: Independent Investment Research* [online]. Morningstar, 2014 [quoted 2014-05-09]. Available at: http://www.morningstar.com/InvGlossary/sharpe_ratio.aspx

[43] SHARPE, William F. The Sharpe Ratio. *The Journal of Portfolio Management*. Fall 1994. Available at: http://www.stanford.edu/~wfsharpe/art/sr/SR.htm#fn3

$$S_h \equiv \frac{\overline{D}}{\sigma_D}$$

Source: SHARPE, William F. The Sharpe Ratio. *The Journal of Portfolio Management*. Fall 1994. Available at: http://www.stanford.edu/~wfsharpe/art/sr/SR.htm#fn3

Where D-bar is defined as:

Formula 3: D-bar in historical Sharpe Ratio Calculation

$$\overline{D} \equiv \frac{1}{T}\sum_{t=1}^{T} D_t$$

Source: SHARPE, William F. The Sharpe Ratio. *The Journal of Portfolio Management*. Fall 1994. Available at: http://www.stanford.edu/~wfsharpe/art/sr/SR.htm#fn3

Where *t* represents time period for which the D-bar is measured, *T* the total amount of historical time periods and D_t the difference between return rate of the measured portfolio (R_{Ft}) in time *t* and the benchmark portfolio or security (R_{Bt}) as indicated by the next formula:

Formula 4: Dt in Historical Sharpe Ratio

$$D_t \equiv R_{Ft} - R_{Bt}$$

Source: SHARPE, William F. The Sharpe Ratio. *The Journal of Portfolio Management*. Fall 1994. Available at: http://www.stanford.edu/~wfsharpe/art/sr/SR.htm#fn3

The σ_D defined in Formula 2 is defined as follows:

Formula 5: Sigma$_D$ in Historical Sharpe Ratio

$$\sigma_D \equiv \sqrt{\frac{\sum_{t=1}^{T} (D_t - \overline{D})^2}{T-1}}$$

Source: SHARPE, William F. The Sharpe Ratio. *The Journal of Portfolio Management*. Fall 1994. Available at: http://www.stanford.edu/~wfsharpe/art/sr/SR.htm#fn3

where all variables have the same meaning as given to it in the text above.

The original Sharpe ratio (1966) required R_{Bt} to be a risk-free interest rate[44], nevertheless the review by SHARPE (1992) indicates that using a benchmark portfolio shall be more accurate. Therefore I shall construct an index representing the benchmark portfolio based on the asset allocation of the system in the respective year.

Formula 6: Benchmark Portfolio (R_{Bt}) Construction

[44] SHARPE, William. Mutual Fund Performance. The Journal of Business. 1966, Vol. 39, No. 1, Part 2: Supplement on Security Prices, page 122 of the whole document, page 5 of the article.

$$R_{Bt} = w_n * r_n + w_{n+1} * r_{n+1} + \cdots + w_N * r_N + w_R * r_R$$

Source: Own construction based on information provided in BOHL, Martin T., Judith LISCHEWSKI a Svitlana VORONKOVA. Pension Funds' Performance in Strongly Regulated Industries in Central Europe: Evidence from Poland and Hungary. *Emerging Markets Finance & Trade*. 2011, Volume 3, 15 pages. DOI: 10.2307/23047102. Available at: http://www.jstor.org/stable/23047102, page 87 of the whole document, page 8 of the article.

where each w_n through w_N represent one individual asset group, w_R represent remaining part of the portfolio for which an objective return rate is not known (ie. Other investments) or its individual share in the portfolio is not significant (ie. Lands and buildings in portfolios of Czech pension funds), r_n an annualized return for the asset n and r_R a combination of return rates r_n through r_R as explained by

Formula 8.

Benchmark portfolio construction based on more than just one asset is also indicated in BOHL, LISCHEWSKI AND VORONKOVA (2011): "We construct a capitalization-weighted market benchmark index, which is a combination of the domestic government bond and equity indexes. The weights of the bond and equity components were calculated…portfolio-level data on holdings of bonds and equities by pension funds"[45].

For the purposes of this thesis the portfolio shall be a combination of bonds, stocks and money market returns. In case of Finland for its higher asset allocation in properties, the benchmark portfolio is also adjusted by returns of properties in Finland.

An approximation is made for the remaining part of the benchmark index $w_R * r_R$which is brought up to the other above mentioned assets as if those assets formed a 100 percent share of the portfolio – mainly due to unavailability of data for returns of the remaining groups of the portfolios. The remaining part of the portfolio w_R is arrived to as:

Formula 7: Portfolio Remaining Part W_R

$$w_R = 1 - \sum_{n=1}^{N} w_n$$

Source: Authors' own construction.

And therefore the only remaining unknown variable of the calculation of benchmark portfolio return is the r_R which will be arrived to from

Formula 8:

[45] BOHL, Martin T., Judith LISCHEWSKI a Svitlana VORONKOVA. Pension Funds' Performance in Strongly Regulated Industries in Central Europe: Evidence from Poland and Hungary. *Emerging Markets Finance & Trade*. 2011, Volume 3, 15 pages. DOI: 10.2307/23047102. Available at: http://www.jstor.org/stable/23047102

Formula 8: w_n calculation - Remaining Part of the Benchmark Portfolio

$$r_R = \frac{w_n}{\sum_{n=1}^{N} w_n} * w_R * r_n + \frac{w_{n+1}}{\sum_{n=1}^{N} w_n} * w_R * r_{n+1} + \cdots + \frac{w_N}{\sum_{n=1}^{N} w_n} * w_R * r_N$$

Source: Authors' own construction.

CAPM model

CAPM model was created to differentiate the systematic and individual risk of a specific asset, where the systematic risk is represented by the overall economic development and is out of control of the individual issuers of financial instruments and the individual risk is represented by specific risk related to the individual issuer of financial instruments. The systematic risk is – unlike the individual risk – not diversifyable.[46]

As BOHL, LISCHEWSKI AND VORONKOVA (2011) mention, the Sharpe provide only a rough estimation of the pension funds' performance. Therefore an adjusted CAPM model shall be used to evaluate performance of pension funds. Moreover the authors "expand the models by interaction dummies for each year to consider the dynamic development of the emerging stock markets and the potential resulting time variation of the beta coefficient."[47] The resulting Jensen's alpha "estimates how much manager's forecasting ability contributes to the fund's returns"[48].

The extended Jensen regression shall then provide us with an adequate numeric verification of the expected excessive performance of Finnish pension funds over the Czech pension funds.

Formula 9: Adjusted CAPM model by Bohl, Lischewski and Voronkova

$$r_{it} - r_{ft} = \alpha_i + \beta_i\left(r_{mt} - r_{ft}\right) + \sum_{\omega_i} \varphi_{\omega_i i} * \delta_{\omega_i} * \left(r_{mt} - r_{ft}\right) + \varepsilon_{it}$$

Source: BOHL, Martin T., Judith LISCHEWSKI a Svitlana VORONKOVA. Pension Funds' Performance in Strongly Regulated Industries in Central Europe: Evidence from Poland and Hungary. *Emerging Markets Finance & Trade*. 2011, Volume 3, 15 pages. DOI: 10.2307/23047102. Available at: http://www.jstor.org/stable/23047102 **with adjustment according to** JENSEN, Michael. The Performance of Mutual Funds in the Period 195-1964. *Journal of Finance*. 1967, No. 2, 37 pages. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=244153, page 8.

"where r_{it} is the return of pension fund i at time t, r_{ft} the risk-free rate, and r_m the return of the market portfolio. The coefficient α_i indicates Jensen's α of fund i representing a return above the market benchmark; the coefficient β_i denotes its beta which represents a correlation of the

[46] MUSÍLEK, Petr. Trhy cenných papírů. 2., actualized and extended edition. Prague: Ekopress, 2011, 520 pages. ISBN 978-80-86929-70-5.

[47] BOHL, Martin T., Judith LISCHEWSKI a Svitlana VORONKOVA. Pension Funds' Performance in Strongly Regulated Industries in Central Europe: Evidence from Poland and Hungary. *Emerging Markets Finance & Trade*. 2011, Volume 3, 15 pages. DOI: 10.2307/23047102. Available at: http://www.jstor.org/stable/23047102

[48] JENSEN, Michael. The Performance of Mutual Funds in the Period 195-1964. *Journal of Finance*. 1967, No. 2, 37 pages. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=244153, page 1, abstract

individual assets' returns and the market returns, ω_i is the vector of years for which the dummy variables are included depending on the longest available time series for fund *i*; $\varphi_{\omega i}$ indicates of coefficient of the time-related interaction dummy; and $\delta_{\omega i}$ is a dummy variable, which takes the value of 1 for year ω_i and other 0 otherwise"[49] and ε_{it} represents a random error.

Adjustments to the formula:

According to Jensen's original construction of the model, the formula in the article contains a typo and therefore the formula was adjusted to reflect its original construction[50]. The Formula 9: Adjusted CAPM model by Bohl, Lischewski and Voronkova already includes this adjustment made by the author of this work.

Moreover Bohl, Lischewski and Voronkova perform their measurement on fund-level detail while the analysis of this work will be performed on system-level detail. This in practice means, that Bohl, Lischewski and Voronkova had to estimate *Beta* for each individual fund and as such there could have been a difference between the market performance and the performance given by a simple CAPM model – therefore the authors use adjustment of the simple CAPM model to absorb such discrepancies and minimize their effect on the resulting *alpha*.

I shall be using the analysis on system-level and as such there is no need to adjust the formula to absorb such differences and the formula I will be using will therefore copy the original one created by Jensen.

Formula 10: Jensen's Alpha Calculation (Jensen, 1967)

$$r_{it} - r_{ft} = \alpha_i + \beta_i\left(r_{mt} - r_{ft}\right) + \varepsilon_{it}$$

Source: JENSEN, Michael. The Performance of Mutual Funds in the Period 195-1964. *Journal of Finance*. 1967, No. 2, 37 pages. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=244153, page 8.

where all variables have the same meaning as given to them above.

Asset Allocation influence on Investment Performance

While being informed of the excessive returns/losses of the portfolio compared to the accepted risk as measured by the two above mentioned models, the last model shall indicate the impact of individual asset classes to the investment returns. The asset allocation significantly differs

[49] BOHL, Martin T., Judith LISCHEWSKI a Svitlana VORONKOVA. Pension Funds' Performance in Strongly Regulated Industries in Central Europe: Evidence from Poland and Hungary. *Emerging Markets Finance & Trade*. 2011, Volume 3, 15 pages. DOI: 10.2307/23047102. Available at: http://www.jstor.org/stable/23047102

[50] For comparison of the formulas see: (i) JENSEN, Michael. The Performance of Mutual Funds in the Period 195-1964. *Journal of Finance*. 1967, No. 2, 37 pages. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=244153, page 8 **and** (ii) BOHL, Martin T., Judith LISCHEWSKI a Svitlana VORONKOVA. Pension Funds' Performance in Strongly Regulated Industries in Central Europe: Evidence from Poland and Hungary. *Emerging Markets Finance & Trade*. 2011, Volume 3, 15 pages. DOI: 10.2307/23047102. Available at: http://www.jstor.org/stable/23047102, page 6.

through the two pension systems, where the Finnish pension funds diversify its assets broadly through different asset groups as well as domestic and international assets.

The model will be constructed as a simple linear regression where the key asset groups are the explanatory variables, while the investment return is the explained variable. The asset groups share is arrived to from the same data as for calculation of the weighted benchmark return, not including the adjustment made by Formula 7 and Formula 8. Unlike in those formulas, the return rates for individual asset groups are unknown, using a benchmark return would provide misleading results.

Formula 11: Asset Groups' Impact on Investment Returns (regression)

$$R_{it} = \sum_{n=1}^{N} (x_{n_t} - x_{n_{t-1}}) * a_n + \varepsilon$$

Source: Author's own construction

where *N*, represents the total number of explanatory asset groups (shares, bonds etc.), *n* the specific asset group, *t* year for which the R_{it} is given, x_{n_t} transformed weight of the asset group *n* in the portfolio of the pension fund in year *t*, a_n is the coefficient estimated by the regression function and ε random error.

Due to the fact, that the explanatory variables are provided in share percentage, therefore the values can reach only range between 0 and 100%. Such percentage share of individual asset groups in the portfolio might differ from year to year and it is important to construct the model in a way that is as much closer to real economic conditions. The data will be transformed according to the following formula:

Formula 12: Transformation of Variables Representing Shares on a Portfolio Returns

$$x_{n_t} = \arcsin \sqrt{\mathrm{w_{n_t}}}$$

Source: Transformation as advised by Mgr. Milan Bašta, Ph.D., based on FOX, John, Sanford WEISBERG a John FOX. An R companion to applied regression. 2nd ed. /. Thousand Oaks, Calif.: SAGE Publications, c2011, xxii, 449 p. ISBN 14-129-7514-X.

where, w_n represents a share of asset *n* (as defined earlier) on the portfolio of pension funds in time *t*.

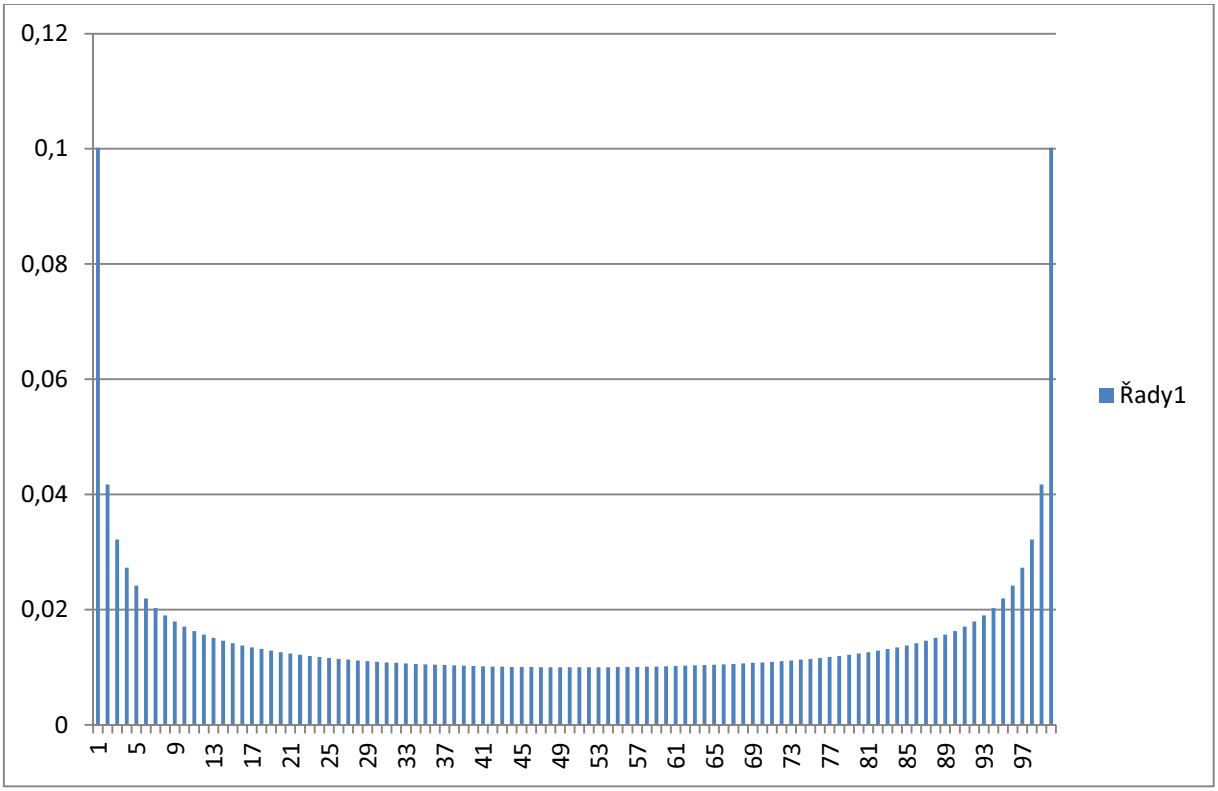
The transformation ensures that any change of share of an individual asset with extreme low or extreme high previous share on the portfolio has higher impact than if the previous share of the asset was in the middle of the range. This in practice means that (for example) change from 3% of the portfolio allocated in shares in year *t* to 4% of portfolio allocated in shares in year *t+1* has

a higher impact on resulting investment returns, than a change from 50% in year *t* to 51% in year *t+1*.

The logic is that if we add one percent of shares in a portfolio of money market instruments, it will have relatively higher influence on the investment returns than adding one percent of shares when the portfolio already includes 50% of shares.[51]

The following graph helps to understand the influence of the transformation.

Graph 10: Asset Percentage Shares on Portfolio Transformation – Impact of 1% Change after Transformation



Source: Author's calculation. Note: the X axis represent a change by one percentage starting at x (ie from 98 to 99%) and the Y axis represent the resulting impact of such percentage change after transformation.

The explanatory variables are transformed according to the above mentioned method. The explained investment return of funds will only be transformed as a first difference between the investment return in year *t* minus year *t-1*, to stay consistent with the explanatory variables.

Linear Regression Model and its' requirements

The CAPM model solution as well as the calculation of impact of individual asset groups on the resulting investment return is done via linear regression equation for both of the countries. The goal of regression analysis on empirical (historical) data is to estimate a theoretical regression

[51] The transformation was advised by Mgr. Milan Bašta, Ph.D., a lecturer of statistics and time series courses at University of Economics in Prague based on FOX, John, Sanford WEISBERG a John FOX. An R companion to applied regression. 2nd ed. /. Thousand Oaks, Calif.: SAGE Publications, c2011, xxii, 449 p. ISBN 14-129-7514-X.

function with most accurate description of statistical relationship of explained variable(s) and explanatory variables (s)[52]. To comply with the most accurate solution, the model has to be tested for specific characteristics:

a) Heteroskedasticity test
b) Test of autocorrelation
c) Test of multicollinearity

Only in case when all the tests are sufficient, the model can be stated as statistically significant.

Heteroskedasticity test measures whether the variance of residuals/random components of the model is finite and constant. If yes, the situation is identified as homoscedasticity and the model is correct. Heteroskedasticity will be tested using the Spearman test suitable also for small data samples. SPSS provides the user with respective t-statistics of the Spearman test. The zero hypothesis, expecting homoscedasticity in the data sample, is denied if the t-value is higher then desired level of significance. In our case it will be 0.05% (standard level of significance).

Autocorrelation test is tightly linked with heteroskedasticity test and measures, whether the non-diagonal components of covariance matrix are random. The presence of autocorrelation can – especially in case of dynamic time-series data – cause periodical bias of the results. In case of the data used in the model test in this thesis the autocorrelation presence is very probable. Autocorrelation will be tested using the Durbin-Watson test. The Durbin-Watson test has a range of values between 0 and 4 and the closer the result is to 2, the stronger evidence that there is no autocorrelation in the data set[53].

Multicolinearity test requires that the explanatory variables are not perfectly correlated to each other, so no explanatory variable can be explained by a linear combination of the other explanatory variable. Multicolinearity is acceptable if all the correlation coefficient of explanatory variable are below the level of 0.9 AND in the same time the all the coefficients squared are below the level of R-square (coefficient of the model quality)[54].

Prior to conclusion of results arising from the econometrical tests, the model will be test for the three above mentioned potential data issues[55].

The regression calculation will be executed in SPSS, a statistical software by IBM. All the tests mentioned above are already included in the software, therefore no manual calculation will be done.

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[52] HINDLS, Richard. *Statistika pro ekonomy*. 4. vyd. Praha: Professional Publishing, c2003, pages. 169-186. ISBN 80-86419-52-5.
[53] Study materials for course Basic Econometrics: 05.cviceni - multi,auto. Prague, 2009.
[54] Study materials for course Basic Econometrics: 05.cviceni - multi,auto. Prague, 2009.
[55] This section was taken over from HUŠEK, Roman. *Ekonometrická analýza*. Vol. 1. Prague: Oeconomica, 2007, pages 71-95. ISBN 978-80-245-1300-3.

Model evaluation the final estimation of the model equation will be evaluated by the following methods:

a) **R square statistics (respectively Adjusted R square statistics)** representing the explanatory power of the model. Both, R square and Adjusted R square values can reach max 100%, where the value explains the % of the functional relationships in between of the data explained by the model. In general, the closer to 100%, the more explanatory power is included in the model.

b) ANOVA model p-value for the whole model represents its overall quality. The p-value should be below the chosen coefficient of the statistical significance, in our case 0.05%.

c) Individual coefficients of the explanatory variables are tested with their p-values. If the p-value of the tested coefficient is below the chosen limit – in our case again 0.05% - than the explanatory variable can be stated as statistically significantly explaining a certain part of the model.

Data

The data consists of 10 yearly periods for each of the pension system between years 2002 – 2012. The investment returns for both countries are obtained via OECD Statistics (stats.oecg.org). OECD Statistics offer a net investment return aggregated for the pension system as a whole on yearly basis. OECD describes the calculation of the net investment returns: "Data have been calculated using a common formula for the average nominal net investment return (ratio between the net investment income at the end of the year and the average level of assets during the year). The average real net investment return have been calculated using the nominal interest rate (as described above) and the variation of the consumer price index for the relevant year for all countries..."[56]

I shall however work with gross investment returns to avoid misleading of the results by consumer price index change and therefore the consumer price index change is added to the net investment returns to arrive to gross investment returns on yearly basis. The gross investment returns shall later be identified only as investment returns. The data of consumer prices indices shall be obtained also via OECD Statistics to secure consistency of the data over the whole measured period.

[56] OECD, Accompanying statistical tables.xls, Pension Markets in Focus: 2013 [online]. 2013 [quoted 2014-02-24], Table A9, Available at: http://www.oecd.org/finance/private-pensions/pensionmarketsinfocus.htm

The data regarding market returns for stock index PX (former PX50) were downloaded from websites of the Prague Stock Exchange (www.bcpp.cz)[57], the calculation of the resulting returns were done by the author of this work.

The data for OMX Helsinki 25 (OMXH25, former also known as HEX25[58]) representing the Finnish stock market return was obtained via websites of the Nasdac Nordic Stock Exchange websites (http://www.nasdaqomxnordic.com)[59] and as the same as for PX index, the resulting returns were calculated by the author of this work.

The data referring to long-term treasury bonds' interest rates were obtained via Eurostat statistical portal (epp.eurostat.ec.europa.eu) under folder Long-term interest rates, Maastrich criterion interest rates, table EMU convergence criterion series - annual data (irt_lt_mcby_a). The data description informs that "selection guidelines require data to be based on central government bond yields on the secondary market, gross of tax, with a residual maturity of around 10 years"[60]. The long-term character of the obtained benchmark rate is important to simulate pension funds' long-term character of bonds in their portfolios. The return of 10year national bonds will further be referred to as the risk-free interest rate.

Money market benchmark rate for Czech market portfolio will be presented by 3M PRIBOR rate. Money market instruments tend to have an immediate or a short-term maturity, therefore only a short-term interest rate is used. The data for 3M PRIBOR were obtained via Czech National Bank websites (www.cnb.cz)[61]. The used interest rate is an average of the rate throughout the whole respective year as calculated by CNB.

Money market benchmark for Finland shall be represented by 3M EURIBOR rate. The data were obtained from Euribor-rates website (euribor-rates.eu)[62]. The website does not include one-year average rates, therefore the respective rate was chosen to be the rate on the first business day of the year consequent to the respective year. The length was chosen the same as in case of The Czech Republic to stay consistent with the calculation.

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[57] Burzovní indexy. *Burza cenných papírů Praha, a.s.* [online]. Praha: Burza cenných papírů Praha, a.s., 1988-2014 [quoted 2014-05-05]. Available at: http://www.bcpp.cz/dokument.aspx?k=Burzovni-Indexy

[58] Helsinki Stock Exchange. In: *Wikipedia: the free encyclopedia* [online]. San Francisco (CA): Wikimedia Foundation, 2001- [quoted 2014-05-05]. Available at: http://en.wikipedia.org/wiki/Helsinki_Stock_Exchange

[59] Historical prices. *NASDAQ OMX NORDIC* [online]. NASDAQ OMX Group, Inc. [cit. 2014-05-05]. Available at: http://www.nasdaqomxnordic.com/indexes/historical_prices?Instrument=FI0008900212&InstrumentName=OMX%20Helsinki%2025

[60] Maastricht criterion interest rates (irt_It_mcby): Reference Metadata in Euro SDMX Metadata Structure (ESMS). *Eurostat European Commission* [online]. Eurostat, the statistical office of the European Union [quoted 2014-05-06]. Available at: http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/en/irt_lt_mcby_esms.htm

[61] Sazby PRIBOR: měsíční a roční průměry. *Česká národní banka* [online]. Česká národní banka, 2003 - 2014 [quoted 2014-05-06]. Available at: http://www.cnb.cz/cs/financni_trhy/penezni_trh/pribor/prumerne_form.jsp

[62] Historical euribor rates by year. *Euribor rates: all information on Euribor* [online]. Triami Media [quoted 2014-05-06]. Available from: http://www.euribor-rates.eu/euribor-rates-by-year.asp

The property data for Finland were obtained via KTI server (www.kti.fi)[63] – an agency informing about property development in Finland, providing aggregated data and calculating regular property price indices. The investment returns are provided in each of the annual market report[64].

The following two tables summarizes all the above mentioned downloaded data which shall work as inputs in the latter chapters of this work.

Table 15: Inputs Summary The Czech Republic

	CZ Funds Net Rate of Return [in % p.a.]	CZ Inflation [in % p.a.]	Cz Funds gross Rate of Return (in % p.a.)	PX index as at 31.12.20xx (or closest prior working day)	PX Index of Change (t/t-1)	10year CZ bonds' returns [in % p.a.]	PRIBOR 3M [in %]
2001				394,6		6,31	
2002	3,2	1,8	5,0	460,7	1,17	4,88	3,55
2003	2,2	0,1	2,3	659,1	1,43	4,12	2,28
2004	0,7	2,8	3,5	1032	1,57	4,82	2,36
2005	2,7	1,9	4,6	1473	1,43	3,54	2,01
2006	1,3	2,6	3,9	1588,9	1,08	3,80	2,30
2007	-2,1	3,0	0,9	1815,1	1,14	4,30	3,09
2008	-1,5	6,3	4,8	858,2	0,47	4,63	4,04
2009	-0,6	1,0	0,4	1117,3	1,30	4,84	2,19
2010	0,7	1,5	2,2	1224,8	1,10	3,88	1,31
2011	0,5	1,9	2,4	911,1	0,74	3,71	1,19
2012	0,2	3,3	3,5	1038,7	1,14	2,78	1,00

Own summary from data described above in chapter Data.

Table 16: Inputs Summary Finland

	FIN Funds net Rate of Return [in % p.a.]	FIN Inflation [in % p.a.]	FIN Funds gross Rate of Return [in % p.a.]	OMX Helsinki 25 (HEX25) as at 31.12.20xx (or closest prior working day)	OMX 25 Helsinki Index of Change (t/t-1)	10year FIN bonds' returns [in % p.a.]	EURIBOR 3M [in %]	FIN Property Market Return [in % p.a.]
2001				1 601,0		5,04		
2002	-2,1	1,6	-0,5	1 293,2	0,81	4,98	2,86	6,00
2003	0,4	0,9	1,3	1 531,0	1,18	4,13	2,12	5,80
2004	7,4	0,2	7,6	1 831,0	1,20	4,11	2,09	5,60
2005	12,1	0,6	12,7	2 301,3	1,26	3,35	2,35	7,50
2006	6,2	1,6	7,8	2 910,5	1,26	3,78	3,6	10,10
2007	2,4	2,5	4,9	3 010,1	1,03	4,29	3,782	11,30
2008	-19,7	4,1	-15,6	1 515,7	0,50	4,29	2,221	5,10
2009	14,0	0,0	14,0	2 035,6	1,34	3,74	0,341	3,80
2010	7,1	1,2	8,3	2 628,5	1,29	3,01	0,421	7,00
2011	-5,2	3,4	-1,8	1 942,1	0,74	3,01	0,39	6,00
2012	6,6	2,8	9,4	2 210,0	1,14	1,89	0,131	6,00

[63] The Finnish Property Market. KTI: High Quality Property Information [online]. Helsinki: KTI [quoted 2014-05-07]. Available at:http://kti.fi/en.php?k=18904

[64] Usually in chapter called “Property Investment Market in xxxx” or “Real Estate Market’s Performance in xxxx” in older versions or similar.

Own summary from data described above in chapter Data.

Market Benchmark Interest Rate Calculation

The market benchmark interest rate is calculated as weighted-index of interest rates of asset groups represented in the portfolio of both pension systems. As mentioned above, the benchmark rate for The Czech Republic shall consist of investment returns of shares, bonds and money market interest rate. In case of Finland, the composition shall be enriched by returns of properties and land. The following table indicates weights of each of the asset groups in the resulting benchmark rate and the historical returns of the instruments:

Table 17: Composition of Benchmark Portfolio for The Czech Republic and Historical Returns of the implemented Assets

	Change of PX [in %]	10year CZ bonds' returns [in % p.a.]	PRIBOR 3M [in %]	% share of money market instruments	% share of shares in CZ	%share of bonds in CZ	Remaining % of portfolio wR
2001		6,31		3,96	7,333	83,897	4,81
2002	1,17	4,88	3,55	5,20	6,394	85,647	2,76
2003	1,43	4,12	2,28	7,90	4,902	84,881	2,32
2004	1,57	4,82	2,36	9,61	5,506	82,96	1,93
2005	1,43	3,54	2,01	8,21	7,479	80,302	4,01
2006	1,08	3,80	2,30	6,40	9,89	79,338	4,38
2007	1,14	4,30	3,09	9,56	5,866	75,235	9,34
2008	0,47	4,63	4,04	8,06	2,989	78,89	10,07
2009	1,30	4,84	2,19	10,17	1,617	80,484	7,73
2010	1,10	3,88	1,31	6,77	0,819	84,463	7,95
2011	0,74	3,71	1,19	7,86	0,414	84,507	7,22
2012	1,14	2,78	1,00	9,78	0,212	84,393	5,62

Source: Own calculation, the sources of data are indicated in section Data.

The same approach is applied in case of Finland, despite the fact that in this case the data for buildings and lands' returns are also available and therefore the percentage of not-covered part of the portfolio should be lower.

Table 18: Composition of Benchmark Portfolio for Finland and Historical Returns of the implemented Assets

	% change of OMX25	10year FIN bonds' returns	EURIBOR 3M	Property market FIN	%of money market instruments	% share of assets in FIN	% share of bonds in FIN	% share of real estates	% share of the remaining part of the portfolio wR
2001		5,04			0	28,04	60,12	11,85	0,00
2002	0,81	4,98	2,86	6	0	24,15	62,99	12,85	0,00
2003	1,18	4,13	2,12	5,8	0	28,88	59,03	12,09	0,00
2004	1,20	4,11	2,09	5,6	0,6	35,00	55,20	8,70	0,50
2005	1,26	3,35	2,35	7,5	0,527	38,35	50,89	9,96	0,27
2006	1,26	3,78	3,6	10,1	0,396	43,79	46,32	9,31	0,19
2007	1,03	4,29	3,782	11,3	0,556	46,77	43,07	9,21	0,39
2008	0,50	4,29	2,221	5,1	0,653	33,32	42,56	10,46	13,00
2009	1,34	3,74	0,341	3,8	3,462	40,91	46,48	7,35	1,81
2010	1,29	3,01	0,421	7	0,718	47,57	37,03	8,77	5,91
2011	0,74	3,01	0,39	6	1,434	41,35	40,99	9,09	7,15
2012	1,14	1,89	0,131	6	4,163	37,13	40,60	10,97	7,13

Source: Own calculation, the sources of data are indicated in section Data.

The remaining part of the portfolio is disbursed according to Formula 7 and Formula 8. The resulting return rates R_{Bt} are following:

	RBt Czech	RBt FIN
2001		
2002	0,056	-0,01
2003	0,059	0,08
2004	0,075	0,10
2005	0,065	0,12
2006	0,041	0,14
2007	0,048	0,05
2008	0,027	-0,16
2009	0,050	0,16
2010	0,037	0,17
2011	0,034	-0,10
2012	0,026	0,07
Geomean	0,047	0,052

Authors' calculation, data source indicated in section Data.

The results indicate that the market benchmark for Finnish pension funds will be more volatile and also challenging for the pension funds as the geometrical average calculated according to the Formula 1 is higher than in the case of The Czech Republic.

Hypothesis

The detailed market analysis and conditions in which both pension systems operate indicate that the Finnish pension system will operate with higher investment returns. These investment returns are expected to be created by more efficient asset allocation. As the Czech pension funds invest nearly all the assets in national bonds and money market instruments, the standard deviation of gross annual investment return shall be lower in Czech pension system representing lower acceptance of risk.

An interesting comparison of investment ability shall be provided by Sharpe ratio and adjusted CAPM model.. As the risk factor in both of these indicators will be represented by the "market" investment returns and the approximation of individual investment classes' weights in the pensions portfolio, I do not expect the results to be extremely different between the both systems. The market benchmark portfolio however does not include international diversification and yet I expect that the Finnish pension system will provide its contributors with higher return/risk ratio.

Summary of the hypothesis:

1) The average investment returns are higher in Finland
2) The standard deviation of the returns over the measured period is lower in The Czech Republic
3) The return/risk ratios measured by Sharpe ratio and adjusted CAPM model are in favor of the Finnish pension system
4) The more the pension funds' portfolios consist of shares and real estate (in case of Finland), the higher the investment returns. Contrary to that, the more the portfolio consists of bonds and money market instruments, the less attractive the resulting investment returns.

It is important to note that even if the third hypothesis is confirmed by both methods, the resulting econometric models will most probably be – due to limited data availability – statistically insignificant.

The hypothesis will be tested as ranked in the list above, starting with the first two "easiest hypothesis". The investment returns and their standard deviations is a simple descriptive statistics task, however it shall provide us with a first sight information of how the data looks summarized for all the time periods where the measurement is executed and therefore will also be recalled later when discussing the results of the Sharpe and CAPM model results.

Calculation and Results

Investment returns of the both pension system are calculated as geometrical average of return over the measured period as indentified in Formula 1. It is important to note that such returns are not considered as the returns to the participants, but as investment returns of the invested assets. The first sight indicate that Finnish pension system shall have a higher rate of return with higher associated risk – as also mentioned in the hypothesis of this work.

Table 19: Pension Funds' Investment Returns and Standard Deviations

	CZ	FIN
Gross Rate of Return	2,477	4,049
Std. Dev	1,474	7,938
Return/risk	1,681	0,510

Own calculation, data source is as described above in section Data. Note that the table does not represent returns to the contributors of any of the systems, but only returns as described in section Data.

The reader can see that the Czech pension funds indicate a higher "simple" return per risk ratio. This indicator shall be taken as purely information as it will later be substituted by more accurate calculation based on a similar principle – the Sharpe ratio. The table however indicates that the two hypothesis resulting from the first sight on the calculated data – were both correct. The

Gross Rate of Return in Finland is by 1.573% p.a. higher than in The Czech Republic, however the risk associated with the returns is 5.4 times higher than in case of CZ funds.

The simple comparison of return/risk might indicate that the Sharpe ratio and CAPM results shall not be in favor of the Finnish funds or the gap between both systems might be lower, than initially expected.

Sharpe Ratio Calculation

As mentioned above, the Sharpe ratio calculation is based on its revised version (Sharpe, 1992) which compares the results of funds with a benchmark portfolio instead of risk-free rate. The indicator is based on a simple calculation and therefore shall only work as a supportive indicator of the later calculated CAPM model.

	CZ	FIN
D-bar	-1,868288309	-1,316168789
STDD	1,832839749	4,378866144
Sharpe ratio	-1,019340786	-0,300572967

Own calculation, data source is as described above in section Data.

The Sharpe ratio indicates that the return per risk is more attractive in the Finnish pension system than in the system run by Czech pension companies. This stays in line with the original expectations, however the gap between the results of both system is higher than it was originally expected by the author. Nonetheless the results indicate the direction the results of CAPM model will probably turn into.

Inconsisently with the authors' expectations, the Finnish pension system – as well as the Czech one – has a negative Sharpe's ratio indicating that despite the more creative asset allocation, the system has not reached the return level of the benchmark portfolio.

It is important to note that both, the CAPM model and the Sharpe ratio also – even thought the results are not estimated via statistical regression – are calculated only from a data set consisting of 11 time periods, therefore the results might be significantly affected by the limited number of regressive equations.

CAPM model calculation

The CAPM model will be calculated using the SPSS statistical software – as indicated above in the section describing methods of the calculation. The supportive tests of the model robustness are calculated using the same software. First in this chapter I shall perform the formal test of heteroskedasticity, autocorrelation and multicolinearity presence. The data will not be check for normality as it is obvious from the small data sample, that the normality would be rejected.In the last part of this chapter the results of the CAPM equation will be presented.

The Spearman showing the mutual correlation between variables and its strength indicates that in The Czech Republic the correlation is quite low in case of between the return rates of pension funds and risk-free rate, moderate between the risk free rate and the benchmark portfolio returns and moderate/high between the benchmark portfolio returns and the returns of the pension system.

Table 20: Spearman Correlation Test Czech Data

Correlations

			Rit CZECH	Rft CZECH	RBt Czech
Spearman's rho	Rit CZECH	Correlation Coefficient	1,000	,018	,064
		Sig. (2-tailed)	.	,958	,853
		N	11	11	11
	Rft CZECH	Correlation Coefficient	,018	1,000	,391
		Sig. (2-tailed)	,958	.	,235
		N	11	11	11
	RBt Czech	Correlation Coefficient	,064	,391	1,000
		Sig. (2-tailed)	,853	,235	.
		N	11	11	11

Source: Output of SPSS statistical software, data as described in section Data.

The results are logical as the benchmark portfolio partly consists of the risk-free rate and the benchmark portfolio is adjusted according to the asset allocation in the pension systems in each individual year.

In Finnish data we can see a higher diversification of the portfolio returns, as the benchmark portfolio returns and the actual returns of the pension funds are highly correlated (0.818) and contrary to the results in The Czech Republic, the risk-free rate is negatively correlated to both of the other return rates. This indicates the difference of the composition of the rate of return in The Czech Republic and Finland, where in Finland, the benchmark and actual returns are not composited of the risk-free rate.

Table 21: Spearman Correlation Test Finnish Data

Correlations

			Rit FIN	Rft FIN	RBt FIN
Spearman's rho	Rit FIN	Correlation Coefficient	1,000	-,557	,818**
		Sig. (2-tailed)	.	,075	,002
		N	11	11	11
	Rft FIN	Correlation Coefficient	-,557	1,000	-,411
		Sig. (2-tailed)	,075	.	,209
		N	11	11	11

	RBt FIN	Correlation Coefficient	,818**	-,411	1,000
		Sig. (2-tailed)	,002	,209	.
		N	11	11	11

**. Correlation is significant at the 0.01 level (2-tailed).

Moreover and despite the limited data availability, the correlation between pension systems' actual returns and returns of the benchmark portfolios are correlated at 0.01 level of significance indicating the the benchmark portfolio is a strong estimation of the actual returns. The correlation between risk-free rate and the actual portfolio is significant on 0.1 level which taking into account the limited data sample can also be considered as a strong results.

Normally logarithmic transformation would be suggested, however the data sample includes negative values and forming a model where logarithms of first differences would be calculated does not economically make sense. Therefore the data will be accepted as it is.

Autocorrelation tests are executed directly on the difference between the pension system returns and the risk-free rate and the difference between market portfolio benchmark and the risk-free rate because the Durbin-Watson statistics is directly implemented as one of the regression model tests.

Table 22: Durbin-Watson and R square Test for CAPM model (Czech Data)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,053[a]	,003	-,108	1,827489056891368	2,373

a. Predictors: (Constant), RBt - Rft CZECH

b. Dependent Variable: Rit - Rft CZECH

Source: Output of SPSS statistical software, data as described in section Data.

The Durbin-Watson test indicates that there is no or limited autocorrelation in the model for Czech data as the value 2.373 is very close to the desired value of 2. However it is important to note that the R Square parameter, which generally indicates the robustness of the statistical model is very low – this is caused by the low amount of observations in the data set.

Table 23: Durbin-Watson and R square Test for CAPM model (Finnish Data)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,908[a]	,825	,805	3,832903923562559	2,250

a. Predictors: (Constant), RBt - Rft

b. Dependent Variable: Rit - Rft
Source: Output of SPSS statistical software, data as described in section Data.

The Durbin-Watson test for Finnish data – as well as the one for Czech data – indicates no or limited autocorrelation of the variables. Moreover the R square indicator for the regression robustness indicates that the model is much stronger and more robust than in the case of Czech data.

The explanation of the non-satisfactory results of the model robustness has already been mentioned above, the models strive from the lack of data samples. The potential solutions would either be a logarithmic transformation of the data as set out in the model for asset allocation impact on the resulting return rate, or reducing extreme values from the data set – this would however mean another reducing of the small data set and therefore such adjustment was not executed.

Equation Estimation

Despite the non-satisfactory results of the above proceeded tests especially in case of Czech pension system, I shall present the regression equation from the models for both countries.

The model for estimating the regression equation of the Jensen's alpha in The Czech Republic is in general very week. This has already been identified by the very low level of R square indicator. The low value of R square is supported by the significance level of the F statistics, which in case of The Czech Republic is nearly 87.7% confirming that the model has no explanatory power.

Table 24: CAPM Model Summary (The Czech Republic)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,085	1	,085	,025	,877[b]
	Residual	30,057	9	3,340		
	Total	30,143	10			

a. Dependent Variable: Rit - Rft CZECH

b. Predictors: (Constant), RBt - Rft CZECH
Source: Output of SPSS statistical software, data as described in section Data.

For informational purposes only I shall further present the parameters of the regression equation for Czech data.

Table 25: Coefficients of the CAPM Model and their Significance (Czech data)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1,115	,602		-1,853	,097
	RBt - Rft CZECH	,065	,409	,053	,160	,877

a. Dependent Variable: Rit - Rft CZECH

Source: Output of SPSS statistical software, data as described in section Data.

The significance levels of individual coefficients for the model with use of Czech data comply with the fact that the model has no explanatory power. Any of the coefficient (respectively the significance statistics of the coefficient) can not deny the zero hypothesis meaning that none of the coefficients has an explanatory power to the model. If – hypothetically – the coefficients had an explanatory power and the model had an explanatory power, the output would mean that the constant (in this case the Jensen's Alpha) is negative (-1.115) and that the pension funds underperformance compared to the benchmark portfolio.

Unlike the model for Czech data, the model for Finnish data shows high R square indicator as well as the Adjusted R square indicator. The models' explanatory power is also confirmed by the ANOVA significance statistics.

Table 26: CAPM Model Summary (Finland)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	622,909	1	622,909	42,400	,000[b]
	Residual	132,220	9	14,691		
	Total	755,129	10			

a. Dependent Variable: Rit - Rft

b. Predictors: (Constant), RBt - Rft

Source: Output of SPSS statistical software, data as described in section Data.

The presented model, however not considering the negative results of formal statistical tests as explained above, would have a strong explanatory power. The individual coefficients show that the return above risk-free interest rate is created mainly by the correlation of the portfolio with the benchmark portfolio – therefore the returns are not excessive returns in the meaning of Jensen's Alpha, but reward for additional risk acceptance.

Table 27: Coefficients of the CAPM Model and their Significance (Finnish data)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,766	1,177		-,651	,531

	RBt - Rft	,725	,111	,908	6,512	,000

a. Dependent Variable: Rit - Rft
Source: Output of SPSS statistical software, data as described in section Data.

The individual coefficients indicate that even the pension funds in Finland reach a negative Jensen's Alpha coefficient – hereby represented by the constant of the model. However the influence of the coefficient is not confirmed by its significance statistics. Contrary to that the model (at least) presents a statistically significant relationship between the (i) the first difference between the benchmark portfolio and the risk-free rate and (ii) the first difference between the funds' returns and risk-free rate. This indicates a strong relationship of the funds' performance and their additional risk acceptance.

Asset Allocation Impact on Investment Returns

The model estimating the coefficients of asset allocation impact will be tested for its robustness and strength in the same way as the CAPM model of Jensen's alpha calculation.

First of all I will examine the Spearman correlation test. None of the correlations are statistically significant as it can be seen from the following table – this is again as in the case of the CAPM model caused mainly by the limited set of observations.

Table 28: Asset Allocation Correlations Czech Data

Correlations

			DIFF1 Rit CZECH	DIFF1 Transformed CZECH % share of money market instruments	DIFF1 Transformed CZECH % share of shares in CZ	DIFF1 Transformed CZECH %share of bonds in CZ
Spearman's rho	DIFF1 Rit CZECH	Correlation Coefficient	1,000	-,697*	,152	,333
		Sig. (2-tailed)	.	,025	,676	,347
		N	10	10	10	10
	DIFF1 Transformed CZECH % share of money market instruments	Correlation Coefficient	-,697*	1,000	-,370	-,430
		Sig. (2-tailed)	,025	.	,293	,214
		N	10	10	10	10
	DIFF1 Transformed CZECH % share of shares in CZ	Correlation Coefficient	,152	-,370	1,000	-,345
		Sig. (2-tailed)	,676	,293	.	,328
		N	10	10	10	10

	DIFF1 Transformed CZECH %share of bonds in CZ	Correlation Coefficient	,333	-,430	-,345	1,000
		Sig. (2-tailed)	,347	,214	,328	.
		N	10	10	10	10

*. Correlation is significant at the 0.05 level (2-tailed).
Source: Output of SPSS statistical software, data as described in section Data.

Not considering the statistical insignificance, the strongest positive correlation is between share of bonds and the resulting investment return and the strongest negative correlation is between the share of money market instruments and the resulting investment return. Apparently the share of shares in portfolio has a lower correlation coefficient with the resulting investment return, than the share of bonds.

In case of Finland, there is an additional variable – the share of real estate investments in the funds' portfolios.

Correlations

			DIFF1 Rit FIN	DIFF1 Transformed FIN %of money market instruments	DIFF1 Transformed FIN % share of assets in FIN	DIFF1 Transformed FIN % share of bonds	DIFF1 Transformed FIN % share of real estates
Spearman's rho	DIFF1 Rit FIN	Correlation Coefficient	1,000	-,491	-,576	-,042	,527
		Sig. (2-tailed)	.	,150	,082	,907	,117
		N	10	10	10	10	10
	DIFF1 Transformed FIN %of money market instruments	Correlation Coefficient	-,491	1,000	-,079	,855**	-,297
		Sig. (2-tailed)	,150	.	,829	,002	,405
		N	10	10	10	10	10
	DIFF1 Transformed FIN % share of assets in FIN	Correlation Coefficient	-,576	-,079	1,000	-,430	-,467
		Sig. (2-tailed)	,082	,829	.	,214	,174
		N	10	10	10	10	10
	DIFF1 Transforme	Correlation Coefficient	-,042	,855**	-,430	1,000	-,091

	d FIN % share of bonds	Sig. (2-tailed)	,907	,002	,214	.	,803
		N	10	10	10	10	10
	DIFF1 Transforme d FIN % share of real estates	Correlation Coefficient	,527	-,297	-,467	-,091	1,000
		Sig. (2-tailed)	,117	,405	,174	,803	.
		N	10	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).
Source: Output of SPSS statistical software, data as described in section Data.

There is a statistically significant correlation between the share of bonds in the portfolio and the share of money market instruments (0.855) indicating strong autocorrelation in the data sample. The other correlation coefficients are not statistically significant. Not considering the statistical insignificancy, it is interesting to see that the only positive correlation between the funds' returns and the assets allocation is in the case of real estate investments. This in general indicates that the correlation coefficients are biased due to the limited number of observations as economically such result would mean, that the portfolio increases its returns only when the share of real estate investments is growing and vice-versa with all other forms of investments. The estimation of the regression equation will (hopefully) present us with economically more acceptable results.

Autocorrelation of the explanatory variables will be – as well as in the case of CAPM model – tested with the Durbin-Watson test. The DW value for the asset allocation model in The Czech Republic is slightly lower than the value for CAPM model, nevertheless the value of 2.204 does not indicate any strong autocorrelation.

Table 29: Durbin-Watson and R square Test for Asset Allocation Model (Czech Data)

Model Summary[c,d]

Model	R	R Square[b]	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,632[a]	,400	,143	,022444704344022	2,185

a. Predictors: DIFF1 Transformed CZECH %share of bonds in CZ, DIFF1 Transformed CZECH % share of shares in CZ, DIFF1 Transformed CZECH % share of money market instruments

b. For regression through the origin (the no-intercept model), R Square measures the proportion of the variability in the dependent variable about the origin explained by regression. This CANNOT be compared to R Square for models which include an intercept.

c. Dependent Variable: DIFF1 Rit CZECH

d. Linear Regression through the Origin

Source: Output of SPSS statistical software, data as described in section Data.

The low value of R square indicates that (unfortunately) the regression model will not have any explanatory power. As well as in the case of CAPM model, this is caused by the limited number of observations in the data set.

The Durbin-Watson statistics looks satisfactory also for the same model with Finnish data applied. The value of 1.977 is nearly at the same level of the desired value 2 and therefore the model is considered not to include any autocorrelation.

Table 30: Durbin-Watson and R square Test for Asset Allocation Model (Finnish Data)

Model Summary[c,d]

Model	R	R Square[b]	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,822[a]	,676	,461	,012499	1,977

a. Predictors: DIFF1 Transformed FIN % share of real estates, DIFF1 Transformed FIN % share of bonds, DIFF1 Transformed FIN %of money market instruments, DIFF1 Transformed FIN % share of assets in FIN

b. For regression through the origin (the no-intercept model), R Square measures the proportion of the variability in the dependent variable about the origin explained by regression. This CANNOT be compared to R Square for models which include an intercept.

c. Dependent Variable: DIFF1 Rit FIN

d. Linear Regression through the Origin

Source: Output of SPSS statistical software, data as described in section Data.

Asset Allocation Impact – Estimate of Regression Function

The previous tests did not provide us with a strong expectation of the explanatory power of the tests. As it has been mentioned repeatedly, the key reason is limited data availability, which (unfortunately) can not be solved by any transformation. This section shall therefore at least indicate the approach by which the asset allocation impact would be tested if satisfactory data were available.

First I shall confirm the general strength of the model with a general p-value significance. In case of The Czech Republic, the significance level is too high to be accepted – 0.283. This confirms that the model has no explanatory power and its practical use is nearly impossible.

Table 31: Asset Allocation Model Summary (The Czech Republic)

ANOVA[a,b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,002	3	,001	1,555	,283[c]
	Residual	,004	7	,001		
	Total	,006[d]	10			

a. Dependent Variable: DIFF1 Rit CZECH

b. Linear Regression through the Origin

c. Predictors: DIFF1 Transformed CZECH %share of bonds in CZ, DIFF1 Transformed CZECH % share of shares in CZ, DIFF1 Transformed CZECH % share of money market instruments

d. This total sum of squares is not corrected for the constant because the constant is zero for regression through the origin.

Source: Output of SPSS statistical software, data as described in section Data.

For information purposes, the parameters of the estimated regression equation are as follows:

Table 32: Coefficients of the Asset Allocation Model and their Significance (Czech data)

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	DIFF1 Transformed CZECH % share of money market instruments	-,389	,277	-,653	-1,401	,204
	DIFF1 Transformed CZECH % share of shares in CZ	-,047	,225	-,086	-,209	,841
	DIFF1 Transformed CZECH %share of bonds in CZ	,010	,353	,013	,028	,979

a. Dependent Variable: DIFF1 Rit CZECH

b. Linear Regression through the Origin

Source: Output of SPSS statistical software, data as described in section Data.

The asset allocation model using Czech data does not seem to provide us with any economically defendable data, as both of the explanatory variables have negative coefficients (moreover statistically insignificant) and the only positive coefficient (0.010 in case of bonds) is extremely insignificant from both, economical and statistical perspective.

The general R square indicator was higher in case of the same model filled with Finnish data, which is also noticeable from the p-value of the whole test. Despite not being under the desired 5%, the resulting value of 0.103 is at least limitedly close to the minority-accepted significance level of 10%.

Table 33: Asset Allocation Model Summary (Finland)

ANOVA[a,b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,002	4	,000	3,134	,103[c]
	Residual	,001	6	,000		
	Total	,003[d]	10			

a. Dependent Variable: DIFF1 Rit FIN

b. Linear Regression through the Origin

c. Predictors: DIFF1 Transformed FIN % share of real estates, DIFF1 Transformed FIN % share of bonds, DIFF1 Transformed FIN %of money market instruments, DIFF1 Transformed FIN % share of assets in FIN

d. This total sum of squares is not corrected for the constant because the constant is zero for regression through the origin.

Source: Output of SPSS statistical software, data as described in section Data.

Unfortunately when we turn the attention to the coefficients of the individual betas of each explanatory variable, we discover the same problem as in the case of Czech data measuring.

All the coefficients are negative which in case of a model without a constant already indicates a null economical argumentation.

Table 34: Coefficients of the Asset Allocation Model and their Significance (Finnish data)

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	DIFF1 Transformed FIN %of money market instruments	-,109	,088	-,388	-1,237	,262
	DIFF1 Transformed FIN % share of assets in FIN	-,183	,097	-,745	-1,897	,107
	DIFF1 Transformed FIN % share of bonds	-,182	,124	-,485	-1,462	,194
	DIFF1 Transformed FIN % share of real estates	-,036	,228	-,064	-,160	,878

a. Dependent Variable: DIFF1 Rit FIN

b. Linear Regression through the Origin

Source: Output of SPSS statistical software, data as described in section Data.

Moreover the negative coefficients of the explanatory variables, none of them is statistically significant even on the minority-accepted 10% level. This supports the statement of the null economical explanatory power of the model.

The asset allocation models for any of the countries have not presented us with any economically worth results – not only are the coefficients of the explanatory variables statistically insignificant, but the values assigned to them don't make much of a sense either. Due to lack of data it is statistically impossible to check whether the weak models' results are cause by the lack of data or by incorrect construction of the model or its assumptions.

Conclusion

The main goal of this work was to provide, compare and analyze a complex set of information about the pension systems in The Czech Republic and Finland. The Czech Republic has recently reformed its pension system (effective since 2013) adopting a model which directs the system closer to a form of mutual funds' investing. This is caused by two key factors: (i) the newly created funds will not have to comply with the Black-zero system and (ii) the regulations for asset allocation in these funds is less strict than prior to the reform. A system with similar regulations is set up in Finland and therefore the comparison provides a forward looking approach to where pensions in The Czech Republic might be heading.

Finland is currently economically much more developed than The Czech Republic with the GPD per head 32.6 % higher, yet the demographic situation is worse than in The Czech Republic with only 3.2 active workers per pensioner, which is one of the lowest rates among all the OECD-inclusive countries.

The analysis shows that asset allocation in both countries is limited by similar regulatory constraints on exposure to individual asset groups like shares or bonds. Additionally both systems are governed by similar accounting principles, yet the asset allocation is significantly different. Unlike in The Czech Republic, the assets in Finnish pension funds are diversified through all available asset groups both, domestic and international. For example the percentage of Finnish funds' investments held in shares in the period between 2002-2012 averages to 37.11% and the real-estate component averages to 10.05%. In The Czech Republic the shares averaged only 4.45% and the real-estate component is nearly omitted on behalf of 82.08% of assets held in bonds.

One of the assumptions of this work was that such differences would result in a significant gap in average long-term investment returns. The gap however reaches only 1,53 % p.a., where Finnish pension funds' investment return is "only" 4 % p.a. Such result is however affected by the extreme negative return of Finnish pension funds at the peak of the financial crisis in 2008 (minus 15.6% annualized).

The implementation of riskier assets in general induces higher volatility of portfolios. The Sharpe ratio between the level of return and risk indicates that the Finnish funds outperform the Czech ones as the Finnish funds reach a Sharpe ratio of minus 0.3 and Czech funds of minus 1.09. The outperformance is also confirmed by an adjusted CAPM model and Jensen's Alpha calculation. The pension funds in The Czech Republic reach Jensen's Alpha of minus 1.115 % p.a. which turns into a result of 0.35% p.a. then in the case of Finland (minus 0.776% p.a.).

I subjectively expected the outperformance of the Finnish pension funds over the Czech ones from the first look at the available data. The negative Jensens' Alpha returns in case of the Finnish funds however was not expected. It's important to note at this stage, that due to the limited data availability, the sample included only eleven observations which are not enough to arrive at a statistically significant result of a regression model.

The lack of data unfortunately also affected the last model indicating the impact of individual asset groups on the resulting investment returns. The idea was to decompose the returns and examine the effect of adding a specific asset group to a pension funds' portfolio. The tests' results were presented in the previous chapter however their economic justification could be misleading. Despite the unreliability of the statistical models I believe that the logical hypothesis behind it is not incorrect and it would be interesting to perform the test with sufficient data set.

After analyzing both of the pension systems, their pros and cons and the long-term results, I believe that the reform of the Czech third pillar pension system will in the long-term lead to progressive asset diversification and result in higher long-term returns. The key factor is that the pension funds funded after 1st January 2013 do not have to comply with the so-called Black-zero system and therefore might provide the contributors with riskier investment strategies.

On the other hand it is important to note that such strategies will be linked with higher volatility of portfolio values which might not be suitable for every pension contributor. The undisputable advantage of the reformed system, however is that unlike the current system it provides opportunities for all - conservative, moderate or aggressive - investors.

Definitions

"Act 42/2004" defines Act No. 42/2004 Coll. State-Contributory Supplementary Pension Insurance Act *(Zákon č. 42/2004 Sb. o penzijním připojištění se státním příspěvkem a o změnách některých zákonů souvisejících s jeho zavedením)* understood with all its´ amendments.

"Act 427/2011" defines Act No. 427/2011 Coll. Supplementary Pension Insurance *(Zákon č. 427/2011 Sb. o doplňkovém penzijním připojištění).*

"Act 563/2001" defines Act No. 563/2001 Coll. Accounting Act (*Zákon č. 563/2001 Sb. O účetnictví).*

"APF" defines the Association of Pension Funds of The Czech Republic.

"Black-zero System" has the meaning given to it in Section Pension System Reform and Legal Background.

."**CNB"** shall have the meaning of Czech National Bank – in this paper mostly mentioned as the regulatory and screening entity of the Czech financial market.

"CR" shall have the meaning of The Czech Republic.

"CZK" shall have the meaning of Czech Crowns as legal currency in The Czech Republic.

"EEA" shall have the meaning of the European Economic Area.

"ECB" shall have the meaning of the European Central Bank.

"EIB" shall have the meaning of the European Investment Bank.

"IMF"shall have the meaning of the International Monetary Fund.

"Member State" shall have the meaning given to it in Act 427/2011- means a state which is a member of either European Union or European Economic Area (also EEA).

"New Fund" shall have the meaning of any fund formed under new legislation regimes defined in Act 427/2011 (as defined above). New fund is either an Obligatory Conservative Fund or a Participants´ Fund.

"New Pension System" shall have the meaning of pension system defined under Act 427/2011 Coll. effective in The Czech Republic since 1st January 2013 and later.

"Notice 501/2002" shall have the meaning of Notice 501/2002 Coll supplementary to the Act 563/2001 as defined above.

"Obligatory Conservative Fund" shall have the meaning of a fund obligatorily operated by a Pension Company under specific rules defined in Act 427/2011 Section 7 §93-117, particularly §95 and §98.

"OECD" shall have the meaning of the Organization for Economic Co-operation and Development.

"Old Pension System" shall have the meaning of the system of pension funds regulated by Act 42/1994 applicable until end of 2012.

"Participants´ Fund" shall have the meaning voluntarily founded fund by a Pension Company also as defined in Act 427/2011 Section 7 §93-117.

"PAYGO" shall have the meaning of pay-as-you-go system of financing pension funds defined in Section Financing of Pension Systems of this thesis.

"Pension Fund" shall have the meaning of Transformed Funds and New Funds together.

"Pension Company" shall have the meaning of a legal entity in form of joint-stock company operating one or more pension funds as defined under Section IV §29-73 of Act 427/2011.

"Regulated Bank" shall have the meaning of a bank (i) a bank with registered seat in The Czech Republic, or (ii) a bank with registered seat in a Member State (as defined above), or (iii) a bank not registered in any other state if CNB accepts its prudential rules equivalent to those in European Union

"Transformed Fund" shall have the meaning of pension funds formed before the system was reformed (effectively since 1st January 2013). Such funds are managed by the Pension companies under different conditions specified in Act 427/2011 §171-196

"TELA" shall have the meaning of The Finnish Pension Alliance TELA managing most of the Finnish pension funds.

"WB" shall have the meaning of the World Bank

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Sources

Articles and Publications

[1] BOHL, Martin T., Judith LISCHEWSKI a Svitlana VORONKOVA. Pension Funds' Performance in Strongly Regulated Industries in Central Europe: Evidence from Poland and Hungary. *Emerging Markets Finance & Trade*. 2011, Volume 3, 15 pages. DOI: 10.2307/23047102. Available at: http://www.jstor.org/stable/23047102

[2] CIPRA, Tomáš. Pojistná matematika: teorie a praxe. 2., actualized and extended edition. Prague: Ekopress, c2006, 411 pages. ISBN 80-869-2911-6.

[3] FOX, John, Sanford WEISBERG a John FOX. An R companion to applied regression. 2nd ed. /. Thousand Oaks, Calif.: SAGE Publications, c2011, xxii, 449 p. ISBN 14-129-7514-X.

[4] GRIFFIN, Mark. A Global Perspective on Pension Fund Asset Allocation. Financial Analyst Journal. 1998, year 1998, number 54. Available at: http://www.jstor.org/stable/4480067

[5] HINDLS, Richard. *Statistika pro ekonomy*. 4. vyd. Praha: Professional Publishing, c2003. ISBN 80-86419-52-5.

[6] HUŠEK, Roman. *Ekonometrická analýza*. Vol. 1. Prague: Oeconomica, 2007. ISBN 978-80-245-1300-3.

[7] JENSEN, Michael. The Performance of Mutual Funds in the Period 195-1964. *Journal of Finance*. 1967, No. 2, 37 pages. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=244153, page 1, abstract.

[8] MUSÍLEK, Petr. Trhy cenných papírů. 2., actualized and extended edition. Prague: Ekopress, 2011, 520 pages. ISBN 978-80-86929-70-5.

[9] OECD. Annual Survey of Investment Regulation of Pension Funds: 2013. OECD, 2013, 130 pages. Available at: http://www.oecd.org/finance/private-pensions/annualsurveyofinvestmentregulationofpensionfunds.htm

[10] OECD. Pension Markets in Focus: 2013 [online]. 2013 [quoted 2014-02-24]. Available at: http://www.oecd.org/pensions/PensionMarketsInFocus2013.pdf

[11] OECD. Pensions at a Glance 2013: OECD and G20 Indicators, OECD Publishing. Available at: http://dx.doi.org/10.1787/pension_glance-2013-en

[12] OECD. SURVEY OF INVESTMENT REGULATION OF PENSION FUNDS: August 2012. OECD, 2012, 130 pages [online]. Available at:

http://www.oecd.org/daf/fin/private-pensions/2011SurveyOfInvestmentRegulationsOfPensionFunds.pdf

[13] SHARPE, William. Mutual Fund Performance. *The Journal of Business*. 1966, Vol. 39, No. 1, Part 2: Supplement on Security Prices, 19 pages.

[14] SHARPE, William. The Sharpe Ratio. *The Journal of Portfolio Management*. Fall 1994. Available at: http://www.stanford.edu/~wfsharpe/art/sr/SR.htm#fn3

[15] THE FINNISH PENSION ALLIANCE TELA. *Principles for Responsible Investment of the Finnish Pension Alliance TELA* [online]. 2008, Available at: http://www.tela.fi/instancedata/prime_product_julkaisu/tela/embeds/telawwwstructure/14196_130208PrinciplesForResponsibleInvestmentOfTheFinnishPensionAllianceTELA.pdf

Electronic sources

[1] AXA PENZIJNÍ SPOLEČNOST, a.s. Annual Report 2012. Brno, 2013.

[2] CZECH NATIONAL BANK. Česká národní banka [online]. 2003 - 2013. Available at: http://www.cnb.cz/cs/index.html

[3] CZECH STATISTICAL OFFICE. Český statistický úřad [online] 2013. Available from: http://www.czso.cz/

[4] FINNISH CENTRE FOR PENSIONS. *Finnish Centre for Pensions: Expert on earnings-related pension provision* [online]. Finnish Centre for Pensions, 2014. Available at: www.etk.fi

[5] Helsinki Stock Exchange. In: *Wikipedia: the free encyclopedia* [online]. San Francisco (CA): Wikimedia Foundation, 2001-. Available at: http://en.wikipedia.org/wiki/Helsinki_Stock_Exchange

[6] Historical euribor rates by year. *Euribor rates: all information on Euribor* [online]. Triami Media. Available from: http://www.euribor-rates.eu/euribor-rates-by-year.asp

[7] Historical prices. *NASDAQ OMX NORDIC* [online]. NASDAQ OMX Group, Inc. Available at: http://www.nasdaqomxnordic.com/indexes/historical_prices?Instrument=FI0008900212&InstrumentName=OMX%20Helsinki%2025

[8] KANTOR, Milan. Komentář Asociace penzijních společností ČR k vybraným obchodním a ekonomickým výsledkům za 4. čtvrtletí 2013. In: Komentář k výsledkům za rok 2013 [online]. 2013 [quoted 2014-03-01]. Available at: http://www.apfcr.cz/cs/komentare-dane/komentar-k-vysledkum-za-rok-2013.html

[9] Maastricht criterion interest rates (irt_lt_mcby): Reference Metadata in Euro SDMX Metadata Structure (ESMS). *Eurostat European Commission* [online]. Eurostat, the statistical office of the European Union. Available at: http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/en/irt_lt_mcby_esms.htm

[10] OECD. OECD Statistic (GDP, unemployment, income, population, labour, education, trade, finance, prices, health, debt...)

[11] PRAGUE STOCK EXCHANGE [online]. Praha: Burza cenných papírů Praha, a.s., 1988-2014. Available at: www.bcpp.cz

[12] Private pensions: OECD classification and glossary = Les pensions privées : classification et glossaire de l'OCDE [online]. Paris, France, c2005, 102 p. ISBN 978-926-4016-996.

[13] Sharpe Ratio. *Morningstar: Independent Investment Research* [online]. Morningstar, 2014. Available at: http://www.morningstar.com/InvGlossary/sharpe_ratio.aspx

[14] State-Contributory Supplementary Pension Insurance Act. In: Coll. 1994, No. 42. Available at: http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/en/legislation/acts/download/act_42_1994.pdf

[15] Supplementary Pension Insurance Act. In: Coll. 2011, No. 427. Available at: http://business.center.cz/business/pravo/zakony/doplnkove-penzijni-sporeni/

[16] *Study materials for course Basic Econometrics: 05.cviceni - multi,auto*. Prague, 2009.

[17] THE ASSOCIATION OF PENSION COMPANIES OF THE CZECH REPUBLIC. APF CR [online]. 2009. Available from: http://www.apfcr.cz/en/

[18] The Finnish Property Market. KTI: High Quality Property Information [online]. Helsinki: KTI. Available at:http://kti.fi/en.php?k=18904

[19] ZAVADILOVÁ, Tereza. Penzijní fondy ČP a Generali se sloučí. Penzijní fondy ČP a Generali se sloučí [online]. 2013 [cit. 2014-03-01]. Available at: http://zpravy.e15.cz/byznys/finance-a-bankovnictvi/penzijni-fondy-cp-a-generali-se-slouci-996945

[20] Zhodnocení penzijních fondů za rok 2012: Žádná sláva. Investujeme.cz [online]. 2013. Available from: http://www.investujeme.cz/zhodnoceni-penzijnich-fondu-za-rok-2012-zadna-slava/