

Charles University in Prague

Faculty of Social Sciences
Institute of Economic Studies



MASTER'S THESIS

**The supplementary pension savings
scheme in the Czech Republic:
Microeconomic evidence of the
2013 policy change**

Author: **Bc. Adam Rückl**

Supervisor: **Petr Janský, Ph.D.**

Academic Year: **2016/2017**

Declaration of Authorship

The author hereby declares that he compiled this thesis independently; using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

The author grants to Charles University permission to reproduce and to distribute copies of this thesis document in whole or in part.

Prague, January 6, 2016

Signature

Acknowledgments

I would like to express my gratitude to my supervisor Petr Janský for his encouragement and excellent cooperation. My acknowledgement also deserves Jiří Šatava for valuable discussions and comments. Finally, I would like to thank to all of my family and beloved for their endless support.

Bibliographic record

Rücl, A., 2017. *The supplementary pension savings scheme in the Czech Republic: Microeconomic evidence of the 2013 policy change*. Master's thesis. Charles University in Prague

Character count: 168634

Abstract

The thesis investigates determinants of participation in the supplementary pension savings scheme in the Czech Republic and estimates their change with respect to the policy intervention realized in 2013. Using the time series of cross-sectional microeconomic data provided by the Statistics on Income and Living Conditions, the probability of participation and the level of contributions are estimated separately by probit and multiple linear regressions, respectively. The estimated coefficients of both models are tested for structural differences caused by the policy change, employing the pooled dataset of multiple years with additional coefficients to treat the compared period. The analysis confirms that income, age, education and economic activity have a positive effect on both the probability of participation and expected level of contributions. Whereas gender differences for the level of contributions have not been detected, single women on average show, *ceteris paribus*, 4.6 percentage points higher probability of participation than single men. Unexpectedly high level of activity was observed in case of retired individuals, who in 2014 represented approximately 15% of all participants and collected 20% of the credited direct state subsidy. With respect to the 2013 policy change, no evidence of a significant long-term effect on the participation rate was found. In terms of contributions, the intervention registered a positive impact in general, however the greatest response was observed in case of older and higher educated individuals. In contrast, the low-income, young and less-educated individuals were affected with lower intensity, suggesting that the policy change failed to diminish the existing disparities in participation of various population groups.

JEL Classification

J32, J11, H24, C21, C25

Keywords

supplementary pension savings scheme, Czech Republic, determinants of participation, policy change, regression analysis, probit

Author's e-mail

ruckladam@gmail.com

Supervisor's e-mail

jansky.peta@gmail.com

Abstrakt

Diplomová práce se věnuje výzkumu determinantů účasti v doplňkovém penzijním spoření v České republice a odhaduje jejich změnu spojenou s reformou provedenou v roce 2013. S použitím časové řady průřezových mikroekonomických dat, získaných z výběrového šetření Příjmů a životních podmínek domácností, jsou za pomoci probit regrese odhadnuty koeficienty modelu vyjadřujícího pravděpodobnost účasti v penzijním spoření. Dále jsou pomocí lineární regrese metodou nejmenších čtverců odhadnuty koeficienty modelu vyjadřujícího očekávanou výši příspěvků účastníka. Oba modely, rozšířené o dodatečné koeficienty proměnných pro srovnávané období, jsou poté testovány na přítomnost strukturálních změn v souvislosti s provedenou reformou na sloučeném datasetu zahrnujícím data z více let. Výsledky analýzy potvrzují, že výše příjmu, věk, vzdělání a ekonomická aktivita účastníka mají kladný efekt jak na pravděpodobnost účasti, tak na očekávanou výši příspěvků. Zatímco v případě samotné výše příspěvků nebyly zjištěny rozdíly mezi pohlavími, svobodné ženy vykazují o 4,6 procentních bodů vyšší pravděpodobnost účasti než svobodní muži. Překvapivě vysoká míra aktivity v penzijním spoření byla zjištěna v případě starobních důchodců, kteří v roce 2014 představovali přibližně 15% všech účastníků, a kterým bylo přiznáno 20% všech státních příspěvků účastníkům. V souvislosti s reformou z roku 2013 nebyly zjištěny důkazy potvrzující významný dlouhodobý efekt na míru účasti v doplňkovém spoření. V případě příspěvků byl zjištěn pozitivní efekt intervence napříč všemi populačními skupinami, avšak největší reakce byla zaznamenána v případě starších a více vzdělaných jedinců. V kontrastu s tím se změna projevila méně u lidí mladých, s nižšími příjmy a nižším vzděláním, což naznačuje, že se prostřednictvím reformy nepodařilo oslabit přetrvávající nerovnosti v účasti jednotlivých populačních skupin.

Klasifikace

J32, J11, H24, C21, C25

Klíčová slova

doplňkové penzijní spoření, Česká republika, determinanty participace, reforma, regresní analýza, probit

E-mail autora

ruckladam@gmail.com

E-mail vedoucího práce

jansky.peta@gmail.com

Contents

List of Tables	vi
List of Figures.....	vii
Acronyms	viii
Master's Thesis Proposal.....	ix
1 Introduction.....	1
2 Theoretical background and literature review	6
2.1 Motives for savings.....	6
2.2 Retirement savings and empirical behavior of participants in private pension savings schemes	9
2.3 Evidence from the Czech Republic and assumptions regarding the policy change in 2013	14
2.4 Hypotheses related to the policy change in 2013	17
3 Methodology	21
3.1 Data description	21
3.2 Empirical methods and model set-up	26
4 Results and discussion	35
4.1 Aggregate data	35
4.2 SILC results (microeconomic data)	40
4.3 Results summary.....	71
4.4 Possible measures for improvement	75
5 Conclusion	78
6 Bibliography	81
7 Appendix 1 - Pension scheme in the Czech Republic	87
7.1 Mandatory pension scheme	88
7.2 Supplementary pension savings scheme.....	99
8 Appendix 2.....	103

List of Tables

Table 1.1: The amount of monthly direct state subsidy	4
Table 3.1: Supplementary pension scheme - aggregate statistics overview (source: MFCR)	22
Table 3.2: T-test statistics for participation rate (SILC vs. true population)	25
Table 3.3: T-test statistics for average contributions (SILC vs. true population)	26
Table 4.1: SILC participation rate 2014, incl. 95% confidence interval	41
Table 4.2: Summarized change of average annual contributions between 2011 and 2014, by individual groups, nominal value (CZK) and relative change (%)	53
Table 4.3: Summary statistics - participation	54
Table 4.4: Spearman's rank correlation matrix (participation).....	55
Table 4.5: Participation – results (probit), year 2014; predicted probabilities	57
Table 4.6: Predicted marginal probabilities of participation (at means, 2014).....	58
Table 4.7: Participation – results (probit), test for change in coefficients (years 2010 – 2014, consecutively)	60
Table 4.8: Participation – results (probit), test for change in coefficients Years 2010 and 2011 against 2013 and 2014, individually)	61
Table 4.9: Predicted marginal probabilities of participation (at means, 2010-14)	62
Table 4.10: Summary statistics - contribution (restricted data)	63
Table 4.11: Correlation matrix (contributions – numerical variables).....	64
Table 4.12: Spearman's rank correlation matrix (contributions).....	64
Table 4.13: Contribution– results (OLS), year 2014	65
Table 4.14: Contribution – results (OLS), test for change in coefficients (years 2010 – 2014, consecutively)	67
Table 4.15: Contribution – results (OLS), test for change in coefficients Base: pooled 2010 - 2012; D = after policy change, pooled 2013 - 2014	69
Table 4.16: Contribution– results (OLS), by years individually	70
Table 4.17: Estimated subsidy granted to pensioners in 2014.....	77

List of Figures

Figure 2.1: Direct state subsidy compared to the contribution of the participant.....	16
Figure 4.1: Number of participants in the 3 rd pillar of the pension scheme.....	35
Figure 4.2: Participation rate in the 3 rd pillar of the pension scheme (individuals > 18 years old).....	36
Figure 4.3: Average monthly contribution in CZK (both new and old scheme)	38
Figure 4.4: Contributions of participants per 1 CZK of state subsidy granted	39
Figure 4.5: Average annual contributions (CZK) and participation rate (%)	40
Figure 4.6: Year-to-year change in average annual contributions and participation rate (%).....	42
Figure 4.7: Histogram of annual contributions (CZK, comparison 2011 vs. 2014) ...	43
Figure 4.8: Participation rate by year and income decile (%).....	44
Figure 4.9: Average annual contributions by year and income decile (CZK)	44
Figure 4.10: Annual contributions as % of net income by year and income decile....	45
Figure 4.11: Average annual contributions (CZK, left axis) and participation rate by year and gender (% , right axis)	46
Figure 4.12: (Left) Participation rate by year, gender and marriage (%).....	47
Figure 4.13: (Right) Average annual contributions by year, gender and marriage (CZK).....	47
Figure 4.14: (Left) Participation rate by year and age cohort (%).....	48
Figure 4.15:(Right) Average annual contributions by year and age cohort (CZK)	48
Figure 4.16: Annual contributions as % of net income by year and age cohort	49
Figure 4.17: (Left) Participation rate by year and education (%)	50
Figure 4.18: (Right) Average annual contributions by year and education (CZK)	50
Figure 4.19: Annual contributions as % of net income by year and education	51
Figure 4.20: (Left) Participation rate by year and economic activity (%)	52
Figure 4.21: (Right) Average annual contributions by year and econ. act. (CZK).....	52
Figure 4.22: Histogram of residuals and fitted vs. observed contributions in 2014 ...	65

Acronyms

PAYG	Pay as you go
CZSO	Czech Statistical Office
CSSA	Czech Social Security Administration
MLSA	Ministry of Labour and Social Affairs of the Czech Republic
SPI	Supplementary pension insurance (3 rd pillar before 2013)
SPS	Supplementary pension savings scheme (3 rd pillar after 2013)
OLS	Ordinary Least Squares
LDV	Limited Dependent Variable
MLE	Maximal Likelihood Estimator

Master's Thesis Proposal

Author:	Bc. Adam Rückl
Supervisor:	Mgr. Petr Janský, M.Sc., Ph.D.
Defense Planned:	February 2017

Proposed Topic:

The government-subsidized supplementary retirement savings scheme:
Estimating the impact of a policy change in 2013

Motivation:

One of the most important features of a modern welfare state of the European type is the presence of an efficient public retirement scheme. However, under the pressure of the demographic development with ageing population, retirement schemes financed from public budgets are facing a difficult challenge (Schneider, 2011). In order to maintain a quality life in higher age, governments of a wide range of EU countries develop new concepts of retirement saving schemes, allowing citizens to generate subsidized individual retirement savings and increase their independence on the so far usual “pay as you go” (PAYG) pensions (Berk, 2013).

This is also the case of the Czech Republic, where a reform of the retirement system was introduced in 2011. Together with the existing retirement scheme (1st pillar) based on the PAYG principle, citizens were allowed to save their individual finance in the supplementary retirement savings scheme (3rd pillar). The supplementary scheme offered several benefits of which the most important was the state subsidy in form of a contribution dependent on the amount deposited by the participant.

In 2013, a new policy for the 3rd pillar subsidy started to take effect. Among other changes, the minimal monthly deposit required to claim a state contribution increased to 300 CZK, whereas the cap on the deposit providing the highest possible contribution was increased from 500 to 1000 CZK. Participants saving below 300 CZK per month were therefore motivated to increase their deposits to claim the subsidy. Furthermore, previous research showed that a substantial part of participants were optimizing their level of deposits in order to maximize the state contribution to deposit ratio and a continuing trend can be expected (Janský, 2013).

According to Munell (2001) and Huberman (2007), the presence and a level of compensation provided by the third party (state, employer) belongs to the most influential features affecting the savings related decision making. With a sufficient time lag and the data availability, the policy change gives us a great opportunity to examine the behaviour of participants in the supplementary scheme and estimate the effects on the levels of their participation and contribution.

Another question related to the supplementary savings scheme also arises. Before 2013, a relatively low activity of young and low-income citizens was observed (Janský, 2013). In scope of my interest stands whether the government succeeded in increasing the participation level of these groups. One of the goals of the thesis will be to discuss which measures might enhance the activity of participants and estimate their future impacts on the supplementary retirement scheme.

Hypotheses:

1. Hypothesis #1: The policy change in 2013 increased the average level of contribution to the supplementary retirement savings scheme
2. Hypothesis #2: The policy change in 2013 had no significant positive effects on the level of participation in the supplementary retirement savings scheme.
3. Hypothesis #3: The level of activity in the supplementary retirement savings scheme remains relatively low in case of young and/or low-income citizens.

Methodology:

Prior testing the hypotheses I will examine studies related to the concept of individual (supplementary) retirement saving schemes and academic papers analysing the retirement scheme in the Czech Republic. Spurný (2014), Schneider (2011) and Janský (2013) provide an insight and assess the current Czech pension scheme situation. On the other hand, Honekamp (2010) and Booth (2015) focus on analysing changes in the pension scheme policy in Germany and United Kingdom. Finally, variables determining the participation and contribution in the US individual savings plan are discussed for example by Huberman (2007) and Munell (2001).

To obtain the relevant data for further research I will rely on two main sources. The Ministry of Finance of the Czech Republic offers a general overview of the supplementary retirement schemes with an aggregated statistics. For testing the hypotheses the disaggregated data are required. A suitable source is the EU Statistics on Income and Living Conditions (SILC) accessible via the Czech Statistical Office. Very valuable data could be obtained from commercial institutions which are managing individual pension funds. The availability of this source cannot be unfortunately guaranteed and it will be used for further analysis only in case I will be able to obtain the data.

For the analysis of the policy effects I will employ traditional econometric tools used for regression analysis. Taking into account the data structure, a proper model will be constructed and estimated by a suitable regression method. In the related literature, authors estimate the level of participation using Limited Dependent Variable (LDV) models based on probabilistic or logistic functions. (Huberman 2007; Munell 2001). To measure the level of contribution, I will construct a linear model with a combination of dummy variables and estimate it by the OLS method.

Expected Contribution:

The most important contribution of my research will be the estimation of effects of the policy change related to the government-subsidized supplementary retirement savings scheme and examination of hypotheses concerning the reaction of participants in levels of their participation and contribution. These results will review the impact of the change and may be very useful in determining the effective future policy for the supplementary retirement scheme in the Czech Republic as well as in other countries. Another outcome of my work should be the discussion how to motivate low participating groups to increase their activity in the individual retirement scheme. I will also estimate the expected impact of feasible solutions. As a “side product”, the study will offer an overview of the actual shape of the government-subsidized supplementary retirement savings scheme in the Czech Republic.

Outline:

1. Motivation: the policy change introduced in 2013 allows us to estimate its effects on the behaviour of participants in the supplementary retirement saving scheme
2. Supplementary retirement saving schemes concepts, literature review and practical examples
3. Retirement scheme in the Czech Republic, introduction of the data on the supplementary saving scheme
4. Hypotheses and methods: econometric approach to estimation
5. Results: discussion and verification of hypotheses
6. Concluding remarks: summarization of findings and their implications for future policy development

Core Bibliography:

1. Berk, A., Cok, M., Kosak, M. & Sambt, J.. (2013). CEE Transition from PAYG to Private Pensions. *Finance a Uver* [online], vol. 63, no. 4, pp. 360-381. Available from: <http://search.ebscohost.com/login.aspx?direct=true&db=bth&an=90041049&scope=site> [cit. 2016-01-31]
2. Burger, C. 2014. Geography of Savings in the German Occupational Pension System. *Regional Studies* [online], vol. 48, no. 7, pp. 1176-1193. [cit. 2016-01-31]
3. Huberman, G., Iyengar, S. S., Jiang, W. (2007). Defined contribution pension plans: determinants of participation and contributions rates. *Journal of Financial Services Research*, 31(1), 1–32.
4. Janský, P. (2013). Účastníci penzijního připojištění. Národohospodářský ústav AV ČR. Retrieved from http://idea.cerge-ei.cz/files/IDEA_Studie_3_2013.pdf
5. Munnell, A. H., Sundén, A., Taylor, C. (2001). What determines 401 (k) participation and contributions. *Soc. Sec. Bull.*, 64, 64.
6. Peeters, M. (2012). Better safe than sorry - Individual risk-free pension schemes in the European Union. [online]. Available from: <http://search.ebscohost.com/login.aspx?direct=true&db=edsupe&an=edsupe.33612&scope=site> [cit. 2016-01-31]
7. Poterba, J. M., Venti, S. F., Wise, D. A. (1996). How Retirement Saving Programs Increase Saving. *The Journal of Economic Perspectives*, 10(4), 91–112. Retrieved from <http://www.jstor.org/stable/2138556>
8. Rytířová, L., (2013). *Důchodový systém v České republice*. 1st ed. Anag
9. Schneider, O. (2011). Penzijní dluh – Břímě mladých. Národohospodářský ústav AV ČR. Retrieved from http://idea.cerge-ei.cz/documents/Studie_2011_02_Penze.pdf
10. Schneider, O. (2011). *Důchodové systémy v Evropě: Reformují všichni*. Národohospodářský ústav AV ČR. Retrieved from http://idea.cerge-ei.cz/documents/kratka_studie_2011_06.pdf
11. Schneider, O., Šatava, J. (2012). Český důchodový systém na rozcestí: Pro koho je výhodný přechod do druhého pilíře? Národohospodářský ústav AV ČR. Retrieved from http://idea.cerge-ei.cz/documents/studie_2012_04.pdf
12. Spurný, J., (2014). Master's Thesis: Pension reform in the Czech Republic and its risks. Brno University of Technology
13. Wooldridge, J. (2009). *Introductory Econometrics: A Modern Approach*. 4th ed. Mason, OH: South Western, Cengage Learning
14. World Bank. (1994). *Averting the Old Age Crisis: Policies to Protect the Old and Promote Growth*. World Bank Publications.

Author

Supervisor

1 Introduction

One of the most important features of a modern welfare state of the European type is the presence of an efficient public retirement scheme. Since the first half of the 20th century, the retirement savings of inhabitants in the Czech Republic have been concentrated in the mandatory pension scheme, administered by the government and continuously funded on the principle of “pay as you go” (PAYG). The scheme has been serving as a reliable tool to provide a financial security for retired inhabitants, but in the last decades there were raised concerns about its sustainability in the not too distant future. Similarly as in many other European countries, under the pressure of an unfavourable demographic development with ageing population, the continuously funded pension scheme is facing a difficult challenge (Schneider, 2011). As the fragile stability of the PAYG-based scheme was put into question, in order to maintain a quality life after retirement, the Czech policy makers developed new concepts of retirement saving schemes, allowing citizens to generate individual private retirement savings and increase their independence on the previously exclusive PAYG pensions (Berk et al., 2013).

In parallel to the existing retirement scheme (1st pillar), individuals were allowed to save their private funds in the supplementary pension insurance scheme, in the Czech Republic originally established in 1994. The supplementary scheme offered several benefits, of which the most important was the state subsidy in the form of a contribution dependent on the amount deposited by the participant. The subsidized pension scheme gained in popularity and by the year 2011 the number of participants exceeded 4.5 million. Nowadays, with more than 4.6 million participant contracts in 2016, approximately 70% of economically active population is enrolled. Unfortunately, only relatively few participants show a commitment to generate sufficient savings that could serve as an important source of income in retirement. According to the Ministry of Labour and Social Affairs, funds from the state budget (mostly from the mandatory pension scheme) represented on average 95 % of all retirement income in 2011, providing evidence that the goal of the third pillar to reduce the dependence on the government funds has not been achieved.

So far the most important incentive to partially privatize the pension system in the Czech Republic represented the reform introduced by the Act 427/2011, which came

into force in January 2013. The reform launched the so-called second pillar of the pension scheme, which allowed participants to redirect a part of their contributions from the mandatory scheme (the first pillar) to a private pension fund. However, the Czech political representation failed to reach a consensus on the parameters of the reform, and the second pillar was terminated after only two years of its existence. In the context of this development, even more than before arises question, what are the key factors determining whether an individual participates in the supplementary pension scheme and by what amounts he or she contributes, as the third pillar now remains to be the only official alternative for diversification of the retirement income within the pension scheme. Finding answers to these questions would allow policymakers to effectively set up the pension scheme in the way that individuals across wide range of population groups would be able to participate in the required extent and diversify their future retirement income.

Numerous researchers devoted their work to analyse the incentives for participation in private retirement saving schemes, providing explanation of factors determining the probability and intensity of participation. Among the most important contributions belong works of Sunden and Surette (1998), Munell (2001), Huberman (2007), Johannisson (2008), Lopez (2010) and Borsch-Supan (2011). Multiple explanatory factors proved to have consistently positive effect among the available studies, among the most important determinants can be named the income, age, level of education and gender, as the positive correlation between being a female and probability of having a private pension plan was observed. Furthermore, according to Munell (2001), Duflo (2005) and Huberman (2007), the presence and the level of subsidy provided by the third party (state, employer) belongs to the most influential features affecting the savings related decision making process.

The latest insight to the behavior of individuals with respect to the supplementary pension scheme in the Czech Republic provides Jansky (2015), who estimated the effects of certain explanatory variables on the probability and intensity of participation in the private pension scheme using microeconomic data from 2011. Jansky observed that the distribution of contributions was strongly influenced by the rules for the state subsidy (dependent on the amount of contributions), which imposed a cap on the maximal amount of subsidy an individual could obtain. As a result, in the year 2011 more than one third of all participants contributed by 6000 CZK, on average 500 CZK per month, as exactly this amount provided them the highest possible state subsidy. Jansky argues, that those individuals are showing willingness

to generate additional savings and raising the cap of the state subsidy could motivate them to substantially increase their contributions.

Fortunately, the Czech pension reform introduced in 2013, not too much successful from the perspective of the second pillar, also revised the supplementary private pension insurance (the third pillar of the pension scheme). One of the key changes of the newly introduced policy was an increase in the saving requirement for the state subsidy that could be granted. In order to be eligible for the maximal subsidy, one has to contribute at least 12 000 CZK per year, i.e. twice as much as before the change. Today, with a sufficient time lag and the available microeconomic data from the Statistics on Income and Living Conditions, the policy change gives us a great opportunity to examine the behaviour of participants with respect to this change, as the reform provided a suitable natural experiment to test not only the assumptions stated by Jansky (2015), but also to estimate its effect on the level of participation and contributions across various population groups.

The newly introduced rules related to the supplementary pension savings scheme in the Czech Republic, which came into force on the 1st of January 2013, brought several significant revisions affecting participants in this voluntary private scheme. The revisions can be divided into two categories – changes affecting all the participants and changes affecting only those individuals who established their saving contracts after the new legislation came into force or who voluntarily decided to have their existing contracts administered under the new policy.

A change common to all the retirement saving contracts introduced new rules for the subsidized state contribution matching. In order to motivate participants to increase their regular contributions, the maximal monthly state compensation grew from 150 CZK to 230 CZK, provided that the participant contributes at least 1000 CZK per month. The former policy required the participant to save only a half of this amount to reach the maximal state subsidy. On the other hand, participants, who contributed only very low amounts such as 100 CZK or 200 CZK per month and received subsidy matching up to 50% of their contribution, were motivated to increase their savings as the new policy provides eligibility for matching subsidy only in case the monthly contribution is at least 300 CZK. From the table below it can be seen, that the subsidy in a form of the state contribution relative to the contributed amount generally decreased, but it allowed participants to reach higher absolute amounts of subsidy if they appropriately increased their contributions.

Table 1.1: The amount of monthly direct state subsidy

Contribution (CZK)	Subsidy until 31.12.2012 (CZK)	Subsidy until 31.12.2012 (%)	Subsidy from 1.1.2013 (CZK)	Subsidy from 1.1.2013 (%)
100	50	50%	0	0%
200	90	45%	0	0%
300	120	40%	90	30%
400	140	35%	110	28%
500	150	30%	130	26%
600	150	25%	150	25%
700	150	21%	170	24%
800	150	19%	190	24%
900	150	17%	210	23%
1000	150	15%	230	23%

On the other hand, changes affecting only the contracts administered under the new policy introduced new rules treating the eligibility to receive benefit and security of the pension funds. The possibility to withdraw half of the funds after 15 years of participation was cancelled and for the most of the participants, the horizon of their eligibility to receive benefit from the scheme was postponed as it was set to the retirement age instead of the age of 60. Furthermore, the introduction of optional various investment profiles brought more variability on one side, but abandoned the formerly provided guarantee of nonnegative returns on the other side. Changes introduced only to the new contracts apply more strict rules in terms of benefit accessibility and stimulate participants to use the pension scheme truly as a long-term instrument for retirement savings rather than a medium-term subsidized saving account.

From the perspective of evaluating the success of the pension policy change, the greatest importance of the research lies in estimating its effects on individual population groups. This is consistent with the purpose of the supplementary pension scheme, as it should provide additional income in retirement primarily to those groups of individuals and households, who otherwise would be more reluctant to generate sufficient savings for retirement. The empirical evidence shows, that those who typically lack private retirement savings are low-income individuals with lower education, which usually also implies a low financial education (Lopez, 2010; Huberman, 2007; Chetty, 2014; Munell, 2001). In case of these individuals, incentivized private pension scheme may be highly efficient in terms of generating new savings, which otherwise would be consumed (Duflo, 2005). On the other hand,

individuals with higher income who participate in a subsidized pension scheme tend to rather substitute from their non-subsidized savings. The effect on their overall savings is less evident (Borsch-Supan, 2012; Pfarr-Schneider, 2011; Corneo, Keese, and Schroder, 2010). The efficient policy should be able to motivate low- and medium-income households to contribute in the scheme and thereby increase their long-term savings in general. Another issue related to the supplementary savings scheme in the Czech Republic also arises with respect to young and low-income individuals, as Jansky (2015) observed that their level of participation was significantly lower than in case of the remaining population. Among the priority interests of this work also stands question, whether by revision of the policy the government succeeded in increasing the participation level of these groups, or whether they became even more disadvantaged after the intervention took place.

Providing a brief overview, the purpose of this thesis is to analyse impacts of the pension reform on participants in the third pillar of the pension scheme, as the reform introduced new policies including modified rules for the state subsidy. According to the previous research on the topic of private retirement savings, the level of subsidy belongs to fundamental determinants of participants' contributions. Hence the primary goal is to test the hypothesis of increased contributions as a reaction to the new policy. An important finding will be also detailed information in what way the individuals adapted their saving behaviour based on their income, age, and other personal characteristics. The research is predominantly focused on the microeconomic analysis, however the development of the main aggregate indicators related to the third pillar is being discussed.

In the beginning, the thesis provides an overview of the relevant literature and empirical evidence related to the topic of private retirement savings and establishes the hypotheses regarding the effects of the intervention. After the methodological section devoted to the approach used for the empirical analysis, the participation rate in the scheme and the level of annual contributions are observed separately for individual population cohorts with respect to age, gender, income, education and economic activity. In the next step, the regression analysis is employed for estimating the propensities to generate supplementary retirement savings with respect to various individual characteristics. Finally, the impact of the policy change is measured by testing for the presence of structural differences in the coefficients estimated separately for individual years, both with respect to participation rate and contributions.

2 Theoretical background and literature review

2.1 Motives for savings

Contribution in any supplementary pension savings scheme may be understood as a commitment of an individual or household to generate long-term savings. The question of what actually motivates agents to save and which factors influence the decision making process was discussed by many economists.

2.1.1 Early theories of saving and consumption

On the aggregate level, a modern theory of consumption and savings was introduced by John Maynard Keynes in 1936, who assumed that the level of consumption is a function of income. In contrast to the neoclassical theory, Keynes argued that the consumption does not depend on the interest rate. The marginal propensity to consume, i.e. what proportion of additional income is consumed, is expected to be between 0 and 1. Furthermore, the average propensity to consume falls as income increases, Keynes considered savings to be a luxury. However, further empirical research showed, that the assumptions imposed by Keynes did not always hold. Simon Kuznets proved, that over decades the average propensity to consume tends to be rather stable, regardless the significant increase of income over time. This finding is known as the Kuznets puzzle (Mankiw, 2009).

As a reaction to the Kuznets puzzle, researchers introduced new theories explaining the empirical behaviour of consumers. Irving Fisher developed a microeconomic consumption model in which the decision of an agent whether to consume or save is a matter of an intertemporal choice. Given the intertemporal budget constraint, real interest rate and utility function representing preferences, the individual chooses what proportion of income to consume in presence and what proportion to save for the following periods of time based on the process of optimization. Under the rational preferences, the higher the interest rate is, the more present consumption is the individual willing to give up in exchange for higher consumption in the future. If the disposable income increases, the consumer distributes the additional wealth over the all periods, both consumption and savings therefore increase (Mankiw, 2009).

Modigliani and Brumberg (1954) presented their life cycle hypothesis of saving, based on which a consumer has a given life expectancy and he is economically active only for a part of his life. The consumer has expectations on his lifetime income and by the means of borrowing and savings he smooths his lifetime consumption to be stable. In other words, according to Modigliani the main motivation which drives individuals to save is the wish to accumulate money to use in time when they retire. Naturally, the assumption of rationality is rather too optimistic, as Bernheim and Sholz (1993) argued,

“. . . the life cycle decision is extraordinarily complex, in that it requires an individual to contemplate labour earnings, investment strategies, macroeconomic trends, and a vast assortment of risks, all over a very long time frame. It would be surprising if the average individual, in isolation, with no practice and little or no training, would act as a perfectly rational, farsighted utility maximizer.” (p. 87)

Although the Modigliani's theory in general form does not reflect the empirical behaviour precisely, it well explains the motivation to enter the supplementary pension savings scheme. As the benefit received from the mandatory scheme usually covers only a relatively small portion of the pre-retirement income, participants are motivated to increase their savings in the period of their economic activity. Via the supplementary pension savings scheme, contributing participants are able to distribute their income in the long term horizon.

Milton Friedman (1957) introduced a permanent income hypothesis, where the level of consumption and savings is decided on rational expectation of the permanent income. The whole income is then represented by two components, permanent income and transitory income. The propensity to consume the transitory income is very low, as the consumer realizes it is only a one-time income. Consumption is therefore proportional to the permanent income. Friedman also discussed that inheritance (bequest motive) is another motive to generate savings.

2.1.2 Empirical evidence of saving motives

Further research on savings and consumption developed the concept of the life-cycle and focused on savings under risky income and intergenerational transfers. Skinner (1988) analysed savings behaviour for various occupations, he estimated that precautionary savings under uncertain income and interest rates represented approximately 56 percent of total life cycle savings. Results of Skinner's work stress

that the precautionary savings play a significant role in generating capital accumulation, with at least the same importance as the retirement savings. Similar conclusion reached also Katona (1975) and Kotlikoff (1989), who stated that about 30 percent of family savings in the USA can be explained by precautionary motives. Retirement and precautionary motives as a main driver for savings were confirmed also later in Netherlands (Alessie, Lusardi, and Aldershof, 1997), Japan (Horioka and Watanabe, 1997) and Australia (Harris, Loundes, and Webster, 2002). On the other hand, Jappelli and Terlizzese (1992) analyzed the 1989 Italian Survey of Household Income and found only little relation between saving and uncertainty. Modigliani (1988) argues, that motives for intergenerational transfer of wealth vary for different wealth of families. Whereas the bequest motive plays a significant role for savings of families in the highest income bracket, in case of families with lower income, the intergenerational transfer is caused mostly by precautionary savings.

Individual saving motives were further investigated by Thaler and Shefrin (1988), who considered significant psychological factors represented by mental accounting and self-control. Rabinovich and Webley (2007) argued, that an increased level of stress and lack of self-control might contribute to generally lower saving rate in case of low income households. Canova, Rattazzi and Webley (2005) empirically analysed the hierarchical structure of saving motives and created a pyramid of motives similar to the Maslow's hierarchy of needs. The bottom of the pyramid is built from the most specific goals such as „Purchase“, „Holidays“ or „Money availability“, the upper positions in the pyramid are in contrast abstract such as „Self-gratification“. Illness and retirement pension motives were often mentioned by participants in the research. Nevertheless, Browning and Lusardi (1996) observed a high level of heterogeneity in saving motives. Motivating factors are often strongly dependent on life-cycle stage, age, gender, education and home ownership (DeVaney et al., 2007; Horioka and Watanabe, 1997). Significant differences were found also across individual countries, for example, Yao (Yao et al., 2011) estimated that Chinese urban households showed a higher saving rate than households in the United States. Chinese households more often reported precautionary and education motives, households with lower income stressed the importance of retirement saving.

In the Czech Republic, the aggregate saving rate is rather high and above the average of the CEE region.¹ High levels of domestic savings were presumably retained as a

¹ According to the World Bank, in 2014 gross domestic savings accounted for 26 percent of GDP in the Czech Republic, 27 percent in Germany, 21 percent in Slovakia and 12 percent in the UK)

remnant of the period before the economic transition after 1989. However, private savings in Eastern European EU-accession countries are driven by the similar forces as in the EU-15 countries (Denizer and Wolf, 2000). The comprehensive research of saving motives of Czech households has not been done yet, but similarly as to German households (Borsch-Supan and Essig, 2005), it can be assumed, that the precautionary savings play an important role together with savings for housing. Households in Germany also put a high importance to retirement provisions. In the field of retirement savings the Czech Republic shows fundamental differences as households and individuals still primarily rely on the PAYG funded mandatory pension scheme (MLSA, 2011).

2.2 Retirement savings and empirical behaviour of participants in private pension savings schemes

Retirement savings, as a substantial part of capital that households accumulate during their life-cycle, require a consistent long-term planning horizon and a high level of self-control. Although this assumption is usually present in the economic theory, some economists argue that empirical evidence is often not in line with these assumptions (Lusardi and Mitchell, 2007, 2011, 2013; Caliendo and Findley, 2013). Axel Börsch-Supan (2004) states, that

„An inadequately low savings rate leads to a high level of individual consumption in the short run, but also leads to a reduction in investments which are required for the high levels of long-term economic growth which pave the way for consumption at a later date.“

Caliendo and Findley (2013) argue, that the lack of financial literacy and retirement planning are typical not only for the young individuals, but also for people over 50 years old. Using the US population data they estimate that already a small improvement in retirement planning, when individuals start with their retirement savings few years earlier, may generate aggregate welfare gains. Improving financial literacy and providing attractive offers for retirement savings is in the best interest of any society.

In the last decades, a broad range of European countries implemented some form of a private pension scheme (Schneider, 2011). These alternatives to the usually primary PAYG pension scheme are designed to increase retirement savings of households and to cover the expected cuts in the PAYG scheme given by the lack of funding related

to an adverse demographic development. In order to motivate participants to increase their savings, governments provide subsidies offered as a contribution matching or tax incentives conditioned by contribution into the private pension scheme (Berk et al., 2013; Borsch-Supan, 2012; Booth and Niemietz, 2015).

There is a rich source of economic literature devoted to analysis of factors that influence participation rate and level of contributions in voluntary pension schemes. Lopez (2010) analysed driving forces of individual retirement savings on a sample of 6,036 individuals from eight European countries. However the level of participation varies across countries, results suggest that the influential forces are similar. The same conclusion is reached by Adami and Gough (2008). As the most important factors, Lopez (2010) identifies namely age, financial literacy, household income and saving habit. Borsch-Supan (2004) discussed effectiveness of incentives to support retirement savings in European countries and concluded that the presence of subsidy is a crucial factor for increasing retirement savings. Munell (2001) estimated what drives the contribution of participants in the individual pension plan called 401(k), one of the most widespread employee pension schemes in the United States. As the most influential positive factor appears the contribution matching rate and the presence of planning in the long horizon. On the other hand, young and low income individuals are less likely to contribute. Another important factor increasing participation is the ability to access funds deposited in the scheme. A similar results on 401(k) pension plan participation obtained Huberman et al. (2007), who further stresses that women are more active in terms of participation and contributed amounts. Huberman also argues, that the presence of employee matching contribution is a strong incentive especially for low-income participants. Clark (2002) reviewed works of number of economists with conclusion, that education and financial literacy have a large positive effect on participation in the voluntary pension scheme. Uncertainty and risk aversion also play an important role on decisions whether to enter into supplementary saving scheme (Schie, 2012). According to results obtained from the panel survey of households in Netherlands, the effect of uncertainty is determined by an individual's perceived adequacy of current savings and that individual's financial constraints. For those, who believe they save adequately, uncertainty increases retirement contributions, otherwise the uncertainty has a negative impact on contributions. Reduced uncertainty supports greater contributions for those individuals, who are not already limited by their financial constraints. Honekamp and Schwarze (2010) state that ability to form expectations of future

pension entitlements plays an important role on the decision whether to save for retirement.

An important question for steering the retirement savings policies, a question which has been in point of interest for numbers of economist, is whether an increase in retirement savings, usually incentivised by governments or employers, results in increased aggregate level of savings. Feng, He and Sato (2011) have explained a high saving rate of urban households in China by a pension reform which reduced the replacement rate of public pensions. Unfortunately for policies favouring increase of national savings through positive incentives, the empirical research does not bring enough evidence that subsidized private retirement savings would contribute to a higher level of aggregate savings in general. Although Bailiu and Reisen (1997) estimated a statistically significant positive effect of funded pension savings on aggregate savings with panel data of 10 countries, other researchers did not reach such conclusion. Hubbard (1986) and Gale (1998) state that increase in an anticipated pension wealth significantly offsets savings. Creedy (2015) performed various life-cycle simulations with policy interventions in the field of taxes and pension settings. The model stylised in the economy of New Zealand showed modest reactions of households in terms of their saving rate. Increasing income tax by 6 percent reduced savings by 0.7 percentage point. The increase of compulsory saving rate was on average fully offset by reduction of other financial savings, households therefore substituted savings in order not to increase the total savings. Anton, Bustillo and Macias (2014) analysed the effect of private supplementary pensions subsidized by tax reliefs on the national savings in Spain. They applied method of fixed effects on longitudinal data to estimate the relationship between the level of consumption and the tax-favoured contributions. Results showed that although the effect on households' welfare is positive, participation in the scheme did not lead to a decrease in consumption. That suggests the income and substitution effects cancel out and the positive effect on national savings is not present. Paiella and Tiseno (2011) reached a similar conclusion for tax-favoured retirement saving schemes in Italy. Duflo (2005) argues, that contribution matching incentives are significantly more efficient in increasing participation and savings than the tax-relief based incentives.

Retirement savings incentives, especially those based on the contribution matching, have a strong effect on allocation of savings, as households substitute non-retirement savings for incentivised pension schemes (Pfarr and Schneider, 2011). The positive outcome is that households focus on long term retirement savings, where, compared to other investment opportunities, their competency to withdraw their savings is

limited. As a result, households are not tempted to use their retirement savings for consumption too early before retirement. Freitas, Legendre and Clark (2013) based on the analysis of French household survey argue, that participation in private and occupational savings significantly contributes to diverting poverty in retirement.

The issue, which is often being faced by policies focused on increasing household retirement savings, is an asymmetric effect the imposed savings incentives have on particular groups of households or individuals. Empirical evidence confirms that households in the highest income brackets get easily motivated to increase their retirement savings when a tax relief, contribution matching or another incentives are offered. This could be explained among others by the substitution effect, when the participants only reallocate their savings to those which are supported by incentives (Pfarr and Schneider, 2011; Borsch-Supan, 2012). On the other hand, low income households are much more reluctant to participate in private pension or to increase their contributions. Unfortunately, low income individuals are those, who are mostly endangered by poverty in retirement, as they usually do not generate any other significant retirement savings during the pre-retirement period (Chetty, 2014; Munell, 2001). The explanation why the low-income individuals lag behind in participating in private retirement savings schemes is quite straightforward as they are usually affected by a combination of negative factors mentioned above. Low income is being connected prevalently with low education and financial literacy (Li, Shi and Wu, 2015). Borsch-Supan (2012) argues, that households with low income have a higher probability to believe they are not eligible for participating in a subsidized pension scheme. Uncertainty and lack of self-control and missing long-term planning horizon might also be present in the higher level in case of low income households, with negative effect on retirement contributions (Rabinovich and Webley, 2007). Finally, households with low income do not possess sufficient disposable income to accumulate wealth in the long term. The primary incentive to save, if ever, is the precautionary saving. Long term retirement plans are not suitable for precautionary savings as already contributed funds are not accessible before retirement or the early access to funds results in significant financial penalization.

Despite all the unfavourable factors in case of low-income households, there is also evidence that appropriate incentives may be efficient. Duflo (2005) performed a field experiment for low- and middle-income households in United States, who were offered various rate of match on individual retirement account (IRA) contributions. Results of the experiment showed that under the right conditions even the low-income households can be motivated to increase their retirement savings as the

contributions of household who were provided 50 percent match were up to 7 times higher than contributions of households, who were not offered any matching on their contributions.

2.2.1 Policy change case study: German pension scheme

A lot of economists' interest was devoted to study the voluntary retirement savings scheme in Germany, which served them as a natural experiment on savings behaviour. Through implementation of the two pension reforms in 2001 and 2004, the German pension scheme has undergone a successful transformation from a „monolithic pay-as-you-go system“ to a multipillar system (Borsch-Supan, 2004). The Czech Republic, though it needs much more work to be done, shows many similarities with Germany, including the incentives to transform the pension system and diversify sources of retirement income. Successful story of Germany could be a good inspiration for the ongoing reform in the Czech Republic and it also could provide valuable information on behaviour of retirement scheme participants.

Introduction of the so-called Riester pension in 2001 offered Germans a voluntary, subsidized retirement saving scheme with defined contribution. A direct subsidy is provided, which decreases with income, and a subsidy via tax advantage, which on the contrary increases with income as a result of progressive taxation. The adoption of Riester pension in the first years of its existence was rather slow, but within less than 10 years the scheme gained popularity. In 2010, pension savings via Riester scheme represented 9.4bn Euro with an associated cost of 3.5bn Euro, therefore on two Euros of households' contributions corresponded one Euro of subsidies. In contrast, the German government reported costs for public pension benefits of 225bn Euro in 2010 (Borsch-Supan, 2012).

The economic research of the Riester pension analysed mostly two main questions - whether the introduction of Riester pension was effective in increasing private household savings and whether the scheme was able to target the intended population groups. Corneo, Keese, and Schroder (2010) applied several models on the two panel datasets to estimate the effect on private savings. The authors did not find any evidence that the Riester scheme would have a statistically significant effect on household savings. They explain this by a reallocation of existing household savings, as the German households already display a high level of savings. However, they see the Riester pension as an effective instrument to improve future living standards without reducing current consumption and to “*substitute future increases in social*

security contributions with future tax increases". Pfarr and Schneider (2011) also tested the crowding-out effect and they were not able to refuse the reallocation hypothesis.

Pfarr and Schneider (2011) as well as Borsch-Supan (2012) focused on the population targeting of the scheme and the participants' behaviour. Their results discovered, that the Riester pension was adopted mostly by young age households, surprising result in the contrast with the Czech Republic. As the number of children is a determinant of the direct subsidy in the Riester pension, adoption of the scheme was more probable in case of households with higher number of children. Although households with higher income are leading in participation in the Riester scheme (similarly as in the Czech case), German low-income households also show a considerable growth in participation. Pfarr and Schneider also stress a relatively low importance of education on retirement savings. The answer whether the Riester scheme is successful in targeting the population it was designed for, i.e. low-income households with higher number of children, is relatively mixed. Whereas Borsch-Supan sees the Riester scheme rather successful, Pfarr and Schneider argue, that the participation of low-income households is too low and the political goal was not achieved.

2.3 Evidence from the Czech Republic and assumptions regarding the policy change in 2013

Regarding the incentives to participate in the supplementary retirement saving scheme in the Czech Republic, the most relevant works were published by Schneider and Jelinek (1998) and Jansky (2015). Schneider and Jelinek (1998) used linear probability model and logit model to analyse factors affecting saving in a private pension fund in the Czech Republic based on a survey of 1,151 individuals realized by authors and on data of 2,400 households provided by the Czech Statistical Office. Among factors positively affecting participation in the pension scheme they identified income per head, household size, number of economically active household members and the age of the household head.

From the perspective of the current research, more topical is the work of Petr Jansky (2015), who used Statistics on Income and Living Conditions (SILC) for the year 2011 to identify factors affecting participation of individuals in the supplementary pension savings scheme. Jansky constructed a probit model for estimating a

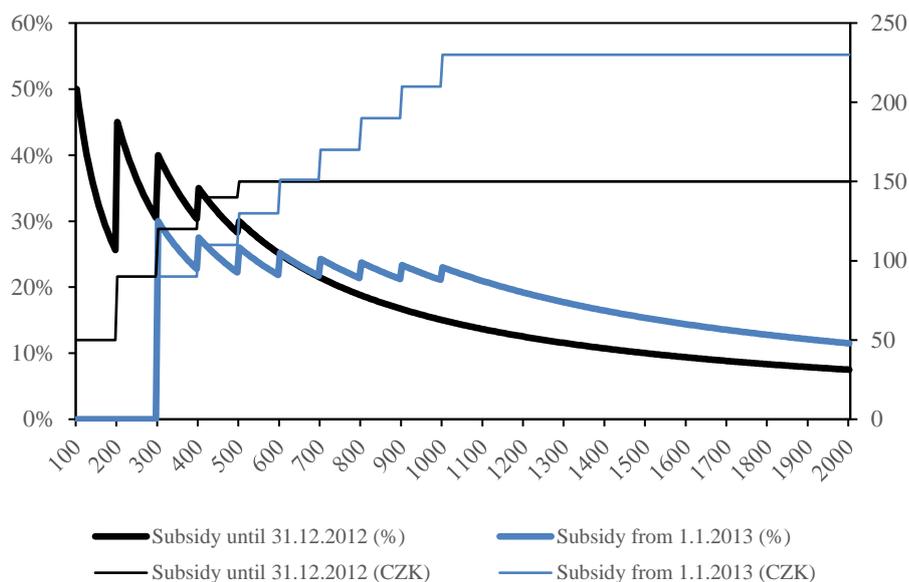
probability of participation in the pension scheme. With a linear model estimated by the method of ordinary least squares he regressed the contributed amount of money on various explanatory factors. Both for participation and contributed amount, a positive and statistically significant effects were identified in case of the net income, age, hours worked per week and whether an individual was self-employed. Furthermore, men showed 8 percent higher probability of participating in the supplementary scheme than women. The analysis performed by Jansky provided evidence that the structure of population participating in the individual pension savings scheme in the Czech Republic is not significantly different from other countries with a similar pension scheme and it is consistent with the theory of consumption and savings. However, in the conclusion of his research, Jansky questions whether a higher participation rate of wealthier individuals is a desired property of the pension scheme. When considering the effects the policy change introduced in 2013 had on participants of the supplementary pension scheme, it is rational to expect that the individuals, who showed a higher probability to participate and contributed higher amounts, will be more sensitive in terms of being motivated to further increase their activity.

Jansky (2015) also focused on the distribution of amounts contributed by participants prior the policy change in 2013. Relatively low commitment of participants illustrates the fact that 99.7 percent of participants contributed less than 1500 CZK per month. Furthermore, Jansky observed two significant patterns of behaviour. One group of participants, representing approximately 35 percent of the sample, contributed lower amounts of 300 CZK or less and enjoyed relatively high percentage subsidy matching their contributions. Another large group, representing 36.3 percent of the sample, contributed by the amount maximizing the absolute value of the state subsidy. According to Jansky, the latter group shows willingness to save and may be further motivated to increase their contributions by stronger incentives.

With respect to the behavioural patterns discovered in relation to the distribution of amount of money contributed and the eligibility for the state subsidy, I assume that a strong explanatory variable for contributions after the policy change is the amount which an individual was contributing before the change. The decision on how much the participant will save is almost certainly a result of optimization to maximize the state subsidy. In general, the participant can choose between the two approaches – either to maximize the total amount of subsidy received, or to maximize the subsidy with respect to amount of money the participant contributed itself. The previous analysis of contributions suggests, that participants were following this approach

before the change, as the distribution of amounts contributed was concentrated mostly around the points which were results of above described optimization. New rules for the direct state subsidy represented shifts in two different directions. On the one hand, the maximal amount of subsidy that can be monthly received increased from 150 to 230 CZK (increase by 53%). On the other hand, for participants who contributed less than 600 CZK per month, the relative subsidy as a percentage of their contributions compared to the original policy decreased and those, who contributed less than 300 CZK per month, were newly not eligible to receive any subsidy. The distribution of subsidy amounts with respect to contributions illustrates the following Figure.

Figure 2.1: Direct state subsidy compared to the contribution of the participant



Source: author

It is a question whether those, who contributed less than 300 CZK and therefore enjoyed a high subsidy in relative terms, will be motivated enough to increase their savings in order to retain the eligibility for a relatively lower subsidy than they received before. For at least a part of individuals who were contributing 500 CZK per month it can be assumed, that they prefer to maximize their subsidy in the absolute terms and that they reacted to the incentive positively and increased their savings to the new optimum of 1000 CZK per month. In case of those, who were already contributing 1000 CZK or more before the policy change, I assume that their behaviour was not significantly affected. The strictly positive change might result in further increase of the contributed amount.

2.4 Hypotheses related to the policy change in 2013

As already outlined in the chapters above, there is a broad range of view angles and factors which are appropriate to be accounted for when evaluating the effects caused by the policy change. In order to thoroughly analyse and estimate these effects, I discuss and evaluate impacts of the reform separately at the aggregate level and primarily at the microeconomic level. In both cases, the assumption is that the newly introduced policy affected behaviour of participants both from the extensive and intensive aspect, i.e. it affected their level of participation in the scheme as well as the amounts of money they contribute. Based on the theoretical background and empirical evidence, I have stated the following hypotheses.

2.4.1 Higher aggregate level of scheme participation and amounts contributed

The first hypothesis is that the redefined conditions for state subsidy eligibility increased the average contributed amount and the total amount of money contributed to the individual pension scheme. This expectation is consistent with the theory that an increased direct subsidy motivates individuals to save more in the subsidized scheme (Lopez, 2010; Munell, 2001; Huberman et al., 2007; Borsch-Supan, 2004). The assumed effect on the aggregate level of participation is not clear, as there are several contradictory factors involved. Stronger subsidy would generally motivate new participants to enter the scheme, however the more strict policy in terms of accessibility of accumulated funds is expected to hinder the positive effect.

2.4.2 Individuals with higher income and education more sensitive to change

The next hypothesis states an assumption that individuals with higher income are more sensitive to the strengthened incentives than those with lower income. This expectation is in line with the theory of savings as well as with empirical evidence. Generally stronger willingness of wealthier individuals to contribute was observed for example by Huberman (2007) in the United States, by Jansky (2015) in the Czech Republic (2013) and by Pfarr and Schneider (2011) in Germany. Higher disposable income provides higher funds available for savings. Another important factor is that wealthier individuals usually simply substitute their existing savings for the subsidized savings instead of generating additional savings, therefore there is no further burden imposed on their budget (Pfarr and Schneider, 2011; Borsch-Supan,

2012). The similar scenario may be expected for individuals with higher education, as however education and income are often being up to a certain extent correlated and the estimated effect may be distributed among these effects.

2.4.3 Individuals of higher age more sensitive to policy change

Another assumption is that the level of activity in the supplementary retirement savings scheme remained relatively low in case of young citizens. In terms of sensitivity with respect to age, there are two likely offsetting effects present. Young individuals tend to be more informed and flexible (Caliendo and Findley, 2013), furthermore, their expected returns connected with the optimal saving policy increase as their retirement age lies in the distant future. On the other hand, for older individuals the supplementary pension scheme is not burdened with the lifetime-long period when the access to funds is limited. As they see their retirement approaching, or even they have already retired, the supplementary pension scheme serves as a convenient instrument to gain additional state subsidy. What further disadvantages young participants is the typical shape of the economic life cycle, presented by Modigliani (1954). Young individuals who become independent, financing their own housing and starting their own family, usually have limited disposable income available for savings. Unfortunately, the current model of supplementary pension savings in the Czech Republic is not much flexible in terms of funds accessibility before retirement and it does not allow to temporarily use funds to respond unexpected events incurring extra costs without penalization. Households are therefore limited by their need to hold a significant amount of money due to the precautionary motive. Although the effects of age on level of activity in private pension schemes vary from negative to positive for different countries and researches, research focused on the Czech data consistently proved positive effect of higher age on saving in supplementary pension funds (Jelinek and Schneider, 1998; Jansky, 2015).

2.4.4 Positive evidence for gender differences

The empirical evidence for gender-driven differences in the pension saving behaviour is positive, as the majority of researchers, e.g. Huberman (2007) and Johannisson (2008), estimated higher activity of females. Malroux and Xiao (1995) concluded, that on average women on average more than men tend to perceive their future retirement income to be inadequate. An interesting discovery was presented by Sunden and Surrette (1998), who suggest that, however single women in general tend

to be more active in the pension scheme, their participation rate decreases when they are married. Presence of gender differences may be expected given the reason that the life expectancy for women is higher, creating a larger need for savings. Another question of interest is, how the transfer of income within a household works and how the household adapted to the policy change. Comparing the process of adaptation to the new rules for the husband and wife may provide valuable clue how the family decision making dynamics works and whether the scheme in its current shape is re-enforcing gender inequality.

2.4.5 Positive evidence for subsidy maximization strategy

In the years preceding 2013, participants in the individual pension savings scheme showed a behavioural pattern related to the contributed amount and the offered amount of the state subsidy. Approximately one third of participants contributed by the amount which would maximize the received subsidy (Jansky, 2015). The third hypothesis therefore assumes that in case of existing participants, the change in their behaviour was influenced by the amount of money they were contributing before the new policy came into force. Participants maximizing their state subsidy by contributing 500 CZK per month are expected to increase their savings in order to remain at the point which maximizes the subsidy under the new policy. Furthermore, participants contributing less than 300 CZK per month are expected to increase their savings above this amount in order to be eligible to receive the direct subsidy even though they will be relatively worse-off. The last assumption is that participants who had already been contributing at least 1000 CZK per month under the original policy will not show a significant change in their behaviour.

2.4.6 Self-employed individuals confirm stronger motivation to save

Jansky (2015) in his research based on 2011 data concluded that self-employed individuals in the Czech Republic show higher activity in the supplementary pension scheme. Reasoning behind the assumption that the self-employed individuals are consistently more willing to participate in the supplementary pension savings scheme is relatively straightforward. The Czech legislation allows these individuals to contribute in the mandatory scheme only by the minimal amount, however, the expected retirement benefit from this scheme is low. Self-employed workers therefore generate additional private retirement savings, for which the third pillar scheme is the logical choice.

3 Methodology

This section presents the data used for analysis in the first place, followed by an introduction of methods used for estimation and constructing the appropriate econometric models for the participation rate and the level of contributions.

3.1 Data description

The empirical analysis operates with the data describing aggregate characteristics of the pension scheme as well as with disaggregate data that capture behaviour of individual participants.

3.1.1 Basic indicators of the development of supplementary pension savings scheme in the Czech Republic

The Ministry of Finance acts as a supervisor of the supplementary pension savings scheme (SPS) including the preceding scheme called supplementary pension insurance (SPI) and regularly publishes aggregated statistics related to the third pillar of the pension scheme.² For the both schemes, the statistics include number of participant contracts, number of contracts newly entered, number of contracts with the employer contribution, amount of subscribed state subsidy, amount of participants' contributions, average monthly state subsidy and average monthly contribution of participants.

The overview of the yearly data mapping the scheme from 2006 to 2Q 2016, which is provided in the table on the following page, already shows the most important trends in the third pillar scheme development, with an evident jump in contribution in 2013 and significantly increased participation already in 2012.

² Aggregate statistics available at <http://www.mfcr.cz/cs/soukromy-sektor/soukrome-penzijni-systemy/iii-pilir-doplukove-penzijni-sporeni-a-p/vyvoj-penzijniho-pripojsteni> [Accessed 8-12-2016]

Table 3.1: Supplementary pension scheme - aggregate statistics overview (source: MF CR)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	1Q 2016	2Q 2016
SPI and SPS (amount / yoy change) ³	3 593 645	3 936 357	4 207 236	4 394 522	4 527 774	4 565 741	5 134 862	4 963 344	4 803 134	4 643 016	4 613 754	4 587 385
		9.5	6.9	4.5	3.0	0.8	12.5	-3.3	-3.2	-3.3	-0.6	-1.2
- thereof SPI	3 593 645	3 936 357	4 207 236	4 394 522	4 527 774	4 565 741	5 134 862	4 886 675	4 585 149	4 281 621	4 208 798	4 133 154
- thereof SPS								76 669	217 985	361 395	404 956	454 231
New SPI and SPS (amount / yoy change)	558 629	586 310	590 490	524 867	495 516	457 033	1 128 020	77 771	145 841	156 062	47 650	101 805
		5.0	0.7	-11.1	-5.6	-7.8	146.8	-93.1	87.5	7.0	-69.5	-34.8
- thereof SPI	558 629	586 310	590 490	524 867	495 516	457 033	1 128 020					
- thereof SPS								77 771	145 841	156 062	47 650	101 805
- thereof transfer from SPI								1 284	14 221	12 959	3 274	7 222
SPI and SPS with employer's contributions (amount / yoy change)	1 028 850	1 129 618	1 222 639	1 261 525	1 284 736	1 271 934	1 317 563	1 352 461	1 354 485	1 362 283	1 369 224	1 374 405
		9.8	8.2	3.2	1.8	-1.0	3.6	2.6	0.1	0.6	0.5	0.9
- thereof SPI	1 028 850	1 129 618	1 222 639	1 261 525	1 284 736	1 271 934	1 317 563	1 339 000	1 313 766	1 289 925	1 287 434	1 282 382
- thereof SPS								13 461	40 719	72 358	81 790	92 023
State subsidy credited for the given period (CZK bn / yoy change)	4.162	4.651	5.088	5.347	5.510	5.602	5.913	6.861	6.847	6.803	1.706	3.411
		11.7	9.4	5.1	3.1	1.7	5.6	16.0	-0.2	-0.7	-74.9	-49.9
- thereof for SPI	4.162	4.651	5.088	5.347	5.510	5.602	5.913	6.799	6.578	6.264	1.526	3.025
- thereof for SPS								0.062	0.270	0.539	0.180	0.386
Participant contributions (CZK bn / yoy change) ⁴	17.607	20.211	21.887	22.955	23.218	23.426	25.493	33.306	32.897	32.667	8.127	16.270
		14.8	8.3	4.9	1.1	0.9	8.8	30.6	-1.2	-0.7	-75.1	-50.2
- thereof for SPI	17.607	20.211	21.887	22.955	23.218	23.426	25.493	32.963	31.556	30.093	7.283	14.461
- thereof for SPS								0.342	1.341	2.573	0.844	1.809
Average monthly state subsidy (CZK / yoy change)	102	104	105	105	105	105	108	117	120	124	126	126
		1.6	1.0	0.3	-0.2	0.4	2.5	8.4	2.8	3.0	1.5	1.8
- thereof for SPI	102	104	105	105	105	105	108	117	119	122	123	123
- thereof for SPS								143	148	152	155	156
Average monthly contribution of participants (CZK / yoy change)	431	450	451	444	440	442	465	570	579	598	601	605
		4.4	0.2	-1.5	-1.0	0.5	5.3	22.6	1.7	3.1	0.6	1.1
- thereof for SPI	431	450	451	444	440	442	465	568	574	589	590	592
- thereof for SPS								749	722	722	723	729

³ Active contracts at the end of the period⁴ Not including contributions provided by employers

Moreover, MFCR also provides the aggregate data cumulatively on the quarterly basis, available from 1Q 2008 until the 2Q 2016. Fortunately, the cumulative amounts may be stripped to individual amounts for each quarter and generate a dataset of 34 observations, with a reasonable distribution before (20 obs.) and after (14 obs.) the policy change in the beginning of 2013. I use the quarterly data for a basic inference to explain how in general the pension scheme reacted on various influences during time, especially with focus on the 2013's policy change.

3.1.2 Individual data on the development of supplementary pension savings scheme in the Czech Republic (MFCR)

As an administrator of the Supplementary pension savings scheme's Information system, by the Act no. 427/2011 the Ministry of Finance is obliged to collect information about participants of the pension scheme. Although this data does not contain much information about the participants as such, it tracks monthly contributions of more than 4.6 million participants' contracts. Analysing the dataset would not provide a deep evidence explaining the behaviour of participants, but it would allow me to analyse the development of contributed amounts for every contract (participant) in the scheme individually.

In terms of the Act no. 106/1999, On the freedom of access to information, I have applied for anonymized monthly longitudinal data including the information about the amount of money contributed by the participant, amount of the eligible state subsidy, sex and age of the participant, and the distinction whether the contract is administered under the old policy (transformed fund) or the new one (participant fund). The Ministry of Finance provided me with answer within the statutory period of 30 days, unfortunately, their decision rejected my application. According to MFCR, the Information system is not designed to generate information of the required structure and it would require manual collection of the data from the database, which was indicated as not feasible and excluded from the application of the Act no. 106/1999. The MFCR argues, that the Information system is able to generate only certain quarterly aggregate statistics, which are described in the chapter above.

3.1.3 Statistics on Income and Living Condition in the Czech Republic

The keystone of the analysis is based on the Statistics on Income and Living Condition in the Czech Republic (SILC) collected and published by the Czech Statistical Office. As a result of EU membership, the Czech Republic is obliged to annually collect data on income and living conditions on the level of households and individuals. According to CZSO, the purpose of the survey is “to gather representative data on income distribution for various household types, information about the method, quality and financial burden of housing, household durables and for labour, financial and health conditions of adults living in households.”

Each year, the collected random sample contains approximately 9,000 households and 20,000 corresponding individuals collected independently across countries with quantity proportional to the population of the particular country within the Czech Republic. From the time perspective, the dataset is an annual series of repeated cross-sections. However, the annual datasets are not completely independent, as each year’s sample contains a part of respondents questioned also in the previous year.⁵

The analysis uses the SILC dataset collected in the years from 2008 to 2015, providing information regarding the years 2007 to 2014, as respondents are questioned retrospectively about their situation in the previous year. The pooled cross-section for individuals contains 167,510 observations and 69 variables (only variables observable over the whole time period were included). Of these variables, those providing information on household composition, age, education, health condition, economic activity, income and contributions to the private pension scheme are primarily used for the analysis.⁶

It must be taken into account that, although the SILC dataset was created by advanced sampling methods, collecting comprehensive and confidential information about approximately 10,000 households faces various issues, including the situations when the respondents refuse to provide some information or change their status between individual waves of the research. As a result, the collected sample does not represent the whole population precisely, however it is a close approximation. To

⁵ The CZSO provides the detailed methodology for the SILC data under the following link: <https://www.czso.cz/csu/czso/prijmy-a-zivotni-podminky-domacnosti>

⁶ The summary statistics of variables used are provided in the empirical section.

find out to what extent the SILC data match the real population in terms of the supplementary pension scheme, we can compare the sample statistics with the aggregate data from MFCR. The SILC dataset provides information about the annual contributions, unfortunately it does not provide the direct information whether an individual participates in the pension scheme – this can be however obtained if we assume that all the individuals with nonzero contributions are participants and the others are not. Naturally, we can discuss participants and non-participants only with respects with population older than 18 years, as only since 2016 the individuals below 18 are eligible to participate in the private pension scheme in the Czech Republic.

The application of the t-test allows us to test the null hypothesis of the identical population mean for the participation rate, which is defined as a share of individuals participating in the private pension scheme on all the individuals eligible to participate, and for the average annual contributions of these participants.

Table 3.2: T-test statistics for participation rate (SILC vs. true population)

Year	Obs	Mean	Std. Err.	Std. Dev.	P-value Pr(T > t)	True Mean
2008	19,204	.43241	.003575	.495423	0.0000	.4884
2009	17,676	.45521	.003745	.497992	0.0000	.5075
2010	17,158	.45611	.003802	.498088	0.0000	.5212
2011	16,897	.46949	.003839	.499083	0.0000	.5267
2012	15,930	.49058	.003961	.499925	0.0000	.5918
2013	15,241	.48324	.004048	.499735	0.0000	.5730
2014	14,838	.47567	.004100	.499425	0.0000	.5543

Results of the test allow us to reject the null hypotheses both for participation and contribution for all the years tested. The sample means for the participation rate are undervalued compared to the true population (represented by MFCR data), on the other hand, individuals responding to the SILC survey on average stated higher contributions than the true population. However, there is a quite straightforward explanation for these differences. Respondents in the SILC database do not state whether they have an individual pension savings account, instead of that they are only questioned how much do they contribute. If we identify the participants based on the fact they contribute nonzero amount to the scheme, we probably divert from the official aggregated statistics, as the number of active contracts includes also those

participants, who have opened an account but do not contribute by any amount. Unfortunately, we do not have neither further information on the distribution of observed data in the true population. The conclusion is that the data provided by the SILC dataset are not directly comparable to the official statistics of aggregated data. Following the above outlined intuition we can assume, that the SILC dataset might provide in some ways even more realistic information than the aggregate statistics, furthermore it carries a valuable information about the personal characteristics about the individuals which is completely omitted in the aggregate dataset.

Table 3.3: T-test statistics for average contributions (SILC vs. true population)

Year	Obs	Mean (CZK)	Std. Err.	Std. Dev.	P-value Pr(T > t)	True Mean (CZK)
2008	8,304	5,599.741	53.7877	4,901.474	0.0003	5,406
2009	8,044	5,987.774	50.7141	4,548.468	0.0000	5,327
2010	7,826	6,057.825	55.7496	4,931.868	0.0000	5,275
2011	7,933	6,230.333	54.3871	4,844.120	0.0000	5,300
2012	7,813	6,780.035	57.5004	5,082.530	0.0000	5,579
2013	7,365	7,480.868	63.9630	5,489.279	0.0000	6,821
2014	7,058	7,980.753	65.5683	5,508.517	0.0000	6,892

3.2 Empirical methods and model set-up

The analysis of the 2013 policy change's impact relies on macroeconomic and particularly on microeconomic data, involving the common statistical methods and econometric approach. On the aggregate level of research, I am primarily using simple descriptive methods of the pension scheme development enhanced by the discussion of observed trends.

From the extensive perspective, i.e. the participation rate represented by the number of pension contracts, it is virtually not feasible to quantify individual effects of particular measures introduced, as these measures were introduced at the same time, some of them were affecting only a fraction of participants, they allowed people to adapt before they finally came into force and furthermore, their impact was most likely contradictory. However, the data provide for each quarter the information about number of participants, newly entered contracts and contracts cancelled in the

given period. Observing the development of these variables allows us to identify the most important trends. The first part of the results section is therefore devoted to the discussion of this issue.

In terms of the intensive perspective, i.e. the level of participants' contributions, the nature of the aggregate data fortunately provides more evidence for performing a more detailed analysis. Being provided the total amounts of funds contributed in the scheme, state subsidy granted and number of participants, we can operate with the average values both for the supplementary pension insurance (SPI) and its successor, supplementary pension savings scheme (SPS). The original SPI scheme continued after 2013 under rules relatively unchanged, with the exception of the state subsidy rules, allowing to receive higher subsidy in the absolute amount in exchange for lower relative return. The reaction of participants in the SPS scheme should therefore reflect solely the elasticity of their contributions with respect to the state subsidy matching.

The microeconomic data from the SILC database allow us to discover the reasoning behind the participants' behaviour in significantly larger depth, particularly to find relationships between individual's characteristics and their level of activity in the private pension scheme. In the first step, a share analysis is performed, observing changes in levels of participation and contribution with respect to the particular quantile of chosen explanatory variables over years before 2013 and after. These statistics provide us with the first glimpse suggesting which population groups are more likely to respond to the policy stimulations. An important remark is that the SILC data do not distinguish whether an individual is participating in the SPS or in the SPI scheme.

For observing the individual development during the time, the panel data would probably serve as the best source of information. The SILC dataset is cross-sectional, although a considerable amount of individuals responded in surveys in several consecutive years. Unfortunately, the reliable identification of individuals occurring in the multiple periods was not feasible and the data are therefore treated as repeated cross-sections in the first place.

3.2.1 Repeated cross-sections approach

Estimation of the policy effects using the pooled repeated cross-sections has the advantage of simplicity and no risk of misinterpretation of data caused by matching

techniques involved in the synthetic panel approach. However, cross-sectional data bring certain limitations as it is impossible to observe the development of participation and particularly contributions of the same individual. As a consequence, we cannot identify the individuals in the control group, which could otherwise be represented by those participants, who contributed above 1000 CZK per month already prior 2013. In case of cross-sectional data, we have to rely on the assumption that the individual's preferences dependent on the observed personal characteristics are consistent in time and therefore the participants behave consistently on the year to year basis. In other words, having a model explaining the participation rate or contributions in terms of personal characteristics, we can expect that without a significant policy change, represented for example by the reform in 2013, the slope of the regression line does not change and the time differences are captured by the intercept. Should the new pension scheme policy have any impact on the behaviour of participants, this impact can be captured either by a significant change in intercept for the given year and/or by a change in the slope of the regression line, i.e. the regression coefficients. Let us assume a general regression equation:

$$y_i = \alpha_0 + \sum_{j=1}^n \alpha_j \cdot X_{ij} + \varepsilon_i \quad (3.1)$$

We get the first intuition whether the coefficients α are constant in time if we use the equation to regress datasets from individual years independently and compare the results. To reach a more rigorous conclusion and test for statistical significance of structural differences, we add an additional dummy variables for each dataset in order to capture both shift in constants and shift in coefficients. For a pooled dataset consisting of 2 independent cross-sections, the resulting model would be represented by the following equation:

$$y_i = \alpha_0 + \beta_0 \cdot D_i + \sum_{j=1}^n \alpha_j \cdot X_{ij} + \sum_{j=1}^n \beta_j \cdot X_{ij} \cdot D_i + \varepsilon_i, \quad (3.2)$$

where D_i is a dummy variable capturing the differences present in the data from the second cross-section. If the coefficient β_0 is statistically different from zero while the coefficients β_j are not, the difference between the periods affected all the individuals equally. On the contrary, statistically significant non-zero coefficients β_j suggest that the relationship between dependent and explanatory variables changes, i.e. some of the individuals recorded a more perceptible change than the others. In case the additional slope coefficients β_j are not statistically different from zero, we can

actually benefit from pooling the datasets and estimate the relationships using all the observations:

$$y_i = \alpha_0 + \beta_0 \cdot D_i + \sum_{j=1}^n \alpha_j \cdot X_{ij} + \varepsilon_i, \quad (3.3)$$

where the term $\beta_0 \cdot D_i$ controls for the difference in the intercepts. (Podesta, 2002)

Whereas the analysis takes into account various combinations of explanatory variables and yearly SILC datasets, the purpose of presenting a particular models in the following chapter is to introduce the dependent variables, regressors and techniques used for the estimation.

Participation rate

As the variable representing the participation in the scheme has a binary outcome (0 - does not participate, 1 - participates), the participation rate is represented by a limited dependent variable model (LDV), where the dependent variable is the probability of an individual participating in the scheme, taking values from 0 to 1. The choice of main explanatory variables is inspired by the previous research papers focused on determinants of participation, and it includes age, gender, net income, number of worked hours and economic activity. Furthermore, the model also accounts for effects resulting from the situation when male or female gets married. In order to capture the effect of the policy change, a second intercept is added and the explanatory variables are additionally combined with the dummy variable signaling periods from the year 2013 on. As mentioned above, since the dependent variable takes on values between 0 and 1, and it behaves as a probability of participation in the scheme, we use the binary response model in order to reflect this limitation of the dependent variable:

$$P(part_i = 1|X_i) = G(\alpha_0 + \beta_0 \cdot D_i + \sum_{j=1}^n \alpha_j \cdot X_{ij} + \sum_{j=1}^n \beta_j \cdot X_{ij} \cdot D_i + \varepsilon_i) \quad (3.4)$$

where G is a function taking values strictly between zero and one: $0 < G(z) < 1$ and the vector $X = X_1, X_2, \dots, X_n$ represents the full set of explanatory variables:

j Variable	SILC code	Description (may be transformed and thus different from the original dataset)
1 Age	VEK	Age of an individual, categorical variable, 0: 18-25, 1: 25-29, 2: 30-34, 3: 35-39, 4: 40-44, 5: 45-49, 6: 50-54, 7: 55-59, 8: 60-64, 9: 65-69, 10: 70-74, 11: 75-80, 12: >80
2 Educ	VZD	Individual's education, categorical variable, 0: elementary education only, 1: maturity, 2: lower university (bachelor), 3: upper university (masters degree and above)
3 Female	POHL	Gender dummy, = 0 if male, =1 if female
4 Married male	STAV	Married male Variable multiplying gender and marriage dummies to capture effect for married men, = 1 if married male, = 0 otherwise
5 Married female	STAV	Married female - Variable multiplying gender and marriage dummies to capture effect for married women, = 1 if married male, = 0 otherwise
6 Econ_act	EA_EU	Economic activity by the definition of EU, categorical variable, 0: unemployed or other inactive, 1: employee, 2: self-employed, 3: retired
7 Hours	ODPRAC	Usual number of hours an individual worked per week
8 Netinc	CPRIJMY	Individual's net income in CZK per year

- D is a dummy variable identifying observations from the years that are being compared with the default period - (e.g. observations after 2013 capturing the possible effect of the policy change)
- ε is an i.i.d. error term $\sim N(0, \sigma)$

As Wooldridge (2009) suggests, in order to reflect the specific nature of the model with restricted dependent variable, we define the G function as a probabilistic function, i.e. the standard normal cumulative distribution function (cdf), which takes a form:

$$G(z) = \Phi(z) = \int_{-\infty}^z \varphi(z) dv \quad (3.5)$$

where $\varphi(z)$ is the standard normal density:

$$\varphi(z) = (2\pi)^{-1/2} \exp(-z^2/2) \quad (3.6)$$

Given the fact the model presented above is nonlinear, any regression using simple linear methods such as Ordinary Least Squares (OLS) is not suitable. Instead of that we use the Maximum Likelihood Estimation (MLE) allowing us to handle the nonlinearity.

Let us assume we have a random sample of size n . To obtain MLE, first we need to obtain the density of y_i given x_i , i.e. the likelihood function:

$$f(y|x_i; \beta) = [G(x_i\beta)]^y [1 - G(x_i\beta)]^{(1-y)} \quad (3.7)$$

where $y = 0, 1$. The Maximal Likelihood Estimator of β is obtained by maximizing the log-likelihood function:

$$l_i(\beta) = \sum_{i=1}^n y_i \log[G(x_i\beta)] + (1 - y_i) \log[1 - G(x_i\beta)] \quad (3.8)$$

where $G(\cdot)$ is the standard normal cumulative distribution function and $\hat{\beta}$ is the probit estimator (Wooldridge, 2009).

Interpretation of the estimated coefficients needs a different treatment than in case of a linear regression model, as the coefficients affect the probability through the transformed z-statistic indirectly. In general, there are two options for interpretation, computing predicted probabilities for defined values of all explanatory variables (mean or specific quantiles are usually used) by substituting into the function $G(x_i\beta)$, or by computing marginal probabilities as the partial derivative (if x_j is roughly continuous variable):

$$\frac{\partial p(x)}{\partial x_j} = g(\beta_0 + x\beta)\beta_j, \text{ where } g(z) = \frac{dG}{dz}(z) \quad (3.9)$$

An important note is that, as can be seen from the equation above, the marginal effects of individual variables in the probit regression are still dependent on values of other explanatory variables and need to be evaluated together. The participation model estimates the probability of individuals with given characteristics to participate in the private pension scheme. The effect of the policy change is captured via the dummy variable combined with the constant and the explanatory variables. If the coefficient of the intercept for the new policy period (β_0) is significant and the coefficients of variables are not, then it can be interpreted that the change affected all the individuals equally. On the contrary, significant coefficients for characteristic variables suggest that some groups of individuals reacted more sensitively to the new policy.

Contributions

The general model for estimating the amounts contributed by the participants uses variables identical to the participation model above. The dependent variable *contribution* is represented by the amount of Czech crowns contributed to the pension scheme in the given year. Since the dependent variable is effectively not restricted (if we assume that the predicted values are non-negative), the multiple linear regression model may be estimated by the traditional method of the ordinary least squares (OLS). The model is represented by the following equation:

$$contribution_i = \alpha_0 + \beta_0 \cdot D_i + \sum_{j=1}^n \alpha_j \cdot X_{ij} + \sum_{j=1}^n \beta_j \cdot X_{ij} \cdot D_i + \varepsilon_i \quad (3.10)$$

where vector $X = X_1, X_2, \dots, X_n$ represents the following explanatory variables:

j Variable	SILC code	Description (may be transformed and thus different from the original dataset)
1 Age	VEK	Age of an individual, categorical variable, 0: 18-29, 1: 30-39, 2: 40-49, 3: 50-59, 4: 60-69, 5: 70-79, 6: >80
2 Educ	VZD	Individual's education, categorical variable, 0: elementary education only, 1: maturity, 2: lower university (bachelor), 3: upper university (masters degree and above)
3 Female	POHL	Gender dummy, = 0 if male, =1 if female
4 Married male	STAV	Married male Variable multiplying gender (POHL) and marriage (STAV) dummies to capture effect for married men, = 1 if married male, = 0 otherwise
5 Married female	STAV	Married female - Variable multiplying gender (POHL) and marriage (STAV) dummies to capture effect for married women, = 1 if married male, = 0 otherwise
6 Econ_act	EA_EU	Economic activity by the definition of EU, categorical variable, 0: unemployed or other inactive, 1: employee, 2: self-employed, 3: retired
7 Hours	ODPRAC	Usual number of hours an individual worked per week
8 Netinc	CPRIJMY	Individual's net income in CZK per year

- D is a dummy variable identifying observations from the years that are being compared with the default period - (e.g. observations after 2013 capturing the possible effect of the policy change)
- ε is an i.i.d. error term $\sim N(0, \sigma)$

The contributions model represents the amount per year contributed by individuals with given characteristics to the private pension scheme. The effect of the policy change is captured via the dummy variable combined with the constant and the explanatory variables. If the coefficient of the intercept for the new policy period (β_0) is statistically different from zero and the coefficients of variables are not, then it can be interpreted that the change affected all the individuals equally. On the contrary, statistically significant non-zero coefficients for characteristics variables suggest that some groups of individuals reacted more sensitively to the new policy.

3.2.2 Cross-section limitations and synthetic panel approach

Although the cross-sectional data provide a solid amount of information about the behaviour of individuals, they also have certain drawbacks. The most important limitation is that we are not able to observe how the contributions of an individual evolved during the time, especially over the period the policy change was introduced. Furthermore, based on the contribution amounts we would be able to set up a control group with participants saving more than 12,000 CZK per year, who should not have been affected by the policy change. The proper difference-in-differences estimation could be then applied and the assumption of, *ceteris paribus*, time-invariant contributions released.

In the past, there were introduced several techniques allowing for construction of synthetic panel data from the repeated cross-sections. One of the first pseudo panel methods was presented by A. Deaton (1985), who suggested to concentrate observations into cohorts based on the similar time invariant characteristics such as age or gender, and to use cohort averages for estimation. Another approach, based on the instrumental variables, was used by Elbers et al. (2003), Dang et al. (2014) and Bourguignon (2015) to monitor poverty and income mobility. The so-called imputation method relies on estimating the model based on time-invariant characteristics in the first survey and using the estimates to predict the unobserved variable (e.g. income or consumption) for the individuals from the second survey.

The pseudo-panel approach showed to be a powerful tool for income mobility estimation and seemed to be also a feasible solution to overcome data limitations in our case. Unfortunately, after the more detailed analysis of the explanatory variables, this option had to be rejected. As the income and employment play an important role in explaining the pension scheme contributions, we cannot build a reliable model on time-invariant variables only. Furthermore, the participants across various income

groups, with different education or gender often show the same contributed amounts (as the scheme is designed for low and broadly affordable amounts). As a result, based on the known characteristics we were able to explain only approximately 20% of the variation in the contribution amounts. The result would be that even if we ignored the time variant part of information and used age, education, gender, marriage, the predicted contributions would strongly suffer by „averaging“ and we could not observe the behavioral pattern in case of individuals in the required detail⁷.

⁷ As outlined in the section 4.1, the main interest would be focused on how participants with maximal efficient-, or with minimal allowed contributions reacted to the change.

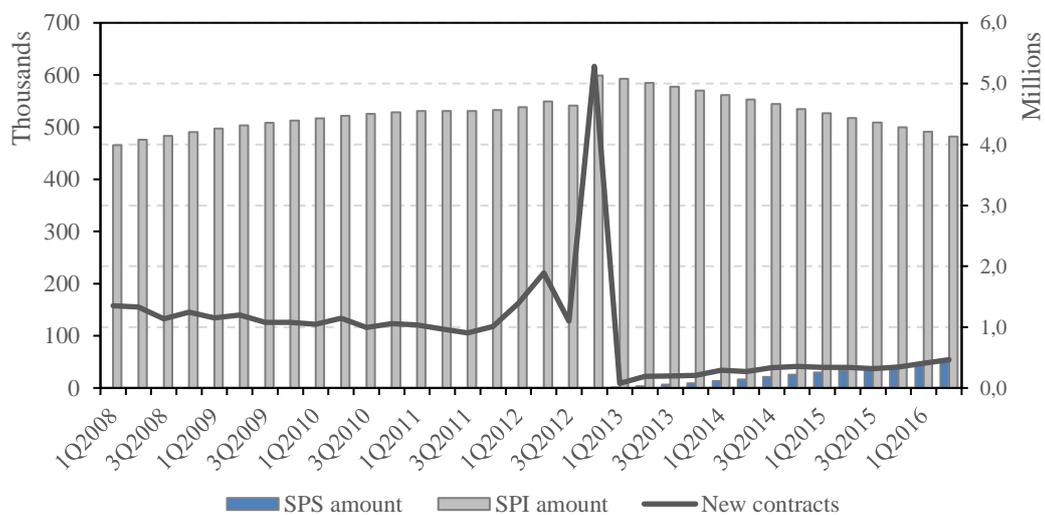
4 Results and discussion

Findings obtained by the analysis of aggregated data are presented and interpreted in the chapter 4.1, focusing on the development of the participation rate, contributions and efficiency of the scheme. The following chapter contains results of the microeconomic analysis performed on the SILC dataset, where initially the determinants of participation are estimated and the models are then tested for the structural differences associated with the intervention.

4.1 Aggregate data

In terms of active contracts, the third pillar of the pension scheme already showed relatively high participation rate prior implementing the new policy. At the end of year 2008, there were 4.2 million participants registered. With approximately 8.6 million inhabitants in the 18+ age bracket by that time, 48.8% of eligible inhabitants were participating in the scheme. This share continued to increase in the following years, reaching 52.1% and 4.53 million active contracts at the end of 2010. The year 2011 recorded virtually no further increase in participation. This can be explained as that the new legislation was already being discussed and the public was waiting for the specific outcome.

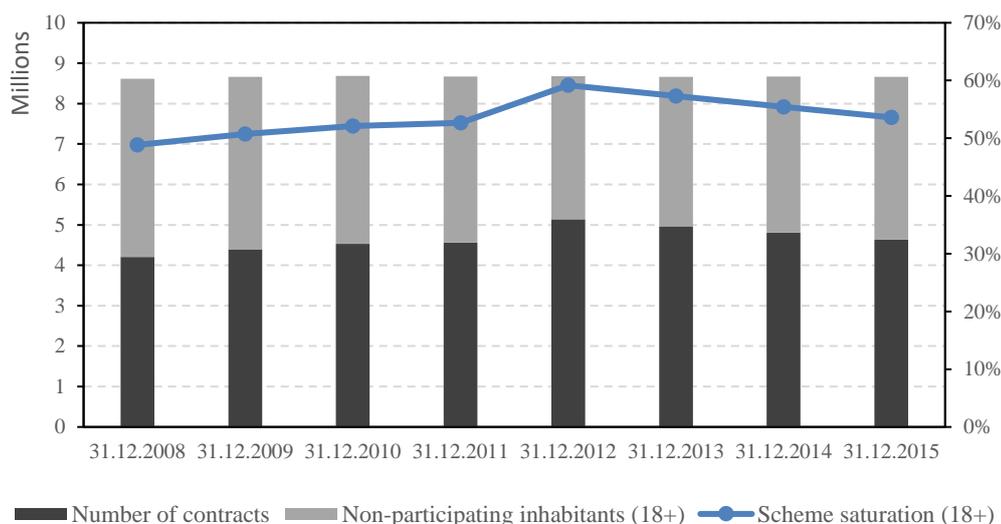
Figure 4.1: Number of participants in the 3rd pillar of the pension scheme



Source: MFCR, author

On 6th November 2011, the Act 427/2011 was finally ratified and although it did not come into force before January 2013, we are able to observe its effect already in the year 2012. In order to enter the scheme under the original policy rules, people started to open their accounts at a higher rate, with a dramatic increase in the 4th quarter of 2012. Within 3 months, 616,663 new contracts were registered, with the total number of active contracts increasing to 5.13 million. The participation rate reached 59.2%, a share significantly higher than many countries with a similar pension scheme in Europe were able to achieve.⁸ In 2013, number of new contracts significantly dropped, with less than 78 thousand new accounts registered during the year. The number of active contracts decreased to 4.96 million, retaining the decreasing trend at least until 2016, with the last available data in 2Q 2016 showing only 4.59 million active contracts.

Figure 4.2: Participation rate in the 3rd pillar of the pension scheme (individuals > 18 years old)



Source: MFCR, author

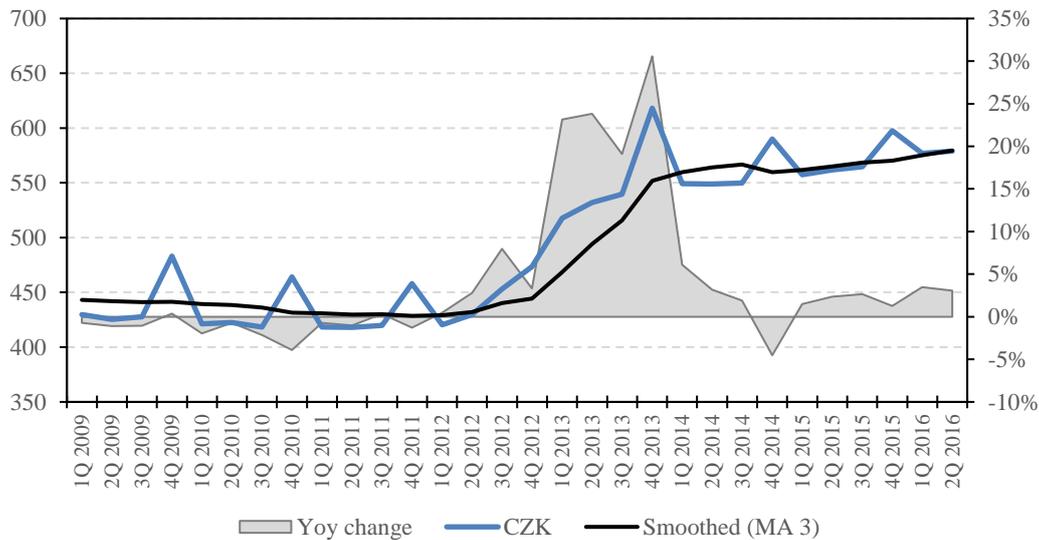
⁸ In Great Britain, the proportion of men and women contributing to private pensions was lower than 40% at the end of 2012 with a decreasing trend. (source: <http://webarchive.nationalarchives.gov.uk/20160105160709/>)

Number of participants in the Slovak reached only slightly above 730 thousand at the end of 2015, approximately 18% of economically active population. (source: <https://www.employment.gov.sk/sk/socialne-poistenie-dochodkovy-system/dochodkovy-system/iii-pilier-doplňkove-dochodkove-sporenie/zhodnotenie-majetku/>)

The Riester Pension in Germany in the first half of 2016 reports 16.5 million of participants, approximately 45% of economically active population. (source: <http://www.bmas.de/DE/Themen/Rente/Zusaetzliche-Altersvorsorge/statistik-zusaetzliche-altersvorsorge.html>)

When looking at the aggregate data, it is obvious that the mass public perceived the introduction of the new policy in 2013 negatively, with the highest probability being caused by less convenient conditions for funds access and loss of the non-negative returns guarantee, intensively discussed by the public media. As a result, the introduction of the new scheme increased the participation rate significantly in the short term, as it motivated people considering entrance in the scheme to enter by December 2012. This long-term effect was naturally opposite, under the new policy in 2013, the number of new contracts immediately dropped. Unfortunately, we are not able to accurately quantify particular effects of the policy change on the participation rate, as there are several offsetting effects included. Whereas the policy change was anticipated and people had enough time to decide, under which policy they want their contract administered, it can be assumed, that the positive impact on participation given by the higher contribution rate was realized already in 2012. On the other hand, the significant decrease of new contracts noticeable since 2013 till present is supported also by the fact that the most of people, who were considering to participate, probably entered the scheme already in the year 2012. Furthermore, another evidence for lower favour of the new scheme compared to the old one is illustrated by a negligible share of contracts that were transferred under the new policy after 2013, representing less than 2% of new contracts in 2013.

Although the supplementary pension scheme in the Czech Republic shows a relatively high participation rate, in terms of contribution the commitment of the most of its participants in long term is low. Under the former policy rules, the maximal monthly state subsidy of 150 CZK was reached when contributing 6,000 CZK per year (500 CZK per month), which is supported by the data. The average monthly contribution of participants was 450 CZK in 2008 and it even decreased to 442 CZK in 2011, corresponding to only 1.8% of average monthly gross wage. Since 2013, the maximal monthly subsidy was increased to 230 CZK, provided that the contribution is at least 12,000 CZK per year (1,000 CZK per month).

Figure 4.3: Average monthly contribution in CZK (both new and old scheme)

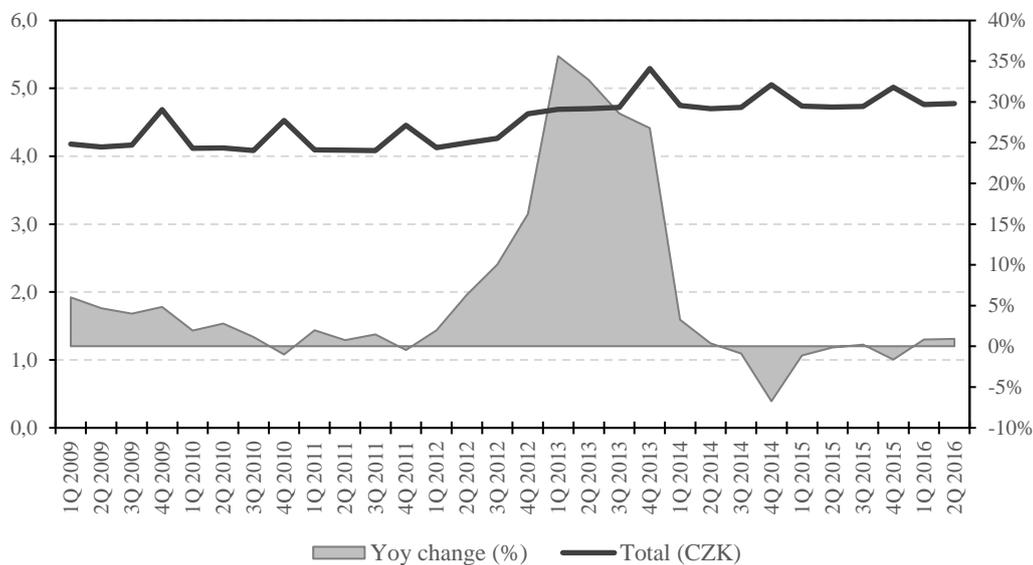
Source: MFCR, author

For discussing the impact of the intervention in 2013, it is necessary to distinguish between the participants continuing with their savings in the transformed funds and those, who established a new account under the new policy (or switched to it voluntarily). The latter group is not exposed to the negligence and delayed reaction, probably occurring in case of participants in the first group. Furthermore, the new pension scheme model might attract participants with different characteristics. In 2013, participants in the supplementary pension scheme contributed on average 749 CZK per month and retained at similar level in the following years, 722 CZK both in 2014 and 2015. According to the quarterly data, some of the participants in the supplementary pension insurance probably started to adapt to new terms already in 2012, as the average monthly contribution increased to 465 CZK. With the year 2013, the average monthly contribution sharply rose to 568 CZK per month (22.1% increase) and continued to grow in the following years, reaching 589 CZK in 2015. One can assume that the existing participants were adapting gradually and some of them probably did not change their behaviour at all, as the contribution on average remained significantly lower than in case of the newly introduced scheme. However, this hypothesis can only be tested using the individual data.

From the policy maker's point of view, it could be also convenient to have a look at how the new policy affected the total amount of costs, represented by the subsidy granted to participants, and in exchange how it affected the funds accumulated in the scheme. As discussed in the Chapter 3.3, the rules for subsidy eligibility allowed to

reach higher absolute amounts of subsidy in exchange for a lower relatively matching to the contributions. The data confirm the assumed outcome – total participant contributions increased by a larger amount than the subsidy granted to them. Whereas in the years from 2009 to 2011 (not accounting for 2012 as a transitory period), participants on average contributed 4.24 CZK per every 1 CZK obtained in the form of the state subsidy, in the years from 2013 to 2015, they contributed 4.82 CZK per 1 CZK of subsidy. If we perceived the state subsidy only as a measure used to motivate participants to contribute in the scheme, we could say that the new pension policy is approximately 13.5% more effective than the former one.

Figure 4.4: Contributions of participants per 1 CZK of state subsidy granted



Source: MFCR, author

In their nominal value, both the total contributions and the state subsidy granted increased in the period under the new policy rules significantly, reflecting also the steep increase of new contracts at the end of 2012. On average, the scheme registered annual contributions of 23.2bn CZK between 2009 and 2011. In the years from 2013 to 2015, contributions on average totalled 32.96bn CZK, i.e. 42% more. For the same time periods, the average annual state subsidy was 5.49bn CZK and 6.84bn CZK respectively, it recorded an increase by 24.6%.

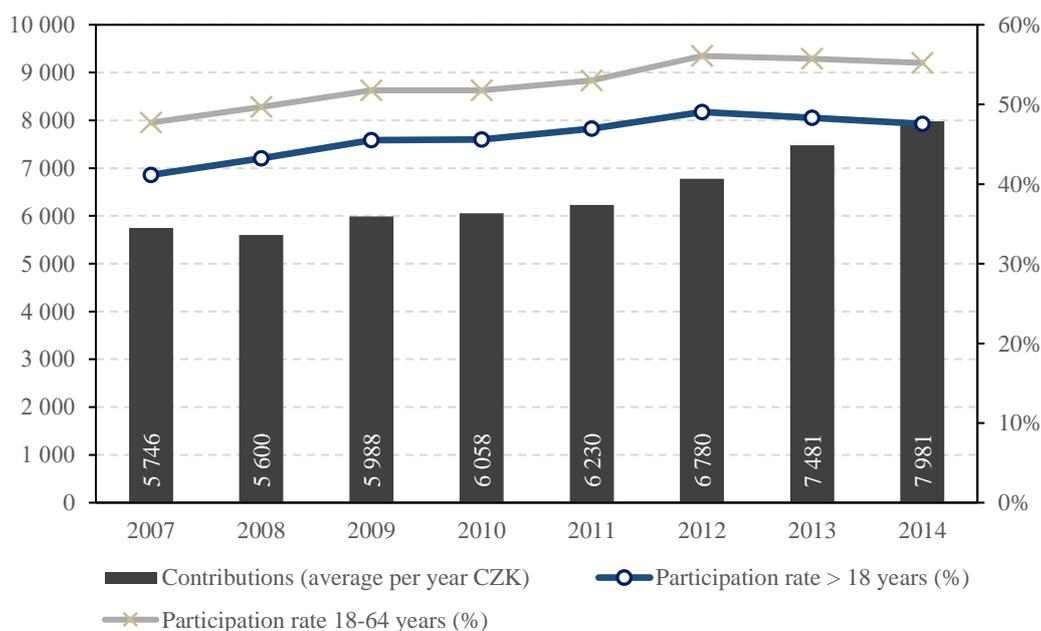
4.2 SILC results (microeconomic data)

The individual effects of the policy change are analysed with use of the SILC data, providing information from period 2007-2014. In the very beginning of the individual analysis it is necessary to recall that the data concerning the participation rate and contributions are not directly comparable to those provided by aggregate official statistics from the MFCR, as they are derived from the answer to the question “How much an individual contributed to the scheme in the given year” and the individuals who stated zero are automatically considered as non-participants.

4.2.1 Descriptive statistics

The share of participating eligible individuals, regardless any other distinction, recorded growth on annual basis during the whole studied period before the policy change was introduced. An increase from approximately 41% in 2007 to 49% in 2012 was accelerated in 2012 after announcement of the planned introduction of the new policy, which itself showed to have a negative effect on the participation, as the participation rate recorded a downturn below 48% after it was introduced. If we restrict individuals only on those in economically active age, i.e. 18-64 years, we can see that the participation is higher by approximately 7 percentage points each year.

Figure 4.5: Average annual contributions (CZK) and participation rate (%)



Source: SILC (CZSO), author

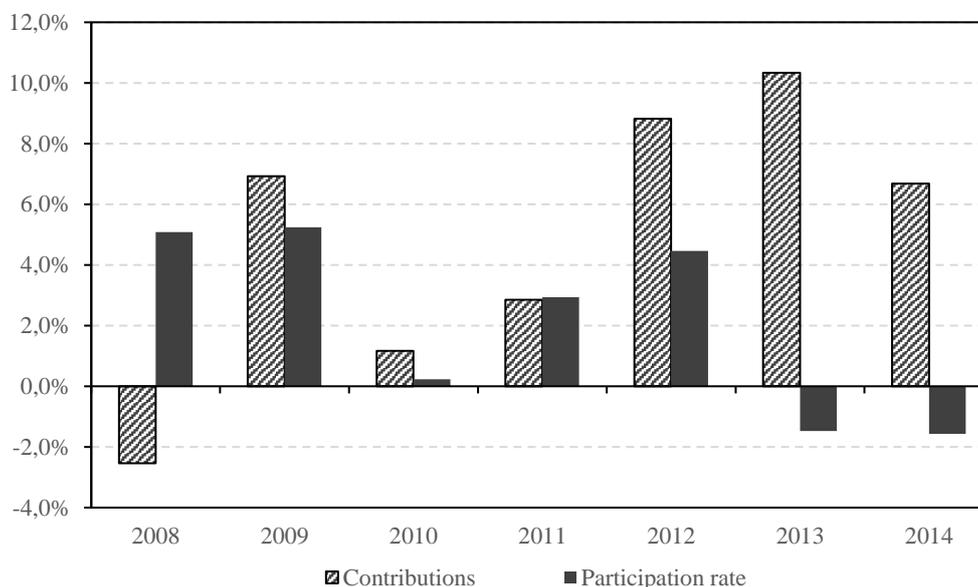
As mentioned earlier, the participation rates reported by the aggregate statistics and by the SILC substantially differ, probably due to the fact that the aggregate data do not distinguish whether the participant is really active, i.e. whether he or she contributes by nonzero amounts. In 2014, the aggregate statistics reported that approximately 55.4% of all inhabitants in the Czech Republic older than 18 years participated in the supplementary pension scheme. Nevertheless, the participation rate observed on the sample of 14,838 individuals from the SILC was only 47.6%. If we assume that the SILC reliably represents the share of active participants, by projection on the whole population the number of inactive participants can be estimated. At the end of 2014, there were approximately 8.665 million individuals older than 18 years in the Czech Republic. According to the MFCR, the third pillar recorded 4.803 million participation contracts at the same time. The participation rate 47.6% reported by the SILC, projected on the Czech population implies only 4.125 million of participants in the whole population. If we take into account the 95% confidence interval for the estimated mean, the number of active participants lies between 4.047 and 4.194 million. This implies that up to 750 thousand participants registered in the third pillar were effectively inactive and did not contribute by any amount in 2014.

Table 4.1: SILC participation rate 2014, incl. 95% confidence interval

Variable	Obs	Mean	Std. Err.	[95% Conf.	Interval]
Participation	14,838	.4757	.0041	.4676	.4837

If we focus on the development of average annual contributions of participants, the response to the policy change acting as a stimulus to increase contributions is evident. Almost 9% year to year growth in 2012 can be explained as a result of an early adaptation of certain participants, and it set up a trend for the following year 2013 and 2014. Comparing annual contributions in 2011 (the last year not influenced by the policy change, already anticipated in 2012) with contributions in 2014 (two years after the change), we see that the average annual contribution increased from 6,230 to 7,981 CZK, i.e. it recorded 28% growth.

Figure 4.6: Year-to-year change in average annual contributions and participation rate (%)

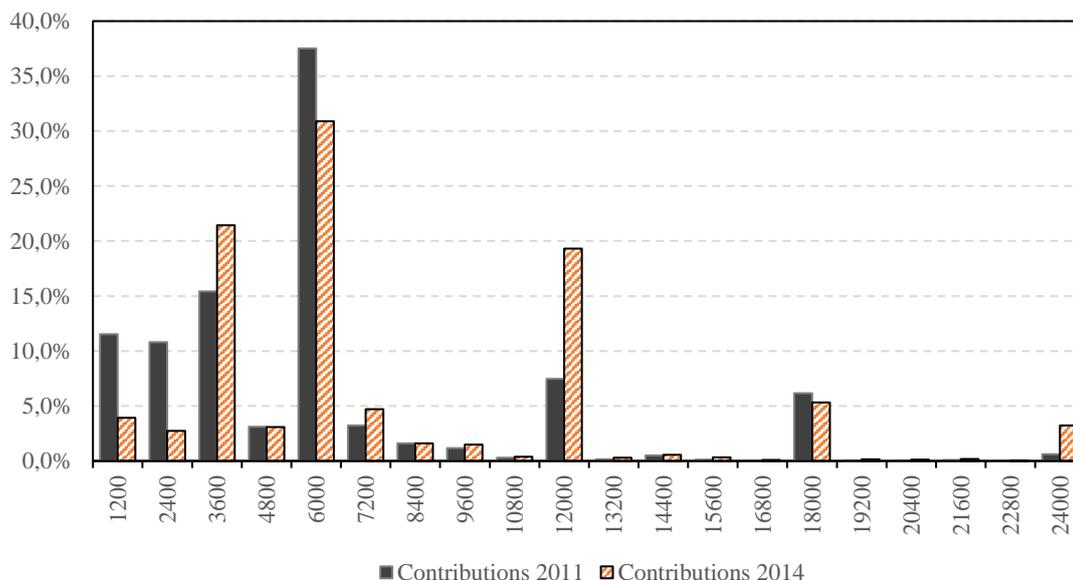


Source: SILC (CZSO), author

Comparing the histograms of annual contributions before and after the policy change clearly shows a shift to higher contributions. Whereas in both periods the median annual contribution remained at the same level of 6,000 CZK, the share of individuals annually saving at least 12,000 CZK doubled as it grew from ca. 15% in 2011 to 30% in 2014. Furthermore, there is an evident increase of individuals with annual contributions of 24,000 CZK, as this amount maximizes the tax relief provided by the scheme. On the other hand, share of participants saving less than 3,600 CZK per year significantly decreased from 23 % in 2011 to only 7 % in 2014. This fact implies also another interesting finding, that a relatively large group of participants lost their eligibility for the state subsidy with the reform. In 2013, it was more than 9 % of participants who contributed less than 3,600 CZK. A year later, the share of participants without claim for state subsidy decreased to approximately 7 %, suggesting that they either adapted to higher contributions or they ceased their savings completely. The analysis of contributions based on the SILC data delivers a conclusion similar to the one provided by the aggregate data from the MFCR. The increase in amounts contributed by the participants is evident, however on average the savings did not grow as much one could expect with the modified subsidy rules. Prior to the policy change, by far the largest share of participants (more than 37% in 2011), was saving 6,000 CZK annually, that time maximizing their subsidy. In 2014, individuals with this amount still accounted for 31% of all participants. Even though

it can be assumed that some of the participants still have not managed to adjust their contributions by the end of 2014, this suggests that the decision to save 500 CZK per month is still convenient for a large number of participants also after the intervention.

Figure 4.7: Histogram of annual contributions (CZK, comparison 2011 vs. 2014)



Source: SILC (CZSO), author

A more detailed insight is provided by the share analysis of contributions and participation for different population groups. Based on the level of income, education, age, gender and economic activity we are able to observe the differences among these groups of participants in general, and with respect to the policy change.

Income

The income level confirms its role of an important determinant when considering participation in the private retirement savings scheme. Dividing the population sample into ten income deciles and comparing them individually shows significant differences among these groups. The wealthiest 10% of respondents reported consistently the highest annual contributions with a large gap dividing the remaining 90% of participants. The upper 10% is also the only population group which on average almost reaches the amount maximizing the state subsidy after the policy change. Contributions of participants in the remaining income deciles are more concentrated and up to a few exceptions their ordering in terms of contributions corresponds with their income. It is noticeable, that the most affluent participants

started to adapt to new rules via increased contributions already in 2012 whereas the participants in the lowest decile did not react until 2013.

Figure 4.8: Participation rate by year and income decile (%)

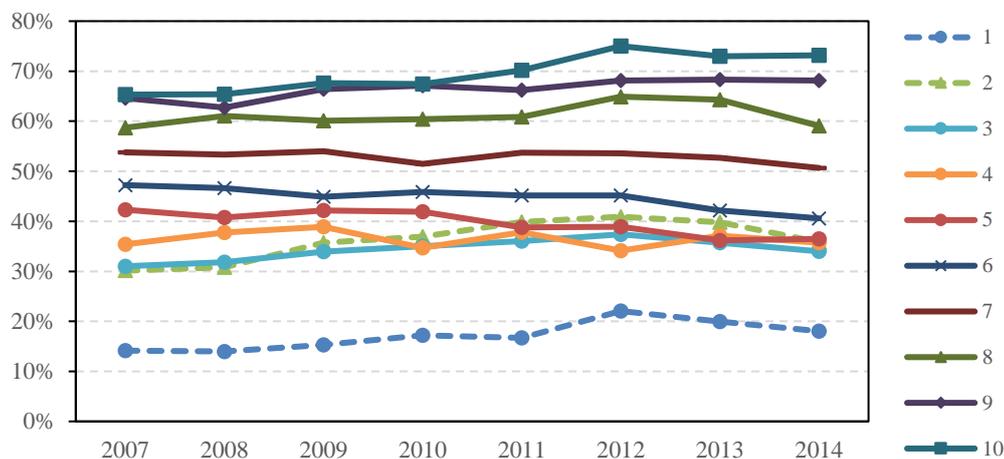
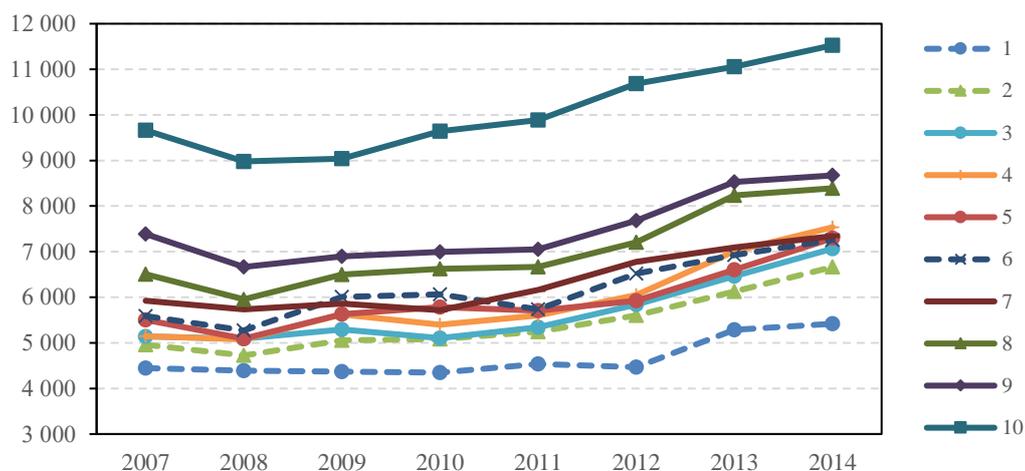


Figure 4.9: Average annual contributions by year and income decile (CZK)



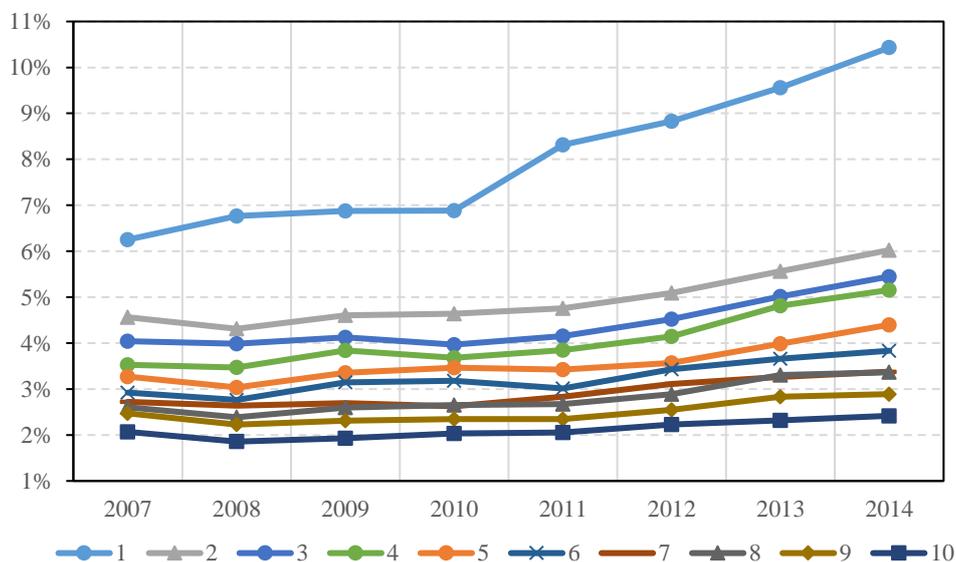
Source: SILC (CZSO), author

The share of participating individuals in particular income deciles follows the same rationale as in case of the contributions. The higher the net income, the higher probability of contributing into the pension scheme. Differences between individual groups are more linearly distributed, with deciles in the middle range showing certain patterns of convergence. In the lowest decile, less than 20% of individuals were participating in the scheme, with the only exemption of the years 2012 and 2013, where the short term effect of change attracted more participants, but by 2014 their share dropped to 18% again. A similar scenario happened in case of other deciles as well, as the year 2012 can be characterized by the lack of trust to the upcoming

change resulting in an accelerated opening of new accounts under the former policy. After two years the short-term effect disappeared and with the exception of the two upper deciles the participation rate declined to the level of 2011 or even below.

If we have a look at what proportion of their net income the participants in different income deciles dedicated to their private retirement scheme, we reach the inverse logic as in case of contributions in their nominal values. The individuals in upper income deciles contribute by highest amounts, but at the same time the contributions represent the smallest share of their income. Savings of individuals in lower deciles represent on average more than a double burden than in case of the upper deciles. As the first decile contains participants with net income below 66,000 CZK per year and they on average devote 10% of their net income to savings, there is a probable explanation that their contributions are result of financial transfers (e.g. from other members of their household with higher income) to optimize the state subsidy eligibility. The positive effect of the new policy is that the annual contributions as a percentage of income increased for participants across all the income groups.

Figure 4.10: Annual contributions as % of net income by year and income decile



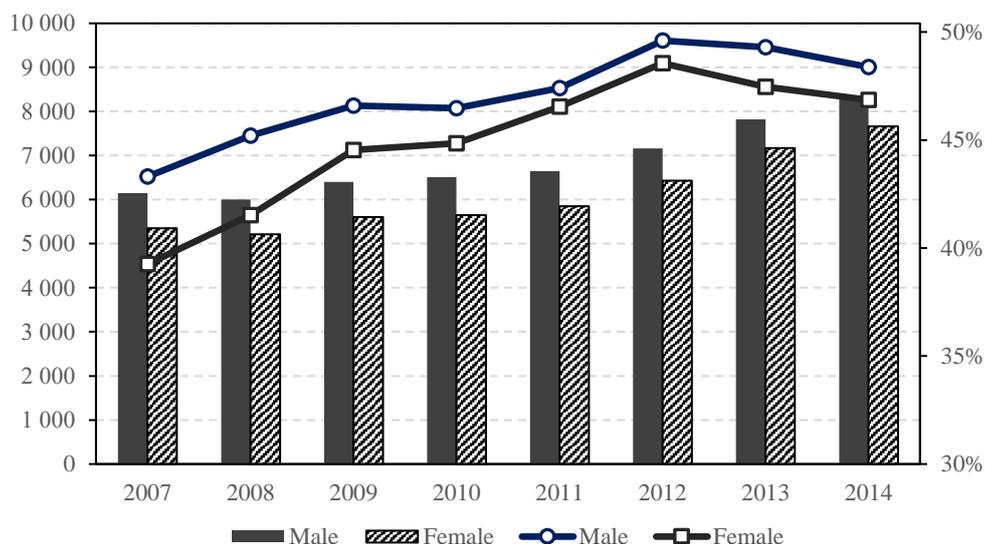
Source: SILC (CZSO), author

Gender and marriage

As mentioned in the previous chapters related to the literature review, empirical evidence for gender differences is relatively unclear. In the Czech Republic, Jelinek

and Schneider (1998) concluded that women were more active in terms of participation, on the contrary Jansky (2015) reached an opposite outcome. The data from the SILC confirm, that on average men participate in the private pension scheme more often and also contribute by higher amounts. There could be a lot of factors involved, among them the fact that men on average dispose by a higher income⁹ and in the traditional family model men play a role of breadwinners and heads of families responsible for material security. Nevertheless, the differences between the two groups are relatively small, and if we control for other effects (such as income disparities), women in general might be more inclined to generate additional retirements savings.

Figure 4.11: Average annual contributions (CZK, left axis) and participation rate by year and gender (% , right axis)



Source: SILC (CZSO), author

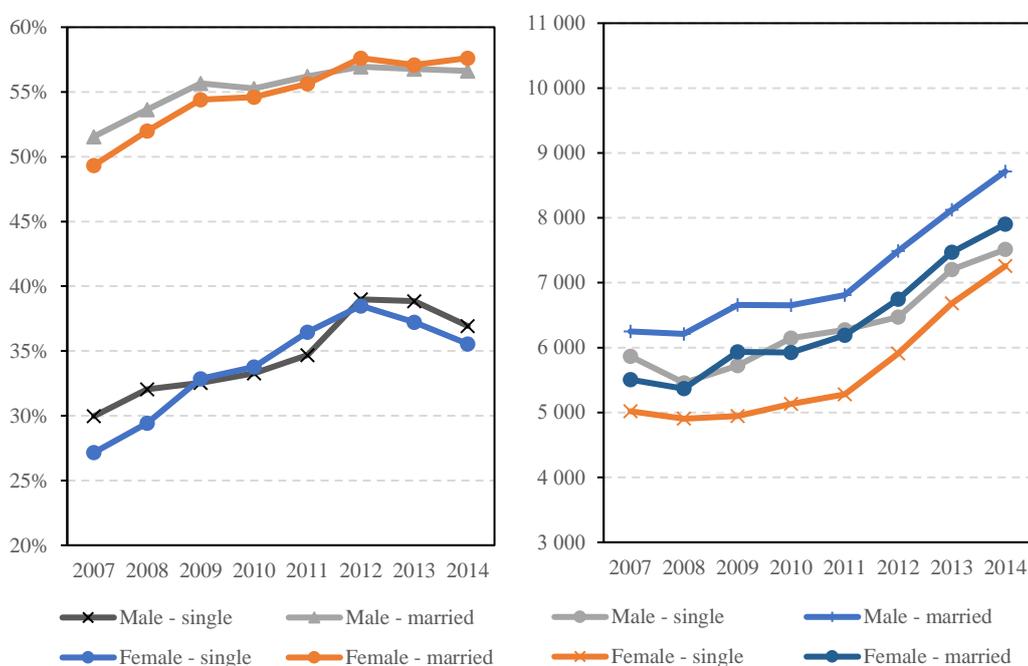
The further division of participants to single and married discovered that entering into marriage plays an important role when analysing the behaviour of individuals with respect to the pension scheme. Whereas the differences in participation between men and women were only decent, single and married individuals show a much stronger divergence. The share of participants among those individuals who were married was almost twice as large as in case of those who were single. Marriage probably has a positive effect on participation as it is usually being established in time when the

⁹ According to the available SILC data, adult men on average report ca. 45% higher income than adult women (including the disparities caused by different levels of employment).

couple gets older, establishes family and gains more responsibility about the future. Moreover, income transfers within the family allow the individuals with lower income to participate as well. An interesting effect of the policy change with new rules for the pension scheme is that women, both single and married, reacted to the incentive positively and more intensively than men. As a result, in 2014 married women had a higher participation rate than men, and, despite lower income, contributions of single men and women converged to the same level.

Figure 4.12: (Left) Participation rate by year, gender and marriage (%)

Figure 4.13: (Right) Average annual contributions by year, gender and marriage (CZK)



Source: SILC (CZSO), author

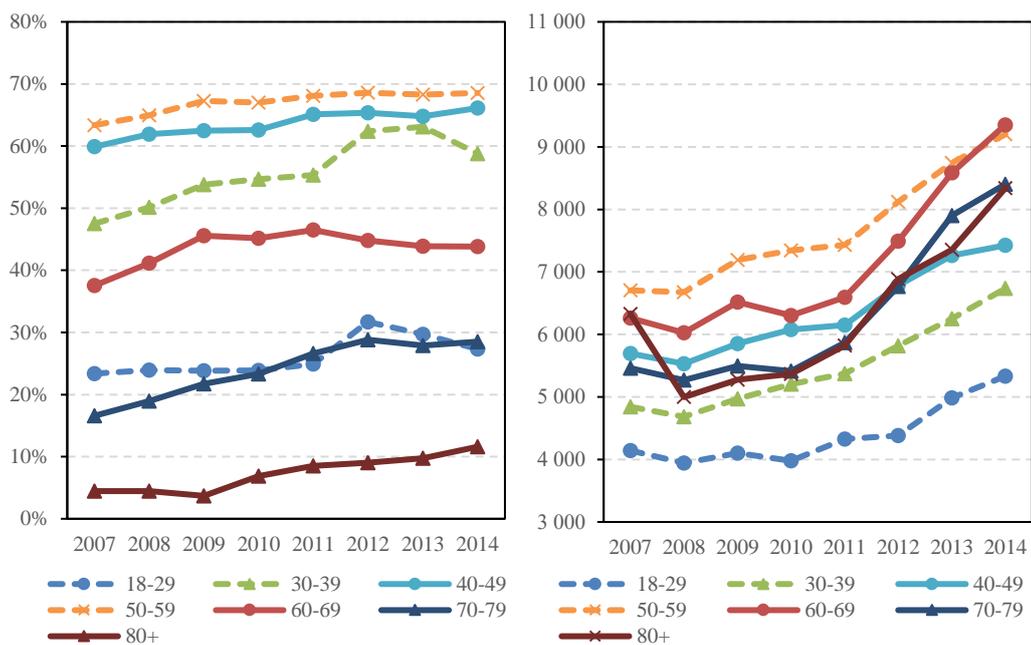
Age

In order to study the participation with respect to age of individuals, the sample of people older than 18 was divided into 6 age cohorts with the intervals of 10 years, the 7th cohort included the remaining individuals older than 80 years. The participation rate significantly varies among the age cohorts. Not surprisingly, the most active are individuals between 40 and 60 years of age, when they are still economically active but they start to realize the retirement horizon. These cohorts consistently reported the participation rate in the interval from 60 to 70% and no effect of the new policy is observable. On the other hand, it seems that the change motivated young individuals,

a group with participation deeply below average, to enter the pension scheme, at least in the short term. The positive development recorded individuals in the 30-39 cohort, who significantly increased their participation, but again with the disputable effect in the long term, as their participation dropped in 2014.

Figure 4.14: (Left) Participation rate by year and age cohort (%)

Figure 4.15:(Right) Average annual contributions by year and age cohort (CZK)



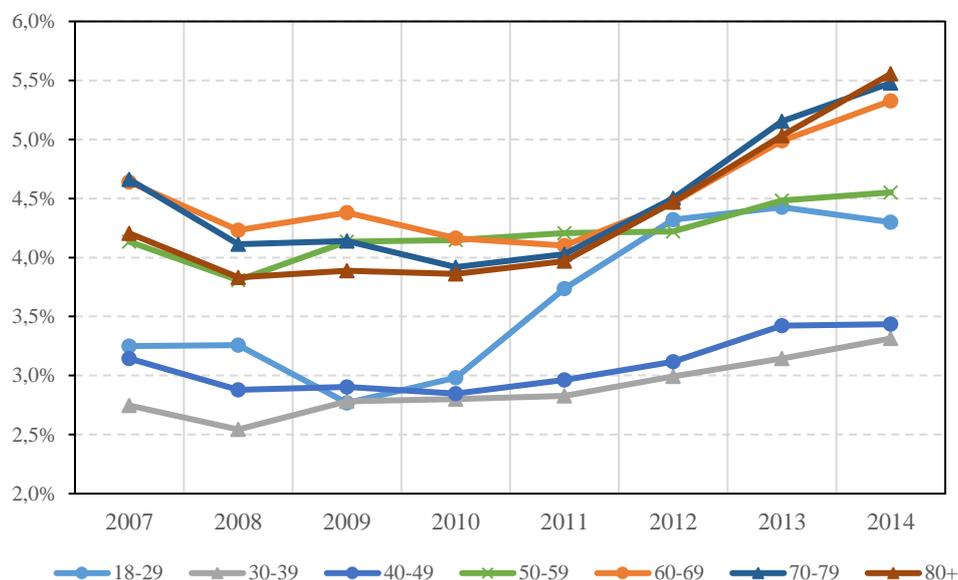
Source: SILC (CZSO), author

A surprising trend can be observed in case of individuals in the two highest age cohorts, i.e. individuals older than 70 years. Although compared to other groups their participation is relatively low, it is generally higher than one would assume and the share of participants in the 70-79 cohort is virtually identical to individuals younger than 30 years. Furthermore, the share of oldest participants is steadily increasing in time. This finding is not consistent with the logic of the retirement savings, as it is supposed to be generated during the period of an active life and paid out to the participants after retirement. Nevertheless, the pension scheme policy is probably attractive also for individuals who already retired, as they are eligible to access funds virtually any time after 5 years of participation, and they can benefit from the state subsidy for which they are also eligible. Some families also probably might use seniors to maximize the benefits of the retirement savings and instead of contributing to a single account they split their savings into accounts of other family members.

Another surprising finding is related to the average annual contributions across individual age cohorts. As expected, the highest contributions are recorded in case of older participants near the retirement age, but the share analysis revealed that after 2012 the individuals older than 70 years recorded a strong growth contributions and represent the second highest contributing cohort. The youngest participants in the first age cohort contribute on average approximately only a half of amounts contributed by participants in the 60-69 cohort. The positive trend of increasing contributions after the policy change can be observed in case of all the participants, however the oldest cohorts recorded the most intensive increase, with average contributions in 2014 more than 40% higher than in 2011.

If we express the annual contributions as percentage of the individuals' net income, it is evident that the contributions relative to income increased in case of all the analysed age cohorts. The most significant increase recorded participants in the three oldest cohorts, who also devote the greatest part of their income to the retirement savings, approximately 5.5%, whereas younger participants between 30 and 50 years on average saved for retirement only 3.4% of their net income.

Figure 4.16: Annual contributions as % of net income by year and age cohort



Source: SILC (CZSO), author

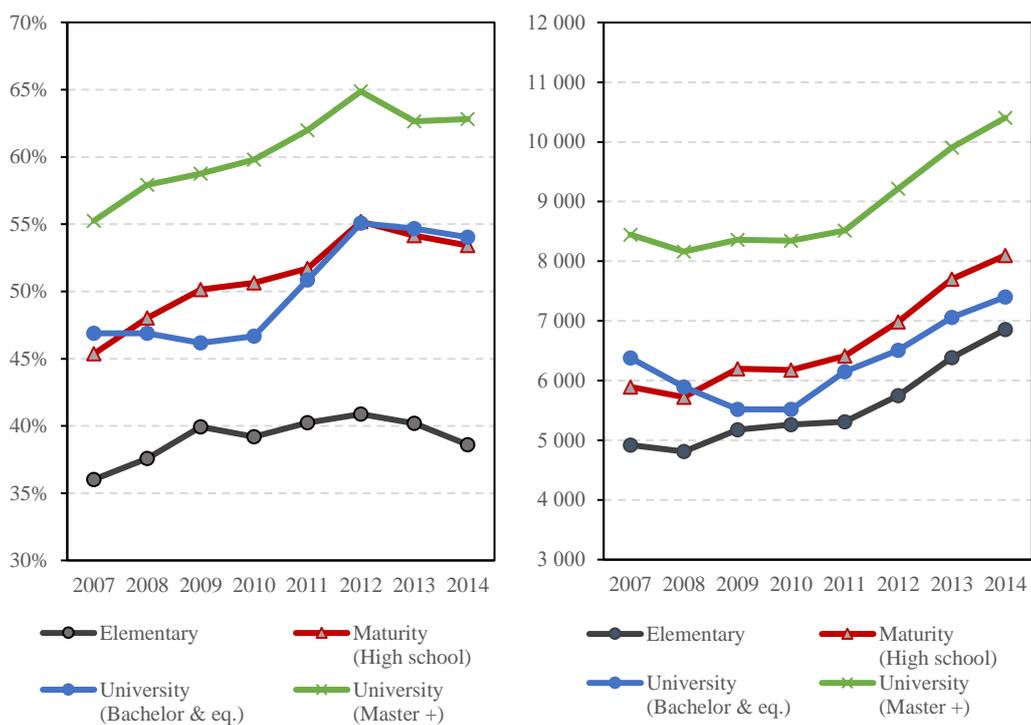
Education

The level of education, which also serves as a proxy for the level of financial literacy, is positively correlated both with the participation rate and the contributions.

Individuals with the higher university degree reported the largest participation rate and the greatest average contributions. According to the observed statistics, on average there is no significant difference between high school graduates and individuals with the lower (bachelor and eq.) university degree. Not surprisingly, the lowest level of participation and the lowest contributions show those individuals who completed only the elementary school (8-9 years of mandatory education). This group was also the only one whose participation rate stagnated in the last 5 years and it even decreased after 2013. Average contributions recorded growth for all the studied cohorts. The positive trend starting already in 2012 may be interpreted as a reaction to the anticipated incentives introduced by the policy change in 2013.

Figure 4.17: (Left) Participation rate by year and education (%)

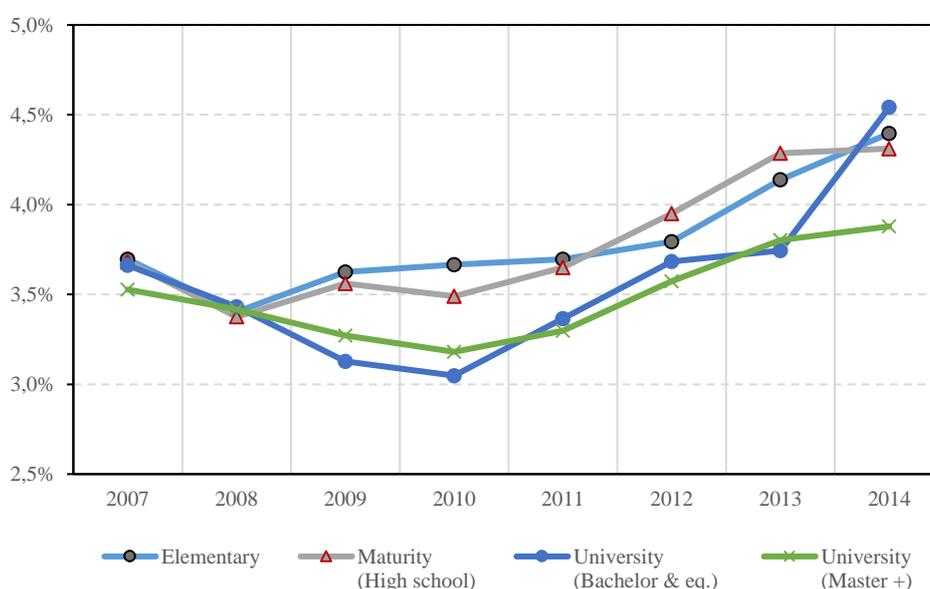
Figure 4.18: (Right) Average annual contributions by year and education (CZK)



Source: SILC (CZSO), author

Contributions relative to the net income were distributed across education cohorts very equally in 2008, when participants on average saved approximately 3.4% of their net income. If we compare contributions to the latest available data from 2014, all the cohorts on average increased their relative savings, but participants with the highest education recorded less significant growth than the remaining cohorts. The higher level of education is also correlated with higher personal income, therefore the effects of the income and education overlap and magnify the difference of the upper cohort from the remaining population.

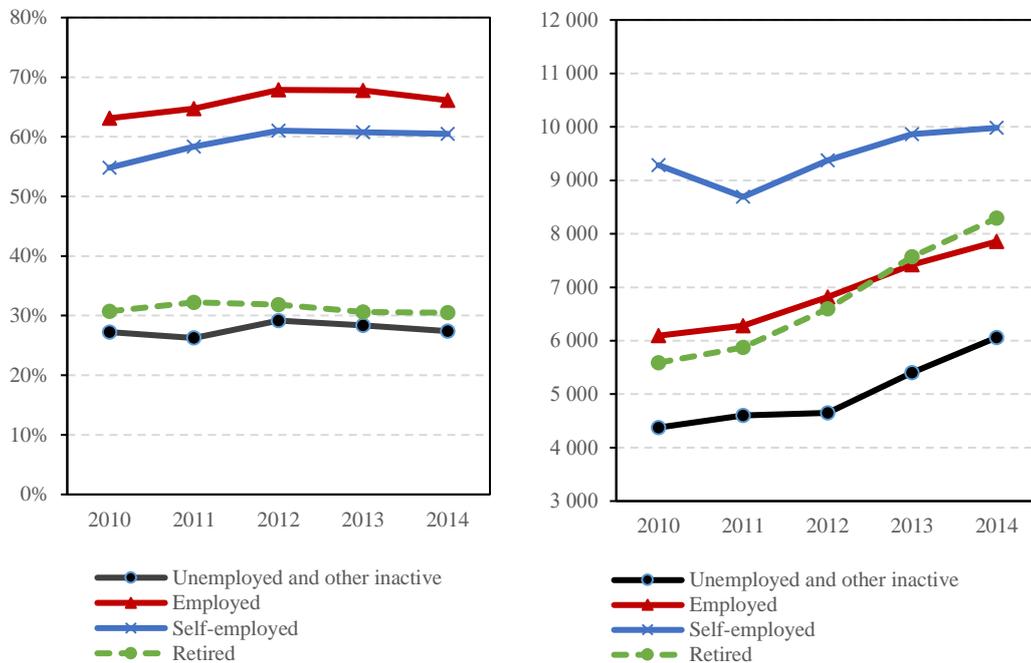
Figure 4.19: Annual contributions as % of net income by year and education



Source: SILC (CZSO), author

Economic activity

The last determinant of the private pension participation analysed in this section is the type of economic activity. The 4 groups are being distinguished – unemployed and other inactive, employed, self-employed and retired individuals. Self-employed participants are more active in terms of contributions as they often do not rely on the mandatory pension scheme in the extent as employees do. On average, self-employed participants contribute by amounts 25% higher than the employees, who, on the other hand, show a higher level of participation (approximately 65% vs 60% in 2014).

Figure 4.20: (Left) Participation rate by year and economic activity (%)**Figure 4.21: (Right) Average annual contributions by year and econ. act. (CZK)**

Source: SILC (CZSO), author

Contributions increased in all cohorts after 2013, especially the retired individuals reacted to the new incentives significantly and in terms of average annual contributions they shifted above the category of employees. This finding is consistent with the shift of individuals above 60 years of age discussed with respect to the age cohorts. On the other hand, the participation rate after 2013 suspended its growth and in case of both unemployed and employees recorded a slight downturn in 2014.

Effects of the intervention in 2013

If we compare the average annual contributions in 2011, the year before the policy change was announced, with 2014, the latest year available in the SILC dataset, we are able to identify the population groups that recorded the most significant increase in contributions during the period. In the table below, the participants are distributed into the cohorts and for each cohort the nominal and relative change is given.

Table 4.2: Summarized change of average annual contributions between 2011 and 2014, by individual groups, nominal value (CZK) and relative change (%)

All participants										
CZK	1 750									
%	28,1%									
Income (decile)	1	2	3	4	5	6	7	8	9	10
CZK	884	1 419	1 724	1 931	1 585	1 524	1 182	1 728	1 623	1 642
%	19,5%	27,1%	32,3%	34,5%	27,8%	26,6%	19,2%	25,9%	23,0%	16,6%
Gender	Male (single)	Male (married)	Female (single)	Female (married)						
CZK	1 236	1 907	1 976	1 714						
%	19,7%	28,0%	37,4%	27,7%						
Age	18-29	30-39	40-49	50-59	60-69	70-79	80+			
CZK	1 004	1 363	1 276	1 769	2 759	2 535	2 518			
%	23,2%	25,4%	20,7%	23,8%	41,8%	43,2%	43,3%			
Education	Elementary	Maturity (High school)	University (Bachelor & eq.)	University (Master +)						
CZK	1 545	1 683	1 251	1 890						
%	29,1%	26,2%	20,3%	22,2%						
Economic activity	Unemployed and other inactive	Employed	Self-employed	Retired						
CZK	1 460	1 572	1 292	2 417						
%	31,7%	25,0%	14,9%	41,2%						

The average increase in contributions for the whole sample is 28.1%, in the nominal value 1 750 CZK. As table suggests, there are 2 groups that recorded an outstanding growth both from the nominal and relative perspective. The first one are the single women, who on average saved additional 1976 CZK in 2014, corresponding to the 37.4% growth. The second group are individuals older than 60 years, i.e. the three oldest age cohorts, who show the greatest relative and nominal increase in savings among the all other observed individuals – additional savings of 2500 CZK correspond with more than 40% increase in contributions. The significant increase among the elder population is also projected into the growth among retired individuals, as these categories naturally show a great penetration of each other. On the other hand, among cohorts with the lowest increase belong single men and individuals in the lowest income decile, who recorded the lowest nominal growth (884 CZK). A low level of growth is associated with the self-employed individuals, but this group already reported high contributions in the previous years and probably was not motivated by the new policy enough to further increase their savings.

4.2.2 Regression analysis – participation

Initially, the correlation analysis of the variables available to be included in the model is performed. For ordered categorical variables, the Spearman's rank correlation was computed and the results confirmed that the threat of multicollinearity is not significant. The greatest level of correlation was found between the net income and hours worked per week, with the value of Rho 0.5876. By comparing several models it is to consider whether both of these variables should be used as regressors.

Table 4.3: Summary statistics - participation

Variable	Obs	Mean	Std. Dev.	Min	Max	Median
Participation (binary)	80,064	.4745579	.4993554	0	1	0
Netinc (CZK ths)	80,064	180.6935	138.9021	0	4,678.751	155.998
Age	80,064	5.733738	3.54862	0	12	6
1 (25-29)	80,064	.0631495	.2432331			
2 (30-34)	80,064	.073741	.2613506			
3 (35-39)	80,064	.0868805	.2816616			
4 (40-44)	80,064	.0785247	.2689971			
5 (45-49)	80,064	.074428	.2624677			
6 (50-54)	80,064	.0762015	.265322			
7 (55-59)	80,064	.0920763	.2891355			
8 (60-64)	80,064	.1050285	.306592			
9 (65-69)	80,064	.0944744	.2924894			
10 (70-74)	80,064	.0665717	.2492804			
11 (75-79)	80,064	.0449515	.207199			
12 (>80)	80,064	.0519834	.2219949			
Educ	80,064	.7637515	.9708564	0	3	
Maturity & eq.	80,064	.3491707	.476711			
Bachelor & eq.	80,064	.0335232	.1799994			
Master +	80,064	.1158448	.3200407			
Female	80,064	.5315623	.4990059	0	1	
Married male	80,064	.2762165	.447128	0	1	
Married female	80,064	.2778028	.4479184	0	1	
Hours (per week)	80,064	20.98519	21.62185	0	98	10
Economic activity	80,064	1.557991	1.116044	0	3	
Employee	80,064	.4307429	.4951833			
Self employed	80,064	.0698067	.2548225			
Retired	80,064	.3292116	.4699299			

Table 4.4: Spearman's rank correlation matrix (participation)

Rho coef.	Participation	Netinc	Hours	Age	Educ	Female	Married
Participation	1.0000						
Netinc	0.3135	1.0000					
Hours	0.3147	0.5876	1.0000				
Age	-0.0820	-0.0205	-0.4399	1.0000			
Educ	0.1612	0.2928	0.1923	-0.1800	1.0000		
Female	-0.0137	-0.3032	-0.2120	0.0662	0.0245	1.0000	
Married	0.1994	0.1282	0.0758	0.2117	0.0353	-0.0673	1.0000

Following the correlation analysis, the most suitable model representing the probability of participation in the private pension scheme was identified and estimated. Several nested and non-nested models were compared using the newest dataset, i.e. the year 2014.¹⁰ The regressors considered in the model included the net income, age cohort, gender, marriage, education and economic activity (dummies for employee, self-employed individuals and number of hours worked per week). As discussed in the section 3.2, the probability of participation was expressed by the binomial regression model and estimated with the probit estimator. Regression coefficients of all the explanatory variables included in the model proved to be statistically significant, however, the final model excluded “hours” from the set of regressors for its correlation with self-employment and net income. The level of subsidy provided by the third party belongs to the most important determinants of participation (Munell, 2001), hence the information whether the participant's employer provides contributions to his or her scheme should be included in the model. The SILC data unfortunately do not distinguish neither whether the employer's contributions are provided for life insurance or retirement savings of the employee, nor provide the information on the amount of these contributions. Another issue would probably occur with respect to exogeneity of the model, as the fact that an employer provides contributions is not automatically the exogenous factor affecting the participation in the scheme.

The model estimated on the 2014 data predicts the probability of participating (contributing non-zero amounts) in the private retirement savings scheme with a solid accuracy, as out of 14,838 observations the model correctly predicted 69.77% (for $P(y = 1) > 0.5$: $\hat{y} = 1$). The positive effect on probability of participation was proven in case of net income, higher age (with exception of the oldest cohorts),

¹⁰ The detailed results of the estimated models are provided in the Appendix 2.

education and economic activity. Furthermore, the higher probability was estimated in case of women, both single and married, whereas the marriage has a positive effect on participation of both men and women. The results show that although the participants who finished at least the high school are participating more frequently, further education increases the probability only slightly. A very low level of participation was estimated for the individuals within the youngest (18-24) and oldest (>75) age cohorts. Although the level of net income is positively correlated with the probability of participation in the scheme, the coefficient of net income itself is very low and the income standalone has a relatively low effect on decision whether to participate or not. Estimated propensities are in line with expectations based on available empirical evidence, as the higher participation rate of older, more educated and wealthier individuals is consistent e.g. with results of Clark (2002) and Lopez (2010). The higher probability of having a private pension plan in case of women and positive marital status corresponds with conclusions of Huberman (2007), Sunden and Surette (1998) and Johannisson (2008), and it could be probably explained by on average greater risk aversion related to these population groups.

The marginal probabilities presented in the table 4.6 provide better understanding of the regression coefficients, as they predict the conditional marginal effects and the conditional probability for each variable. The results imply that for an otherwise average individual, the probability of participating increases by 1.82 percentage points with each additional 100,000 CZK of annual net income. An average individual in the 50-54 age cohort shows a probability higher by 34 percentage points than the same individual of age 18-24. In case of employees, the probability of participating is 21 pp higher than in case of economically inactive individuals, the marginal effect of self-employed individuals is lower, 13.1 pp. The hypothesis that women are more likely to participate has confirmed, as on average single women show the probability of participation 4.6 percentage points higher than single men. Positive additional effect has the presence of marriage, as it increases the probability by approximately 11.6 pp both for men and by 9.6 pp for women. Keeping other characteristics fixed at means, the marginal effect of high school education is ca 10 percentage points, and the bachelor's degree increases the probability by additional 6 pp. The master's degree itself adds only 3 percentage points on the top of the high school education.

Table 4.5: Participation – results (probit), year 2014; predicted probabilities

Y = Participation	Coef.	Std. Err. (robust)	z	P>z	[95% Conf. Interval]
Netinc (ths CZK)	.0005555	.0001745	3.18	0.001	.0002135 .0008974
Age					
25-29	.3670055	.0631186	5.81	0.000	.2432954 .4907157
30-34	.5462889	.0630729	8.66	0.000	.4226684 .6699095
35-39	.7115411	.0631961	11.26	0.000	.587679 .8354032
40-44	.7609982	.0622984	12.22	0.000	.6388956 .8831008
45-49	.8109345	.0640958	12.65	0.000	.6853091 .93656
50-54	.8991235	.064372	13.97	0.000	.7729567 1.02529
55-59	.9877621	.0628787	15.71	0.000	.864522 1.111002
60-64	.7919216	.0606707	13.05	0.000	.6730093 .910834
65-69	.5912404	.0615164	9.61	0.000	.4706705 .7118103
70-74	.5039968	.0643602	7.83	0.000	.377853 .6301405
75-79	.2580122	.0740551	3.48	0.000	.1128669 .4031575
>80	-.1380705	.0764721	-1.81	0.071	-.2879531 .0118122
Educ					
Maturity & eq.	.3195446	.0254935	12.53	0.000	.2695783 .3695109
Bachelor & eq.	.4824857	.0622026	7.76	0.000	.3605708 .6044006
Master +	.3870244	.0395838	9.78	0.000	.3094415 .4646072
Female	.1405128	.0345233	4.07	0.000	.0728485 .2081772
Married male	.3519086	.0353746	9.95	0.000	.2825757 .4212415
Married female	.2932235	.03201	9.16	0.000	.230485 .355962
Employee	.636321	.0389892	16.32	0.000	.5599035 .7127386
Self_empl	.399011	.0548361	7.28	0.000	.2915341 .5064878
_cons	-1.507179	.0496988	-30.33	0.000	-1.604587 -1.409771

Probit regression	Number of obs =	14838
	Wald chi2(21) =	2965.87
	Prob > chi2 =	0.0000
Log pseudolikelihood = -8578.5991	Pseudo R2 =	0.1645

Probit model for participation, goodness-of-fit test	
number of obs. =	14838
number of cov. patterns =	12506
Pearson chi2(12484) =	13372.23
Prob > chi2 =	0.0000

Sensitivity	Pr(+ D)	67.51%
Specificity	Pr(~D)	71.81%
Positive predictive value	Pr(D +)	68.48%
Negative pr. val.	Pr(~D -)	70.90%
False + rate for true ~D	Pr(+~D)	28.19%
False - rate for true D	Pr(- D)	32.49%
False + rate for classified +	Pr(~D +)	31.52%
False - rate for classified -	Pr(D -)	29.10%

Correctly classified 69.77%

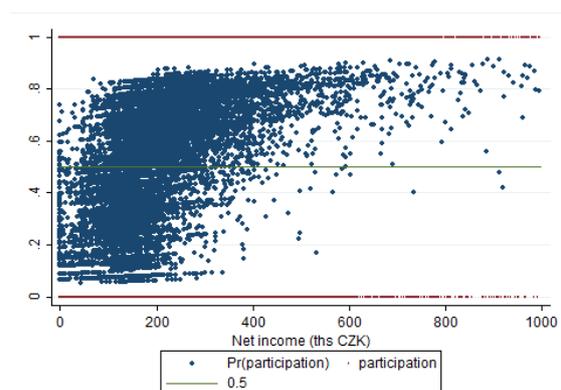


Table 4.6: Predicted marginal probabilities of participation (at means, 2014)

	dy/dx	At Net income (ths CZK)	P (Y=1)	At Age:	P (Y=1)
Netinc (ths CZK)	.0001823	100	.44607	18-24	.25289
Age		200	.46810	25-29	.38269
25-29	.11976	300	.49022	30-34	.45258
30-34	.18316	400	.51238	35-39	.51839
35-39	.24267	500	.53450	40-44	.53807
40-44	.26048	600	.55651	45-49	.55785
45-49	.27840	700	.57834	50-54	.59239
50-54	.30978	800	.59995	55-59	.62640
55-59	.34081	900	.62125	60-64	.55033
60-64	.27159	1,000	.64219	65-69	.47043
65-69	.19930			70-74	.43588
70-74	.16803	At Education:	P (Y=1)	75-79	.34185
75-79	.08246	Elementary	.39480	>80	.21084
>80	-.03987	Maturity & eq.	.52102		
Educ		Bachelor & eq.	.58537		
Maturity & eq.	.10695	Master +	.54783		
Bachelor & eq.	.16113				
Master +	.12951				
Female	.04613				
Married male	.11552				
Married female	.09626				
Employee	.20889				
Self_empl	.13098				

The effects of time (including the policy change) on the estimated relationship may be observed by comparing the regression coefficients for individual years. The model presented in the table 4.5 was estimated independently for the years 2010 – 2014, proving that its consistency holds for the whole dataset. In the next step, the pairs of the adjacent years were both across and consecutively tested for the presence of the structural change represented either by a different mean or different coefficients of explanatory variables, following the approach presented by the equation 3.2.

Based on the results presented in the table 4.7, we are able to reject the hypothesis of structural differences between the pairs of years 2010/2011, 2012/2013 and 2013/2014, as the difference either in the intercepts or regression coefficients has not been proven. On the other hand, the regression comparing the years 2011 and 2012 shows significant difference between these periods. The positive additional intercept D was estimated (.2889), whereas the negative significant coefficients were assigned to particular age cohorts. Results suggest that the year 2012 lead to an increased participation rate in general, but the dependence of participation on age has lowered. The highest increase of participation recorded young individuals (cohorts below 40

years), which is consistent with the development observed in the previous analysis. As the comparison of individual years following after 2012 did not prove further statistically significant structural changes, it can be assumed that the change regarding the level of participation with respect to the policy change in 2013 was realized during the year 2012. To further analyse this transition, the same test for structural differences was performed by comparing the individual annual coefficients with coefficients estimated for the year 2012, and comparing individual annual coefficients of 2010 and 2011 against coefficients after the intervention, i.e. 2013 and 2014.¹¹ The year 2012 shows a higher probability of participation given by the intercept, including also the youngest age cohort of participants. The effect on remaining age cohorts was negative, suggesting that the youngest cohort recorded the largest growth. With respect to the year 2013, no significant differences from 2012 estimates were observed. Comparing the last year before the announcement of the intervention, 2011, with the latest available year 2014 show that the higher increase in participation in 2012 was rather temporal as the difference in coefficients is less significant than in case the years 2011 and 2012 were compared. On the other hand, some new effects, probably too low to be captured on the year-to-year basis, could be observed. Compared to the years 2010 and 2011, the higher probability of participation in addition reported individuals with higher education and married women.

Finally, the coefficients for the pooled datasets consisting of years 2010-2011 and 2013-2014 were estimated and compared to each other, whereas the year 2012 was omitted as the previous results suggest that it finds itself in the transition period and it cannot be truly attributed to neither one of the compared groups representing pre- and post-intervention sample. The results of the pooled comparison are probably affected by averaging the multiple periods and provide weaker evidence than in case of the year-to-year comparison, however the positive differencing coefficients were estimated in case of the intercept (i.e. the youngest cohort), higher education and married women. The dependency of probability on the net income and the age decreased after the intervention, suggesting that in terms of participation the population became slightly more equalized. As the last step, the estimated probabilities predicted for each year independently are compared.

¹¹ For detailed results, please see the Appendix.

Table 4.7: Participation – results (probit), test for change in coefficients (years 2010 – 2014, consecutively)

Y = Participation	Year 2010 D: 2011	Year 2011, D: 2012	Year 2012, D: 2013	Year 2013, D: 2014
p-value < 0.001 - ***				
p-value < 0.01 - **	Obs. = 34,055	Obs. = 32,827	Obs. = 31,171	Obs. = 30,079
p-value < 0.05 - *				
Netinc (ths CZK)	.00068134***	.00088052***	.00095986***	.00036846*
Age				
25-29	.49616457***	.54852609***	.30789717***	.37409632***
30-34	.69474945***	.72197281***	.50033523***	.64063193***
35-39	.79751272***	.7606713***	.58708433***	.76017138***
40-44	.82235804***	.89557556***	.54021796***	.65796573***
45-49	.96089368***	.99584579***	.62288267***	.75442908***
50-54	1.0707401***	1.0843619***	.70724455***	.80679653***
55-59	1.212371***	1.215435***	.85754308***	.97324224***
60-64	.9879079***	.9984106***	.61021702***	.70740508***
65-69	.80107346***	.89545573***	.50112135***	.63064864***
70-74	.5473242***	.65317959***	.36976383***	.47791129***
75-79	.20844242**	.3506213***	.05192841	.17774112*
>80	-.27621864***	-.16612932*	-.46944624***	-.26566467***
Educ				
Maturity & eq.	.24700054***	.24614864***	.28735751***	.29823457***
Bachelor & eq.	.27764683***	.29195536***	.33080639***	.35943578***
Master +	.26804695***	.27483232***	.3468432***	.34682202***
Female	.14959802***	.19828343***	.17609728***	.15341493***
Married male	.29167554***	.28926198***	.29390182***	.32530541***
Married female	.20750507***	.17273801***	.24362593***	.2331816***
Employee	.57543147***	.59999424***	.62912912***	.7034736***
Self_empl	.2786394***	.34658742***	.38237691***	.42853044***
D	-.06316538	.28888147***	-.0741984	-.09561563
Netinc_D	.00021646	.00008098	-.00060074**	.00017356
Age_D				
25-29	.05153992	-.24317495**	.05777711	-.01014621
30-34	.02671758	-.22418327**	.1312774	-.0980522
35-39	-.03687538	-.1762641*	.16292488	-.05315932
40-44	.07374398	-.3582054***	.10633771	.09788229
45-49	.03540338	-.3759034***	.11956343	.05082858
50-54	.01458753	-.37977054***	.08817545	.08715909
55-59	-.00366348	-.36464759***	.10064708	.01066495
60-64	-.02265269	-.4120368***	.05054	.08633225
65-69	.04979176	-.42717373***	.06419451	-.03466261
70-74	.05878112	-.31738694***	.04107775	.03122619
75-79	.09506409	-.33319897**	.057573	.08577393
>80	.06276743	-.3380809**	.13499431	.13293316
Educ_D				
Maturity & eq.	-.00044471	.041435	.01107022	.02090511
Bachelor & eq.	.01416515	.03945589	.03051729	.12331982
Master +	.00815854	.07347214	.00236239	.04015722
Female_D	.04615886	-.0228956	-.02263827	-.01109951
Married male_D	-.00151265	.00537838	.03281978	.02652414
Married female_D	-.03578659	.06994863	-.01193446	.05990323
Employee_D	-.02209068	-.00146882	.01975986	-.05628561
Self_empl_D	.04550721	.03673422	.07844569	-.00032444
_cons	-1.5771704***	-1.6410926***	-1.3502451***	-1.4156661***

**Table 4.8: Participation – results (probit), test for change in coefficients
Years 2010 and 2011 against 2013 and 2014, individually)**

Y = Participation	Year 2010, D: 2013	Year 2011, D: 2013	Year 2010, D: 2014	Year 2011, D: 2014
p-value < 0.001 - ***				
p-value < 0.01 - **	Obs. = 32,399	Obs. = 32,138	Obs. = 31,996	Obs. = 31,735
p-value < 0.05 - *				
Netinc (ths CZK)	.00066762***	.00086107***	.00067633***	.00086942***
Age				
25-29	.49454489***	.54635834***	.49557385***	.54729106***
30-34	.69299548***	.71942597***	.69410953***	.72052153***
35-39	.79520916***	.75702539***	.79667221***	.75859385***
40-44	.81940203***	.89128085***	.82127931***	.8931281***
45-49	.95760117***	.99141761***	.95969217***	.9933221***
50-54	1.0678082***	1.0798826***	1.0696698***	1.0818085***
55-59	1.211099***	1.2137191***	1.2119063***	1.2144561***
60-64	.99015784***	1.0015695***	.98872878***	1.0002104***
65-69	.80450967***	.90045073***	.80232739***	.89830253***
70-74	.5510314***	.65886539***	.54867702***	.65642***
75-79	.21212395**	.35622461***	.20978587**	.35381474***
>80	-.27233468***	-.16045543*	-.27480132***	-.1628955*
Educ				
Maturity & eq.	.24694635***	.24617223***	.24698073***	.24616204***
Bachelor & eq.	.27841701***	.29270829***	.2779278***	.29238437***
Master +	.26840366***	.27558338***	.26817719***	.27526045***
Female	.15063016***	.19975729***	.1499743***	.19912237***
Married male	.29146068***	.28902658***	.29159682***	.28912715***
Married female	.20747922***	.17264851***	.20749539***	.17268659***
Employee	.58255348***	.61030519***	.57803071***	.60587126***
Self_empl	.29899079***	.37500172***	.28606602***	.36277965***
D	.15728058*	.22060208**	.07009209	.13348898
Netinc_D2011	-.00029127	-.00050042**	-.00010232	-.00031269
Age_D				
25-29	-.12787167	-.18059472*	-.13065182	-.18288327*
30-34	-.06029227	-.08771592	-.14959096	-.1770374*
35-39	-.04330093	-.00684747	-.08593177	-.04985503
40-44	-.17011195*	-.2444825**	-.06075596	-.13511723
45-49	-.21191686*	-.24868422**	-.14854899	-.18534451*
50-54	-.2687069**	-.28413673**	-.17076351*	-.18556483*
55-59	-.25595333**	-.25579855**	-.2306463**	-.23177367**
60-64	-.36185924***	-.34368319***	-.24813189**	-.2310094**
65-69	-.28827417**	-.33947558***	-.28878775**	-.34036352***
70-74	-.19099535*	-.25251659**	-.12547003	-.18693639
75-79	-.1545767	-.25131681*	-.03497429	-.13123025
>80	-.11470702	-.17864673	.05386806	-.01053823
Educ_D				
Maturity & eq.	.05243913	.05233961	.07404765*	.0738417*
Bachelor & eq.	.08385017	.06869822	.20716224*	.19143901*
Master +	.08253382	.07377353	.12191184*	.11313826*
Female_D	-.00036715	-.04658153	-.01376635	-.05962972
Married male_D	.03686819	.03783593	.06145636	.06325829
Married female_D	.02330473	.05896198	.0841501	.11972754**
Employee_D	.01297066	.03386389	-.02221164	-.00085431
Self_empl_D	.12753826*	.08278713	.08333746	.03828505
_cons	-1.5796962***	-1.6448647***	-1.5780909***	-1.6432396***

Table 4.9: Predicted marginal probabilities of participation (at means, 2010-14)

At Age:	2010	2011	2012	2013	2014
18-24	0,197	0,199	0,314	0,267	0,253
25-29	0,363	0,383	0,430	0,401	0,383
30-34	0,439	0,451	0,507	0,507	0,453
35-39	0,481	0,466	0,542	0,554	0,518
40-44	0,491	0,520	0,523	0,513	0,538
45-49	0,547	0,559	0,556	0,551	0,558
50-54	0,589	0,594	0,589	0,572	0,592
55-59	0,642	0,644	0,646	0,637	0,626
60-64	0,553	0,561	0,549	0,535	0,550
65-69	0,477	0,520	0,505	0,506	0,470
70-74	0,378	0,424	0,453	0,445	0,436
75-79	0,258	0,311	0,331	0,331	0,342
>80	0,128	0,156	0,169	0,189	0,211

At Education:	2010	2011	2012	2013	2014
Elementary	0,391	0,406	0,424	0,411	0,395
Maturity & eq,	0,488	0,503	0,538	0,529	0,521
Bachelor & eq,	0,499	0,522	0,555	0,553	0,585
Master +	0,496	0,515	0,561	0,548	0,548

At Net income (ths CZK)	2010	2011	2012	2013	2014
100	0,418	0,428	0,452	0,462	0,446
200	0,446	0,463	0,491	0,476	0,468
300	0,474	0,498	0,530	0,490	0,490
400	0,503	0,533	0,568	0,504	0,512
500	0,531	0,567	0,606	0,519	0,535
600	0,559	0,601	0,643	0,533	0,557
700	0,587	0,635	0,678	0,547	0,578
800	0,614	0,667	0,712	0,561	0,600
900	0,641	0,698	0,744	0,575	0,621
1000	0,667	0,728	0,775	0,589	0,642

The probabilities for an average individual at a given age, income or level of education recorded an observable development during the analysed years, with the year 2012 representing a significant change. Particularly the probabilities of youngest age cohorts increased, by up to 50%. With respect to the net income and education, the increase was observed across all the cohorts with similar intensity. In the following years 2013 and 2014, individual cohorts behaved differently. Whereas those cohorts who reacted distinctly already in 2012 recorded a decreasing trend and returned approximately to the pre-intervention values, the oldest age cohorts (over 75 years) increased their probabilities of participation steadily over the whole period. The positive effect of income was magnified in 2012, but in the following years the correlation of net income and the probability of participation showed stagnation or even decreased in case of some income cohorts.

4.2.3 Regression analysis - contribution

In order to improve the accuracy of the regression analysis for the level of contributions, certain restrictions were applied on the dataset. Only observations with non-zero contributions were used for estimation to ensure that only participating individuals are being considered. Furthermore, the 195 outlying observations reporting either annual contributions above 50,000 CZK or annual net income above 1 million CZK were omitted. Furthermore, some of the individuals reported no income and significant contributions at the same time, distorting otherwise present correlation between income and savings. The regression was therefore performed only for those individuals who reported the ratio of contributions to the net income lower than 10%.

Table 4.10: Summary statistics - contribution (restricted data)

Variable	Obs	Mean	Std. Dev.	Min	Max	Median
Contribution (CZK)	35,491	6,501.429	4,547.995	100	45,000	6,000
Netinc (CZK)	35,491	219,614.3	120,056	6,300	995,688	190,200
Age	35,491	2.488434	1.425683	0	6	
1 (30-39)	35,491	.2021921	.4016404			
2 (40-49)	35,491	.2126736	.4092044			
3 (50-59)	35,491	.2389056	.426421			
4 (60-69)	35,491	.1899073	.3922332			
5 (70-79)	35,491	.0648052	.2461852			
6 (>80)	35,491	.0100871	.099928			
Educ	35,491	.9207686	1.033276	0	3	
Maturity & eq.	35,491	.3871968	.4871161			
Bachelor & eq.	35,491	.0362345	.1868758			
Master +	35,491	.1537009	.3606669			
Female	35,491	.5146375	.4997927	0	1	
Married male	35,491	.3385365	.4732186	0	1	
Married female	35,491	.3207574	.4667743	0	1	
Hours (per week)	35,491	29.27193	20.16191	0	98	40
Economic activity	35,491	1.443014	.9113649	0	3	
Employee	35,491	.6263278	.483785			
Self employed	35,491	.0817672	.2740136			
Retired	35,491	.2177172	.4126999			

To see how the variables are correlated between each other, the correlation matrix was computed for numerical variables. As some of the explanatory variables represent ordered categorical variables (i.e. age, education, gender, marriage and economic activity), the Spearman rank-order test was performed in order to test for

significance and effect size of the relationship. The highest level of correlation (0.45) was observed in case of net income and hours worked per week, however, the results suggest that the multicollinearity should not be an issue in case of the linear regression.

Table 4.11: Correlation matrix (contributions – numerical variables)

	Contribution	Netinc	Hours
Contribution	1.0000		
Netinc	0.3839	1.0000	
Hours	0.1270	0.4518	1.0000

Table 4.12: Spearman's rank correlation matrix (contributions)

Rho coef.	Contr.	Netinc	Hours	Age	Educ	Female	Married
Contribution	1.0000						
Netinc	0.2956	1.0000					
Hours	0.0978	0.5425	1.0000				
Age	0.2187	-0.2156	-0.4693	1.0000			
Educ	0.1896	0.3728	0.1574	-0.1598	1.0000		
Female	-0.0944	-0.3576	-0.2364	0.0257	0.0522	1.0000	
Married	0.0793	0.0095	-0.0106	0.1625	-0.0041	-0.0783	1.0000

As the first step, the most suitable model explaining the level of contributions was set up by comparing several nested and non-nested models with the newest data for 2014. Using the top-down approach, the first estimated model included all the available variables identified to be potentially suitable regressors. As the Breusch-Pagan test for the heteroscedasticity allowed rejecting the null hypothesis at the .1% significance level, the heteroscedasticity-robust standard errors were computed.

The level of net income, age and education proved to be consistently statistically significant explanatory variables at the 99% confidence level. On the other hand, the effect of marriage did not prove to be significant neither when treated separately, nor jointly for both genders. The structural difference for men and women proved to be rather negligible, too, as the coefficient for women could not be considered to be statistically different from 0 at 5% level of significance. This finding is consistent with the previous research and suggests that the existing differences between men's and women's contributions are rather consequences of distinct levels of economic activities, income and education. Finally, there were excluded two variables related to the economic activity, employee and hours. There is a relationship present between the type of economic activity and hours, when self-employed individuals work on

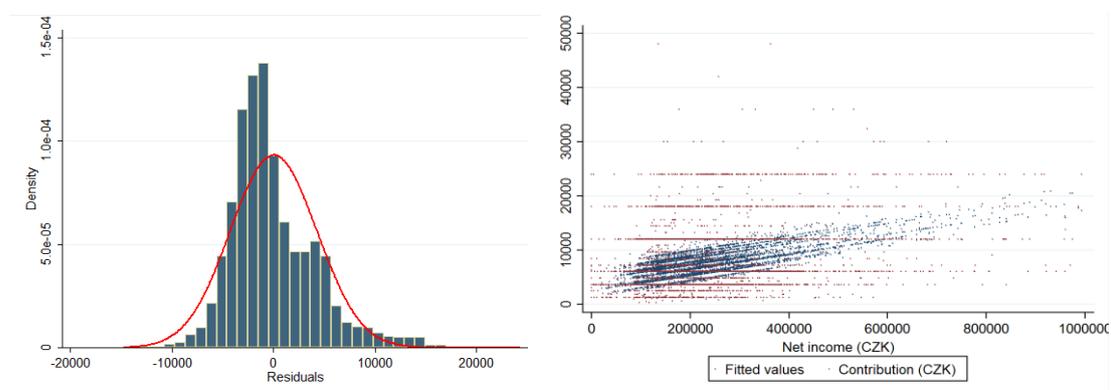
average 46 hours per week, 6 hours more than the employees on average do. Furthermore, the variable hours is positively correlated with the level of net income, therefore excluding hours from the model does not cause a significant loss of information and improves clarity of the model.

Table 4.13: Contribution– results (OLS), year 2014

Y = Contribution (CZK)	Coef.	Std. Err. (robust)	P>t	[95% Conf. Interval]
Netinc (CZK)	.0136782	.0006709	0.000	.012363 .0149935
Age				
30-39	296.5336	199.8962	0.138	-95.32856 688.3957
40-49	1158.052	197.9315	0.000	770.0407 1546.062
50-59	3143.334	209.7415	0.000	2732.172 3554.496
60-69	3651.242	208.1587	0.000	3243.183 4059.302
70-79	3475.614	230.8375	0.000	3023.097 3928.131
>80	3185.103	377.6749	0.000	2444.736 3925.47
Educ				
Maturity & eq.	1189.955	112.069	0.000	970.2625 1409.647
Bachelor & eq.	1284.051	302.492	0.000	691.0668 1877.034
Master +	2186.913	188.1975	0.000	1817.984 2555.842
Self_empl	1483.145	227.0707	0.000	1038.012 1928.278
_cons	1305.483	205.3867	0.000	902.8576 1708.108

Linear regression	Number of obs = 6521
	F(11, 6509) = 116.47
	Prob > F = 0.0000
	R-squared = 0.2371
	Root MSE = 4279.1

Figure 4.22: Histogram of residuals and fitted vs. observed contributions in 2014



The preferred model for 2014 is estimated with use of 6,521 observations. As the Breusch-Pagan test confirmed the presence of heteroskedasticity, robust standard errors are computed for testing the coefficients. The residuals are not normally distributed, their distribution is leptokurtic and skewed to the right, however the zero-mean assumption holds. The R-squared of the model is .2371, which means that the model explains approximately 24% of the sample variance. The contribution is positively correlated with the net income, with each additional 1000 CZK per year the contribution increases on average by 13.6 CZK. Another explanatory factor positively correlated with contributions is the age of participants. Whereas the individuals under 40 years on average save significantly lower amounts than the remaining participants, a great jump occurs in case of participants in the 50-59 cohort, who on average saved 2000 CZK more than the preceding 40-49 cohort. While participants with a high school diploma contribute on average by similar amounts to those with a bachelor degree, participants with a master degree or higher education save on average 900 CZK more than the latter groups and almost 2200 CZK more than participants with elementary education. Self-employed participants annually *ceteris paribus* save on average 1480 CZK more than other participants. From the comparison of the true and predicted values it is obvious, that the dependent variable shows a considerable level of variance and the current amount an individual contributes is affected by certain unobserved characteristics – probably represented by the willingness of participants to maximize the state subsidy and the way how they perceive and trust the private pension scheme concept. The estimated relationships therefore play only a relatively minor role in the complex decision how much an individual is going to save.

Similarly to the case of the participation rate, in order to analyse and capture the effects of time (including the policy change) on the estimated relationships, the following approach was adopted. The model for contributions (Table 4.13) was estimated independently for the years 2010 – 2014, proving that its consistency holds for the whole dataset. In the next step, the pairs of the adjacent years were consecutively tested for the presence of the structural change represented either by the different mean or coefficients of explanatory variables, following the logic represented by the equation 3.2. The same regression was finally applied on the full set of years including the base period of pooled observations including years 2010 – 2012, and the adjacent pooled period representing years 2013 – 2014¹².

¹² The detailed results of the all estimated models are provided in the appendix.

The regressions treating the structural differences of adjacent years correctly identified the positive trend in contributions magnifying in 2012 and persisting in the last year of the dataset. The results suggest that a significant year-to-year growth can be attributed both to the change in the intercept and individuals population cohorts, i.e. the growth was realized by the whole population with distinct groups recording an additional growth on top. The data shows that the age cohorts 50-59, 60-69 and 70-79 reported an additional growth in the years 2012 and 2013, the differencing coefficient of the 60-69 cohort remained significant in 2014.

Table 4.14: Contribution – results (OLS), test for change in coefficients (years 2010 – 2014, consecutively)

Y = Contribution (CZK)	Year 2010 D: 2011	Year 2011, D: 2012	Year 2012, D: 2013	Year 2013, D: 2014
p-value < 0.001 - ***	Obs. = 15,251	Obs. = 15,256	Obs. = 14,621	Obs. = 13,858
p-value < 0.01 - **	R-squared = 0.1918	R-squared = 0.2071	R-squared = 0.2179	R-squared = 0.2160
p-value < 0.05 - *				
Netinc	.01201405***	.01222639***	.01313207***	.01309576***
Age				
30-39	240.04954	341.14289*	393.42597*	155.10248
40-49	894.54384***	984.28979***	1345.9098***	1403.0402***
50-59	2610.6667***	2560.0813***	2795.4399***	2948.8859***
60-69	2220.8235***	2410.1962***	2885.6209***	3425.1841***
70-79	1858.888***	2091.4023***	2595.944***	3161.8593***
>80	1398.7204***	2023.4241***	2580.5252***	2507.7614***
Educ				
Maturity & eq.	709.53341***	905.63752***	977.86989***	1179.0886***
Bachelor & eq.	730.05893*	1007.5951***	1298.3303***	1360.0499***
Master +	1491.2388***	1503.4382***	1748.2963***	2175.4624***
Self_empl	2018.7863***	1395.6488***	1317.2605***	1417.5037***
D	618.15901*	608.52038**	921.71005***	858.94393**
Netinc_D	-.00262551**	-.00198913*	-.00266659**	-.00227038*
Age_D				
30-39	139.4863	161.75957	-124.60631	178.61356
40-49	106.19398	450.0118	139.29436	-202.59248
50-59	197.43127	609.90866*	522.07332*	419.15331
60-69	195.3126	709.78663**	841.17574***	675.53166*
70-79	181.7491	575.60576*	788.89814**	449.01486
>80	536.06581	669.05426	296.17385	941.7087
Educ_D				
Maturity & eq.	366.40009**	283.81476*	373.73499*	120.67023
Bachelor & eq.	447.4618	392.23102	343.8825	234.51224
Master +	431.72405	693.12969**	622.96898*	253.69057
Self_empl_D	.71127151	693.54317*	658.79938*	440.88235
_cons	1106.0089***	1024.4298***	1009.8378***	1283.4601***

Additional gains also reported participants with the highest level of education and self-employed participants, i.e. individuals who showed higher levels of contribution already before the intervention. On the other hand, the additional coefficient for the net income is negative for all periods, which would suggest a decreasing dependency of contributions on income. This is however inconsistent with the net income coefficient increase in the adjacent period of 2012 and 2013. These results support the stated hypotheses that the most sensitive to the intervention were those individuals with higher contributions, i.e. older and more educated participants. Low-income, young and less educated participants recorded growth in contributions too, however it seems that the new policy was not able to target their groups efficiently.

The test for the difference in coefficients before and after the policy change (pooled years 2010-2012 vs 2013-2014) provided in the Table 4.15 surprisingly did not report a significant change in the intercept and suggests that the growth was realized namely by the elder participants (above 50 years), participants with the maturity or the higher university degree. These results are not consistent with the previous conclusions and with the highest probability they are subject to the inaccuracy arising from the fact that the default model for contributions is able to explain only a relatively low portion of variance. As the approach for testing the statistical difference among the individual years provided some inconclusive results, the useful information about the development might provide the direct comparison of coefficients estimated independently for the individual years, although this method is rather indicative.

In terms of average annual contributions, the regression approach confirms the trends observed using the previously performed descriptive analysis. The most significant reaction to the policy change introduced in 2013 can be observed in case of the elder participants above 50 years, with a surprising growth in the oldest age cohorts (>70 years). The participants with higher education and income also increased their contributions with respect to the intervention. We can also see that the coefficient related to self-employed individuals recorded a significant unexplained drop in 2011 compared to the previous year, however it remained stable in the following years and slightly increased after the intervention. Unfortunately, no conclusive evidence of successful targeting of individuals with lowest contributions could be obtained with respect to the intervention. The probably greatest limitation is the inability to analyse panel data, which would provide much better accuracy of estimation and allowed for further testing the hypothesis of subsidy maximization, which currently stays unanswered.

Table 4.15: Contribution – results (OLS), test for change in coefficients
Base: pooled 2010 - 2012; D = after policy change, pooled 2013 - 2014

Y = Contribution	Coef.	Std. Err. (robust)	P>t	[95% Conf. Interval]
Netinc	.0125996	.0003644	0.000	.0118854 .0133137
Age				
30-39	317.9059	94.7613	0.001	132.1709 503.641
40-49	1063.112	98.55266	0.000	869.9461 1256.279
50-59	2639.501	96.99229	0.000	2449.393 2829.609
60-69	2499.365	92.31697	0.000	2318.421 2680.31
70-79	2205.161	105.4222	0.000	1998.53 2411.791
>80	2071.501	217.6508	0.000	1644.899 2498.103
Educ				
Maturity & eq.	860.645	53.9235	0.000	754.9533 966.3367
Bachelor & eq.	1031.719	165.5985	0.000	707.1407 1356.297
Master +	1570.619	101.8418	0.000	1371.006 1770.232
Self_empl	1570.777	126.4239	0.000	1322.983 1818.572
D	253.7473	167.019	0.129	-73.61507 581.1096
Netinc_D	.0008077	.000591	0.172	-.0003507 .0019662
Age_D				
30-39	-100.4568	162.4732	0.536	-418.9094 217.9957
40-49	222.211	166.1216	0.181	-103.3925 547.8145
50-59	409.1758	170.2338	0.016	75.51233 742.8393
60-69	1040.741	165.7224	0.000	715.92 1365.562
70-79	1124.673	190.4219	0.000	751.4405 1497.906
>80	819.7065	346.1984	0.018	141.147 1498.266
Educ_D				
Maturity & eq.	328.821	93.6893	0.000	145.1871 512.455
Bachelor & eq.	300.8163	263.6282	0.254	-215.9032 817.5357
Master +	619.5956	166.3737	0.000	293.4979 945.6933
Self_empl_D	-126.1699	202.4773	0.533	-523.0316 270.6919
_cons	1027.634	97.17614	0.000	837.166 1218.102
Linear regression		Number of obs =	35491	
		F(23, 35467) =	305.36	R-squared = 0.2430
		Prob > F =	0.0000	Root MSE = 3958.3

Table 4.16: Contribution– results (OLS), by years individually

Y = Contribution CZK	2010	2011	2012	2013	2014
Coef. (P-value)	Obs.: 7,362 R-sq.: 0.2170	Obs.: 7,476 R-sq.: 0.2152	Obs.: 7,286 R-sq.: 0.2290	Obs.: 6,846 R-sq.: 0.2423	Obs.: 6,521 R-sq.: 0.2371
Netinc	.01201405 (0.0000)	.01222639 (0.0000)	.01313207 (0.0000)	.01309576 (0.0000)	.01367823 (0.0000)
Age					
30-39	240.04954 (0.1362)	341.14289 (0.0390)	393.42597 0.0173)	155.10248 (0.3767)	296.53357 (0.1380)
40-49	894.54384 (0.0000)	984.28979 (0.0000)	1345.9098 0.0000)	1403.0402 (0.0000)	1158.0515 (0.0000)
50-59	2610.6667 (0.0000)	2560.0813 (0.0000)	2795.4399 0.0000)	2948.8859 (0.0000)	3143.3338 (0.0000)
60-69	2220.8235 (0.0000)	2410.1962 (0.0000)	2885.6209 0.0000)	3425.1841 (0.0000)	3651.2422 (0.0000)
70-79	1858.888 (0.0000)	2091.4023 (0.0000)	2595.944 0.0000)	3161.8593 (0.0000)	3475.6138 (0.0000)
>80	1398.7204 (0.0000)	2023.4241 (0.0000)	2580.5252 0.0000)	2507.7614 (0.0000)	3185.1032 (0.0000)
Educ					
Maturity & eq.	709.53341 (0.0000)	905.63752 (0.0000)	977.86989 0.0000)	1179.0886 (0.0000)	1189.9546 (0.0000)
Bachelor & eq.	730.05893 (0.0161)	1007.5951 (0.0002)	1298.3303 0.0000)	1360.0499 (0.0000)	1284.0505 (0.0000)
Master +	1491.2388 (0.0000)	1503.4382 (0.0000)	1748.2963 0.0000)	2175.4624 (0.0000)	2186.9134 (0.0000)
Self_empl	2018.7863 (0.0000)	1395.6488 (0.0000)	1317.2605 0.0000)	1417.5037 (0.0000)	1483.1447 (0.0000)
_cons	1106.0089 (0.0000)	1024.4298 (0.0000)	1009.8378 0.0000)	1283.4601 (0.0000)	1305.4829 (0.0000)

4.3 Results summary

The first important conclusion resulting from the analysis of the aggregate data is that the new pension scheme policy was probably perceived negatively by the majority of the population. This is illustrated by the fact that the number of active contracts, i.e. the official number of participants, significantly increased earlier in 2012, one year before the new policy was introduced. As the policy change was anticipated already in 2012, people were allowed to start adapting to the new conditions in advance and they were also able to enter the scheme administered under the original conditions by December 2012. A dramatic increase in participation, represented by approximately 600,000 new contracts during last 3 months in 2012, can be interpreted in the way that people were trying to avoid some of the features represented by the innovated pension scheme and those, who considered having a pension savings account in the future entered the scheme under the original policy. Furthermore, the number of newly entered contracts entered after 2013 dropped radically and since the beginning of 2013, the participation rate follows a decreasing trend, which is present also in the newest data from 2016. On the contrary, well observable is the positive effect of the increased maximal level of the state subsidy, which affected all the participants regardless the date when they entered the scheme. In case of the existing participants (those who entered the third pillar before 2013), their annual contributions with respect to the previous year increased on average by 22.1% (1,230 CZK) in 2013, and as the process of adaptation probably further continues, the level of contributions followed a growing trend also in the following years 2014 and 2015. Such a development lies in a direct contrast with the stagnation of contributions in multiple years before 2012 and can be attributed to the positive incentive via the increased level of subsidy. On the other hand, the average annual contributions of 6,816 CZK and 7,068 CZK in 2013 and 2014 respectively suggest that a significant portion of participants contributes much less than 12,000 CZK per year, which is the amount maximizing the state subsidy. The new rules applicable for the state subsidy allowed to receive a higher nominal amount in exchange for a lower relative return, as originally the maximal subsidy represented 150 CZK per 500 CZK of contributions per month, after the intervention it changed to 230 CZK per 1,000 CZK of contributions, i.e. the relative subsidy dropped from 30% to 23%. As a result, the Czech government was able to make the pension scheme relatively more efficient in terms of the funds spent on subsidy compared to savings generated by the participants. Whereas in the period from 2009 to 2011 (not accounting for 2012 as a transitory period), participants on average contributed 4.24 CZK per every 1 CZK

obtained in the form of the state subsidy, in the years from 2013 to 2015, they contributed 4.82 CZK per 1 CZK of subsidy. If we perceived the state subsidy only as a measure used to motivate participants to contribute in the scheme, we could say that the new pension policy is approximately 13.5% more effective than the former one. In their nominal value, both the total contributions and the state subsidy granted increased in the period under the new policy rules significantly, reflecting also the steep increase of new contracts at the end of 2012. On average, the scheme registered annual contributions of 23.2bn CZK between 2009 and 2011. In the years from 2013 to 2015, contributions on average totalled 32.96bn CZK, i.e. 42% more. For the same time periods, the average annual state subsidy was 5.49bn CZK and 6.84bn CZK respectively, it recorded an increase by 24.6%.

Observing the development in the distribution of contributions showed that the share of participants annually saving at least 12,000 CZK doubled after the intervention, as it grew from ca. 15% in 2011 to 30% in 2014. On the other side of the spectrum, the share of participants who were saving less than 3,600 CZK per year significantly decreased from 23 % in 2011 to only 7 % in 2014. This fact also implies that after the intervention a relatively large group of participants lost their eligibility for the state subsidy, approximately 9 % of participants in 2013 and 7% a year after. It can be assumed that these participants will either adapt to higher contributions or completely cease the contributions in the following years. Consistently with the aggregate statistics, the immediate effect of the intervention on the level of contributions is evident, however the level of impact is relatively low, as both the median and mode of annual contributions remained at the level of 6,000 CZK. In 2011, approximately 37% of participants reported median savings, whereas by 2014 their share dropped to 31%. Furthermore, the SILC statistics suggest that a non-negligible part of individuals possessing an active contract in the supplementary pension scheme do not contribute by any amounts. As the SILC identifies only those participants, who reported nonzero contributions in the given year, the participation rate reported by the aggregate statistics and by the SILC significantly differ. If we project the difference in the observed participation rate (67.6% against 55.2% in 2014) on the whole economically active population, it can be estimated that within the 95% confidence interval, up to 750,000 participants, i.e. 16% of all contracts, were effectively inactive in 2014.

The extensity of participation, i.e. the participation rate, is modelled by the limited dependent variable model with binary choice and estimated using the probit regression. The model provides quite satisfactory results as it correctly predicts the

participation in case of approximately 70% individuals in the dataset. The probability of participation is positively affected by the level of net income, age, gender, level of education, marriage status and the economic activity of an individual, as statistically significant coefficients were estimated for the mentioned variables. For an otherwise average individual, the probability of participation in the scheme increases most significantly with higher age, as the probability of an average individual in the 55-59 age cohort is 62.6%, whereas for the same individual in the 18-24 or 30-34 cohort it is only 25.3% and 45.3% respectively. Similarly to evidence from research performed in other countries, e.g. in USA (Huberman, 2007), the women in the Czech Republic show a higher propensity to have supplementary pension savings, on average the probability of participation of single women is 4.6 percentage points higher than in case of single men. The marriage significantly increases the participation of both genders (by ca. 10 pp) and diminishes the gender differences to only 2.7 percentage points. The high school education increases the probability of participation by 12.7 pp on average, the university education further increases this probability by approximately 3 percentage points. The fact that an individual is employed increases the propensity by 21 percentage points, for the self-employment the increase is 13 pp against the economically inactive individuals. The increase in the net income by additional 100,000 CZK results in 1.8 percentage points higher propensity for an otherwise average individual. Estimated propensities are in general consistent with findings realized earlier by other researchers. The exceptions are the results presented by Jansky (2015), who on the contrary reported higher propensity for men using the SILC dataset from 2011. Estimating the model for this period however did not confirm this conclusion. Furthermore, a positive effect of marriage is not consistent with conclusion of Sunden and Surette (1998), who analysed individuals in the US and found that whereas single women were more probably having a pension plan, the effect of marriage was negative.

The model for the intensity of participation, i.e. the annual contributions, is estimated by the ordinary least squares regression using the data for individuals who reported that they contributed nonzero amount in the supplementary retirement savings scheme in the given year. As the model controls for the net income, age, level of education and economic activity, no significant differences in gender or marriage status were found in terms of amounts contributed. The expected level of contribution is positively affected by individual's income, level of education and age, as the greatest amounts are contributed by individuals who are more than 50 years old. Furthermore, the results showed that self-employed individuals on average contribute

by amounts 1,500 CZK higher than the remaining participants. The positive effect of education on contributions is significant, as the individuals with the higher university education save *ceteris paribus* 2,000 CZK more than those with only elementary education. However, the explanatory power of the model is relatively low, which illustrates the R-squared .2371, and the decision making process behind the intensity of participation is affected by other unobserved psychological and economic factors. The data show that the participants tend to choose rounded amounts for contribution and optimize their level in order to maximize the government subsidy. The level of net income is a significant explanatory variable of the contributions, with additional 100,000 CZK of annual net income the expected annual contribution increases by 1,300 CZK, however there was found a large variance in the income-contribution relationship. As the amount providing the maximal level of subsidy is relatively low (1,000 CZK per month), individuals within a wide range of income are able to afford this level contributions.

The results confirmed, with respect to estimated determinants of contributions in the supplementary pension scheme, that the Czech Republic does not diverge from common evidence. Probably the most surprising finding is related to the level of contributions with respect to the age of individuals. Participants in the oldest age cohorts, i.e. 70-79 and > 80 years, on average report higher contributions than individuals in all the remaining cohorts younger than 50 years. Moreover, the data provide evidence that after 2013 the average contributions of the oldest participants were growing at the fastest rate among all participants and from 2011 to 2014 they increased by more than 40%. This suggests either that the current subsidizing policy of the third pillar is attractive also for the oldest inhabitants as a convenient way of savings, or that the households are using the accounts of their old relatives to receive an additional subsidy for their savings. In both cases this can be understood as an inefficiency of the scheme, assuming that the subsidy should primarily motivate economically active individuals to save a part of their income for retirement, not to serve as a short-term savings instrument for more affluent pensioners or being misused to gain additional subsidy. It should be the subject of public discussion, whether the subsidy is supposed to be available also for already retired participants.

The final part of the analysis employed the estimated models to test the presence of structural differences between individual years, allowing to capture the change in behaviour related to the newly introduced policy. In terms of the participation rate, the test provides positive evidence for statistically significant differences between the years before and after the intervention, however, the results suggest that the positive

effect is rather temporary and related to an increased number of contracts in 2012, i.e. already prior to the change, and that the intervention in 2013 had no real positive impact on the extensity of participation. This hypothesis is supported by the aggregate data confirming that the number of active contracts gained a decreasing trend continued also during the years 2015 and 2016. However, the predicted probabilities show that with respect to the pre-2012 period, the probability of participation on average increased in case of the youngest (18-24) and the oldest (>80) age cohorts, and also in case of higher educated individuals. The positive effect of income magnified in 2012, but the correlation diminished again in the following years. The same structural test, performed for the level of contributions, confirmed an increase of average annual contributions with respect to the intervention in 2013. According to the results from the comparison of adjacent years from 2010 to 2014, the realized change in the intercepts between 2012 and 2013 accounted for an increase of annual contributions by only approximately 920 CZK, suggesting that certain population groups reacted to the intervention more distinctly. A significant growth of contributions was estimated for elder participants in 60-69 and 70-79 age cohorts, whose dummy coefficient increased on average by 840 and 790 CZK in 2013 and in case of 60-69 cohort it further grew in 2014 by approximately 675 CZK. On the other hand, there is no evidence that the intervention was able to target younger individuals, whose contributions remained low and increased only through the change in the intercept. An additional increase recorded also the higher educated participants, as the coefficient for having the master university degree grew by more than 620 CZK in 2013. The coefficient for contributions of the self-employed individuals in 2013 was estimated approximately 650 CZK higher than in the previous year. According to the results, there is no positive evidence that the stand-alone level of income would have a stronger positive correlation with the level of contributions after the policy change.

4.4 Possible measures for improvement

Results obtained by analysing the newest available data suggest, that the policy change introduced in 2013 was not able to induce significant improvements in participation of problematic population groups, particularly young individuals and those possessing only the elementary education. In response to such findings, this short chapter offers several proposals for possible measures with a potential to increase popularity and efficiency of the third pillar.

As mentioned earlier in this work, the retirement planning of an individual is a complex process involving the theory of the life-cycle and decision under uncertainty. Especially young individuals are often facing a large level of uncertainty combined with demanding requirements for financing of housing and children. The accessibility of funds embedded in the third pillar is currently very limited, as the premature withdrawal of savings is associated with loss of the earlier credited subsidy and taxation of the capital gains. A more flexible scheme, which would allow for a less penalized access to funds in specific life situations, could be more attractive to a broad range of participants, as they would not have to be worried to deposit greater amounts in the scheme. The third pillar would then serve as a flexible life-long instrument for general savings with the emphasis on the retirement.

The analysis of the SILC data shows that the supplementary retirement savings scheme has become a relatively popular financial instrument for retired individuals, who are also eligible to collect the state subsidy. Using the projection of the sample on the whole population, approximately 30% of all pensioners in the Czech Republic were active participants of the supplementary pension scheme. Even if we account for pensioners with an active income, the level of participation is surprisingly high. The purpose of the thesis is not to criticise the current subsidy rules, however, these findings raise an important question for the public debate. What is the reason behind providing the subsidy for participants of the third pillar? If the state subsidy should motivate economically active participants to increase their retirement savings, than the current form of the subsidy rules fails, because while the young and low-income individuals struggle to participate, a substantial part of funds dedicated for subsidy is collected by pensioners.

According to the CZSO, there were 2.355 million old age pensioners in the Czech Republic at the end of 2014. If we project the sample participation rate of pensioners and the average annual subsidy per pensioner in 2014 on the whole population, we reach to the conclusion that approximately 20% of all funds dedicated for the state subsidy in 2014 were granted to pensioners. The Table 4.17 shows the detailed results of the projection, including 95% confidence intervals.

Table 4.17: Estimated subsidy granted to pensioners in 2014

Number of old age pensioners in CZ 2014	2,355,144		
State subsidy in 2014 - total (CZK)	6.847 bn		
		(95% confidence interval)	
Average subsidy per pensioner 2014 (CZK)	1,861	1,824	1,898
Participation rate of pensioners in 2014	0.305	0.2921	0.3174
Subsidy granted to pensioners in 2014 (estimate, CZK)	1.336 bn	1.255 bn	1.419 bn
Subsidy granted to pensioners 2014 (estimate, share on total)	0.1951	0.1832	0.2073

Another measure which could motivate participants to increase their contributions is the redistribution of the state subsidy with respect to contributed amounts. In 2013, the newly introduced subsidy rules allowed to receive higher nominal amounts of subsidy, however, in the relative terms the subsidy matching decreased. As illustrated by the Table 1.1, if the participant selects the amount of contribution in order to maximize the level of subsidy received, the subsidy matching rate decreased from 30% to 23% after the policy change. In case he or she constantly saved 500 CZK per month both before and after the intervention, the subsidy matching rate recorded a smaller decrease, namely from 30% to 26%. Keeping the relative amount of subsidy constant for higher contributions would provide higher yields and motivate participants to increase their savings.

The last recommended measure to induce higher participation rate and the level of contributions is to further increase the financial literacy among the population. The positive correlation between the level of financial literacy (and education in general) and the active generation of private retirement savings is demonstrated by a wide range of academic papers, including works of Clark (2002), Lopez (2010) or Caliendo and Findley (2013). The results of the microeconomic analysis presented in this thesis confirmed that the individuals with lower education report both lower participation rate and the level of contributions. Although the disparities between individuals with different levels of income and education are hardly completely removable, raising awareness of the importance of retirement saving could significantly contribute to diminishing of them.

5 Conclusion

The thesis examined the current state of the supplementary pension savings scheme in the Czech Republic from the perspective of its participants, identified the microeconomic determinants of participation and estimated impacts of the policy change introduced in 2013, representing a significant incentive to change the saving behaviour of participants through the increased level of the available state subsidy.

In the first phase of the research, the aggregate official statistics published by the Ministry of Finance were evaluated. The following microeconomic analysis was based on the time series of cross-sectional data provided by the Statistics on Income and Living Condition, collected by the Czech Statistical Office on the yearly basis. Using the data from years 2008-2014, with approximately 15,000 observations of individuals for each year, both participants and non-participants of the supplementary pension scheme were analysed. The extensity of participation, i.e. the participation rate, was represented by the limited dependent variable model with binary choice and estimated by the probit regression. Another model representing the intensity of participation, i.e. the annual contributions, was estimated by the ordinary least squares regression using the data on individuals who reported non-zero contributions in the given year. In order to test for statistically significant differences in coefficients for individual years, focusing on the intervention in 2013, both models were extended by the full set of explanatory variables combined with a dummy indicating the compared period and estimated on the pooled datasets of two time periods.

According to results of the regression analysis, the probability of participation is positively affected by the level of net income, age, gender, level of education, marital status and the economic activity of an individual, which is consistent with determinants mainly referred by the previously published research. In 2014, an average individual who belonged to the age cohort of 55-59 years showed the probability of participation 34 percentage points higher than the otherwise same individual in the 18-24 cohort. Positive evidence for gender differences was found, as single women showed on average 4.6 pp higher probability of participation in the scheme than single men. The marriage significantly increases the probability both for men and women, and diminishes the gender differences to approximately 2.7 percentage points.

The determinants of amounts contributed are similar to determinants identified in the case of the participation rate, as the expected level of contribution is positively affected by individual's income, level of education and age. On the other hand, no significant differences in gender or marriage status were found. Higher contributions were observed in case of self-employed individuals, who in 2014 contributed on average 1,500 CZK more than participants with another type of economic activity. Although the results imply that with additional 100,000 CZK of annual net income the expected annual contribution increases by 1,300 CZK, the ability of the model to predict the correct amount contributed by the given participant is limited. The level of contributions with respect to observed determinants is distributed with a large variance, suggesting that the decision making process takes into account another unobserved factors, such as individual's level of risk aversion or his/her confidence in the pension scheme.

In addition, two interesting findings arise from the analysis of participation using the microeconomic data. The first one is a relatively high share of inactive participants, i.e. those individuals possessing a scheme contract who did not contribute by any amount in the given year. Given the disparities of the individual and aggregate data I estimate that out of 4.6 million savings scheme contracts up to 750,000 (ca. 16%) were effectively inactive in 2014. The second finding is regarding the participation of retired individuals in the scheme. The participation rate of older individuals in time is steadily increasing, furthermore, their contributions are relatively high compared to other participants. Based on evidence provided by the SILC data, I estimate that in 2014 the old age pensioners represented up to 16% of all active participants in the supplementary pension savings scheme and that they received the direct subsidy of up to 1.34 billion CZK, representing approximately 20% of the subsidy paid to the participants in the given year.

With respect to the policy change introduced in 2013, the effect of the increased participation rate was observed already in the preceding year 2012. This behaviour might be explained in the way that a significant share of inhabitants perceived the newly introduced rules negatively and decided to enter the scheme prior 2013 in order to have their contracts administered under the original policy. Among these individuals, especially the youngest cohorts reacted significantly, increasing their average probability of participation by 11.5 percentage points compared to the previous year. Evidence of the following years however suggests, that the increase in 2012 was rather temporary with no significant long-term effects. With the exception of the oldest population cohorts, the participation rate in 2013 immediately decreased

again, followed by a further decrease or stagnation in 2014. The further development could be a research question in the future, when the new SILC data will become available. However, certain suggestions are provided by the aggregate data, showing that by 2016 the overall participation rate returned virtually to the pre-2012 level.

The increase in annual contributions of participants related to the 2013 intervention is well observable, although its magnitude is relatively low. Whereas the share of participants contributing at least 12,000 CZK per year increased from 15% in 2011 to 30% in 2014, almost one third of all participants in 2014 contributed with only 6,000 CZK, which also represents the median amount. On the individual level, the analysis confirmed that the increasing contributions were recorded among all the population groups, although with different intensity. The largest increase realized on average those participants who showed higher contributions already before the intervention, i.e. older and higher educated individuals. On the other hand, there is no evidence that the intervention was able to target younger, less educated and low-income individuals, whose contributions remained deeply below average also after the intervention. Based on the available data we can therefore say that the 2013 intervention did not succeed in inducing significant improvements in disparities regarding the participation of individual population groups in the pension scheme.

Probably the most important limitation for a comprehensive and more exact analysis of impacts related to the policy change was the unavailability of individual panel data, which would allow to observe how the contributions of particular individuals developed in time. Under such circumstances, we could identify a suitable control group and employ the difference-in-differences estimation method. Unfortunately, the methods for constructing a synthetic panel dataset could not be applied, as the observed determinants explain only a relatively small amount of variance in contributions. It can also be assumed that the process of adaptation to the new policy has not ended so far and it should be evaluated again with a larger time delay.

An additional research question that would be interesting to answer using suitable microeconomic data, is whether the stronger incentives affected the overall saving rate of individuals. Former investigation of this question in another countries did not reach unambiguous conclusions (Borsch-Supan, 2012; Pfarr-Schneider, 2011; Corneo, Keese, and Schroder, 2010) and the Czech Republic could be a good candidate to continue with the research.

6 Bibliography

Adami, R., Gough, O. (2008). Pension reforms and saving for retirement: comparing the United Kingdom and Italy, *Policy Studies*, Vol. 29, no. 2, p. 119-35

Alessie, R., Lusardi, A., Aldershof, T. (1997). Income and wealth over the life cycle: Evidence from panel data. *Review of Income and Wealth*, 43(1), p. 1–32.

Anton, J., De Bustillo, R., Fernández-Macías, E. (2014). Supplementary private pensions and saving: evidence from Spain, *Journal of Pension Economics and Finance*, Cambridge University Press, vol. 13(04), p. 367-88

Bailliu J., Reisen H. (1997). Do Funded Pensions Contribute to Higher Aggregate Savings?: A Cross-Country Analysis, *OECD Development Centre Working Papers 130*, OECD Publishing.

Berk, A., Cok, M., Kosak, M. & Sambt, J. (2013). CEE Transition from PAYG to Private Pensions. *Finance a Uver* [online], vol. 63, no. 4, pp. 360-381. Available at: <http://search.ebscohost.com/login.aspx?direct=true&db=bth&an=90041049&scope=site> [Accessed 2016-01-31]

Bernheim, B., Scholz, J. (1993). Private saving and public policy. *Tax Policy and the Economy* 7, p. 73–110.

Booth, P., Niemiets, K. (2015). Changes in the Pension System: Lessons for Privatisation in the UK, *Institute of Economic Affairs*, Vol. 33-3 (2015), p. 659-86.

Borsch-Supan, A. (2004). Mind the Gap: The Effectiveness of Incentives to Boost Retirement Saving in Europe, *Mannheim University*. Available at: http://ub-madoc.bib.uni-mannheim.de/2569/1/dp07_27.pdf [Accessed 27 July 2016]

Borsch-Supan, A., Essig, L. (2005). Household Saving in Germany: Results of the First SAVE Study, *University of Chicago Press*. Available at: <http://www.nber.org/chapters/c10365> [Accessed 27 July 2016]

Bourguignon, F., Moreno, H. (2015). On the construction of synthetic panels. Online document [Accessed on 19th November 2016] Available at:

https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=NEUDC2015&paper_id=301

Browning, M., & Lusardi, A. (1996). Household saving: Micro theories and micro facts. *Journal of Economic Literature*, XXXIV (4), p. 1797–1855.

Caliendo, F., Findley T. (2013). Time inconsistency and retirement planning, *Economics Letters*, Volume 121, Issue 1, p. 30-34. Available at: <http://www.sciencedirect.com/science/article/pii/S0165176513003236> [Accessed 27 July 2016]

Canova, L., Rattazzi, A., Webley, P. (2005). The hierarchical structure of saving motives, *Journal of Economic Psychology*, 26 (2005), p. 21–34

Chetty, R., et al. (2014). Active vs. Passive Decisions and Crowd-Out in Retirement Savings Accounts: Evidence from Denmark. *The Quarterly Journal of Economics*, Oxford University Press, vol. 129(3), p. 1141-219

Clark, R., D'Ambrosio, M. (2002). Financial Education and Retirement Savings. Available at SSRN: <http://ssrn.com/abstract=390642> [Accessed 2016-07-27]

Corneo, G., Keese, M., Schroder, C. (2010). The Effect of Saving Subsidies on Household Saving: Evidence from Germany. *Ruhr Economic Paper No. 170*. Available at SSRN: <http://ssrn.com/abstract=1592453> [Accessed 2016-07-27]

Creedy, J., Gemmell, N., Scobie, G. (2015). Pensions, savings and housing: A life-cycle framework with policy simulations, *Economic Modelling*, Elsevier, vol. 46(C), pages 346-57.

Dang, Lanjow, Luoto & McKenzie. (2014). Using Repeated Cross-Sections to Explore Movements in and out of Poverty. *Journal of development economics* 107 (2014) p. 112-128. Elsevier.

Deaton, A. (1985). Panel Data from Times Series of Cross-Sections. *Journal of Econometrics*, 30, 1985.

Denizer, C., Wolf, H. (2000). The Savings Collapse during the Transition in Eastern Europe, *World Bank Policy Research Working Paper No. 2419*. Available at SSRN: <http://ssrn.com/abstract=632490>

DeVaney, S., Anong, S., Whirl, S. (2007). Household Savings Motives. *Journal of Consumer Affairs*, 41, p. 174–186.

Duflo, E., et al. (2005). Saving Incentives for Low- and Middle-Income Families: Evidence from a Field Experiment. National Bureau of Economic Research, Available at: <http://www.nber.org/papers/w11680> [Accessed 2016-07-27]

Elbers, Ch., Lanjouw, Jean O., Lanjouw, P. (2003). Micro-level estimation of poverty and inequality. *Econometrica* 71 (1), p. 355–364.

Feng, J., He, L., Sato, H. (2011). Public Pension and Household Saving: Evidence from Urban China. *Journal of Comparative Economics* 39(4), p. 470–85.

Fiala, T, Langhamrova, J. Vývoj ekonomického zatížení důchodového systému ČR při různých variantách zvyšování důchodového věku. In: RELIK Reproduction of the Human Capital. Praha, 09.12.2013 – 10.12.2013. Slaný: Melandrium, 2013, p. 1–13. ISBN 978-80-86175-89-8

Freitas, N., Legendre, B., Clark, G. (2013). Individual Private Retirement Insurances: holding behaviours among pensioners. HAL archives. Available at: <https://hal.archives-ouvertes.fr/hal-00951881/document> [Accessed 2016-07-27]

Friedman, M., (1957). *A Theory of The Consumption Function: A study by the National Bureau of Economic Research*, New York, Princeton: Princeton University Press.

Gale, W. (1998). The Effects of Pensions on Household Wealth: A Reevaluation of Theory and Evidence. *The Journal of Political Economy*, Vol. 106, no. 4 (Aug., 1998), pp. 706-23

Guiso, L., Jappelli, T., Terlizzese, D. (1992). Earnings uncertainty and precautionary saving, *Journal of Monetary Economics*, 30, issue 2, p. 307-337.

Harris, M. N., Loundes, J., & Webster, E. (2002). Determinants of household saving in Australia. *Economic Record*, 78(241), p. 207–223.

Honekamp, I, Schwarze, J. (2010). Pension Reforms in Germany: Have They Changed Savings Behaviour?. *Pensions: An International Journal*, Vol. 15 (2010), no. 3, p. 214-25

Horioka, C. Y., & Watanabe, W. (1997). Why do people save? A micro-analysis of motives for household saving in Japan. *Economic Journal*, 107(442), p. 537–552.

Horioka, C., Watanabe, W. (1996). Why Do People Save? A Micro-Analysis of Motives for Household Saving in Japan, ISER Discussion Paper 0412, Institute of Social and Economic Research, Osaka University.

Hubbard, R. (1986). Pension Wealth and Individual Saving: Some New Evidence. *Journal of Money, Credit and Banking*, vol. 18, no. 2, p. 167-78.

Huberman, G., Iyengar, S. S., Jiang, W. (2007). Defined contribution pension plans: determinants of participation and contributions rates. *Journal of Financial Services Research*, 31(1), p. 1–32.

Janský, P. (2015). Penzijní připojištění: kteří občané se jej účastní nejvíce a platí nejvyšší příspěvky? *Český finanční a účetní časopis*, 2015, vol. 10, no. 3, p. 43-55

Jelinek, T., Schneider, O. (1998). Influence of Pension Funds on Private Savings in a Transition Country. Charles University, CERGE-EI, Prague, June.

Johanisson, I. (2008). Private pension savings: gender, marital status and wealth – evidence from Sweden in 2002, Licentiate thesis, University of Gothenburg.

Katona, G. (1975). *Psychological Economics*. New York: Elsevier.

Keynes, J., (1991). *The General Theory of Employment, Interest, and Money*, San Diego: Harcourt, Brace, Jovanovich.

Kotlikoff, L. J. (1989). *What determines savings?* Cambridge, MA: The MIT Press.

Li, H., Shi, X, Wu, B. (2015). The Retirement Consumption Puzzle in China. *American Economic Review*, Vol. 105, no. 5, p. 437-41

Lopez, S., et al. (2010). What Are the Driving Forces of Individuals' Retirement Savings?, *Czech Journal of Economics and Finance*, Vol. 60 (2010), no. 3

Lusardi, A., Mitchell, O. (2007). Financial Literacy and Retirement Planning: New Evidence from the Rand American Life Panel. Available at: http://www.dartmouth.edu/~alusardi/Papers/American_Life_Panel.pdf [Accessed 27 July 2016]

Lusardi, A., Mitchell, O. (2011). *Financial Literacy and Planning: Implications for Retirement Wellbeing*, *Financial Literacy. Implications for Retirement Security and the Financial Marketplace*, Oxford University Press, p. 17 – 39.

Lusardi, A., Mitchell, O. (2014). The Economic Importance of Financial Literacy: Theory and Evidence, *Journal of Economic Literature*, American Economic Association, vol. 52(1), p. 5-44.

Mankiw, N.G., (2009). *Principles of economics 5th ed.*, Mason, OH: South-Western Cengage Learning.

Modigliani, F. (1988). The Role of Intergenerational Transfers and Life Cycle Saving in the Accumulation of Wealth, *The Journal of Economic Perspectives*, Vol. 2, No. 2, p. 15-40.

Modigliani, F., Brumberg, R. (1954). *Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data*, *Post Keynesian Economics*, Rutgers University Press, New Brunswick, NJ.

Munnell, A. H., Sundén, A., Taylor, C. (2001). What determines 401 (k) participation and contributions, *Social Security Bulletin*, Vol. 64, no. 3 (2001/2002).

Paiella, M., Tiseno, A. (2014). Evaluating the impact on saving of tax-favored retirement plans. *Journal of Pension Economics and Finance*, vol. 13, no.1, p.62-87.

Pfarr, Ch., Schneider, U. (2011). Choosing between subsidized or unsubsidized private pension schemes: a random parameters bivariate probit analysis. MPRA Paper 29400, University Library of Munich. Available at: https://mpra.ub.uni-muenchen.de/29400/1/MPRA_paper_29400.pdf [Accessed 2016-07-27]

Podesta, F. (2002). Recent developments in quantitative comparative methodology: The case of pooled time series cross-section analysis. *DSS Papers Soc*, vol. 3, 2002, p. 5-44

Rabinovich, A., Webley, P. (2007). Filling the gap between planning and doing: Psychological factors involved in the successful implementation of saving intention, *Journal of Economic Psychology*, 28 (2007), p. 444-61

Schie, R., et al. (2012). Savings adequacy uncertainty: Driver or obstacle to increased pension contributions?, *Journal of Economic Psychology*, Vol. 33 /2012), p. 882-96

Schneider, O. (2011). Důchodové systémy v Evropě: Reformují všichni. Národohospodářský ústav AV ČR. Available at: http://idea.cerge-ei.cz/documents/kratka_studie_2011_06.pdf [Accessed 27 July 2016]

Shefrin, M., Thaler, R. (1988). The Behavioral Life-Cycle Hypothesis, *Economic Inquiry*, Western Economic Association International, vol. 26(4), p. 609-43.

Skinner, J. (1988). Risky Income, Life Cycle Consumption and Precautionary Savings, *Journal of Monetary Economics* 22, p. 237-255.

Sunden, A., Surette, B. (1998). Gender Differences in the Allocation of Assets in Retirement Savings Plans, *The American Economic Review*, Vol.88, No.2,p.207-211

Wooldridge, J. (2009). *Introductory Econometrics: A Modern Approach*. 4th ed. Mason, OH: South Western, Cengage Learning

Yao, R., Wang, F., Weagley, R., & Liao, L. (2011). Household saving motives: Comparing American and Chinese consumers. *Family and Consumer Sciences Research Journal*, 40(1), p. 28-44

7 Appendix 1 - Pension scheme in the Czech Republic

This section offers an overview of the complex pension scheme in the Czech Republic, serves as a tool for understanding the study background and stresses the importance of the supplementary pension savings scheme for the further sustainability of the pension system in the Czech Republic.

Using the terminology of the European Union (2014), pension scheme in the Czech Republic is currently represented by the two pillars. The first pillar is a mandatory pension insurance, defined by benefits and funded on the PAYG basis from the state budget. The pension scheme is universal and the participation is required for all economically active individuals. The legal regulation treats all the participants equally, with the exception of the so-called power sectors such as soldiers, policemen, customs officers or firefighters who show certain variations. According to the Czech Ministry of Labour and Social Affairs (2016), the pension from the mandatory pension insurance is drawn by more than 99 % of the population which is eligible to receive pension.

In addition to the mandatory pension scheme, participants may also enter into the third pillar, a supplementary pension insurance scheme. The supplementary pension scheme is provided independently on the first pillar scheme, defined by contributions and capital funded. Eligible participants are provided a state contribution and tax benefits. In the third pillar there are also included products offered by commercial insurance companies, particularly life insurance. Compared to the mandatory pension scheme, benefits granted from the third pillar represent in terms of funds volume only a minor role in the pension system.

The second pillar of the pension scheme, a private fund oriented scheme, was introduced in the Czech Republic in the beginning of the year 2013 and it should have served as a tool for diversification of income during retirement. However, after three years of operation, the second pillar was discontinued.

7.1 Mandatory pension scheme

The mandatory pension insurance together with the sickness insurance build up the Czech social security system established by the Act No. 582/1991, on organization and implementation of the social security in terms of further regulations. The fundamental substantive law regulation which governs the entitlement to a pension from the basic pension insurance, methods of determination of pension benefits and conditions of payment, is the Act No. 155/1995, on pension insurance, as amended, which came into effect on 1 January 1996. The social security scheme is administered by the Czech Social Security Administration (CSSA) established by the Ministry of Labour and Social Affairs (MLSA). The CSSA collects the pension insurance premiums from more than 8.5 million clients and with the annual income of approximately CZK 350 billion it contributes by almost one third to the national budget (CSSA, 2016).

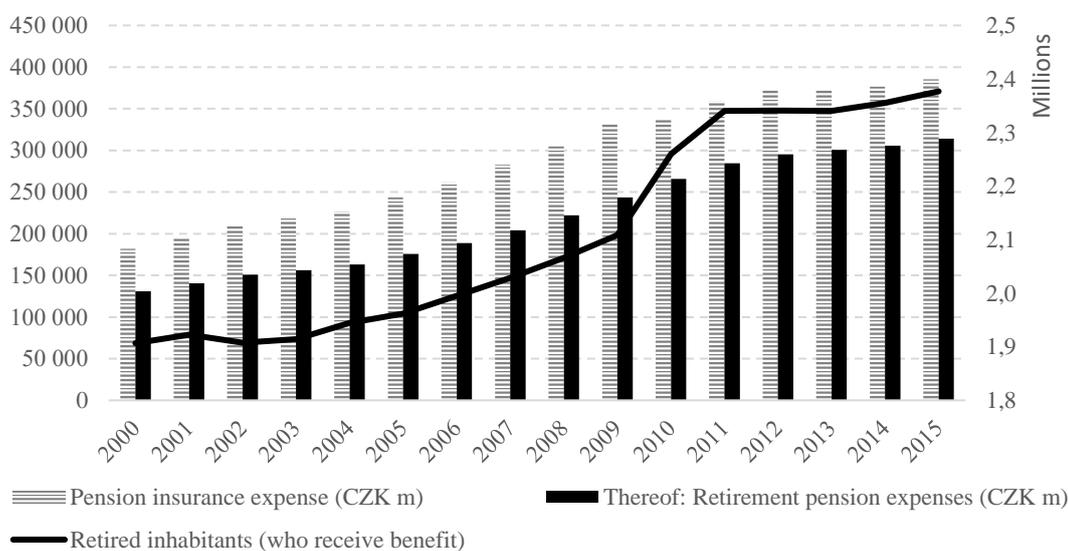
The participation in the social insurance scheme is mandatory for a broad range of economically active individuals, namely for employees, self-employed individuals and further specially defined groups of population. Individuals may also enter the pension insurance scheme on the voluntary basis. The insurance premium is determined by the assessment basis represented by the aggregate income of the individual. According to the law, the participants in the pension insurance are secured in living situations such as age, invalidity and death. On such occasions, the participants are eligible for receiving financial benefits of the pension insurance.

For employees, the currently applied insurance premium rate is 31.5% of the assessment basis, thereof 25% is paid by the employer and 6.5% by the employee. 28% of the assessment basis (88.9% of the insurance premium amount) is a contribution to the pension scheme. 2.3% is devoted to the sickness insurance and 1.2% to the state employment policy. For employees, there is applied a maximal assessment basis, the ceiling for the yearly amount is set to 48 times monthly average wage (for 2016 it is CZK 1 298 288). In general, self-employed individuals contribute by 29.2% of their assessment basis, thereof 28% for the pension insurance and 1.2 for the state employment policy. Voluntary participants in the pension scheme pay only the pension insurance premium, which is determined as 28% of their assessment basis. It can be seen that the social insurance premium represents a significant amount of the individual's income and the premium devoted for the pension insurance accounts for a vast portion of the contributed amount, however, the Pension Committee (2015) argues, that in terms of GDP the Czech pension scheme is

relatively modest in the international comparison and compared to other European countries, the Czech first pillar of the pension scheme is highly egalitarian.

From the pension insurance scheme, the mostly utilized pension is naturally the retirement pension, in 2015 it accounted for more than 81% of pension scheme expenses (CSSA, 2016). Participants are eligible to receive the retirement pension when they reach the age defined by the applicable law and contributed in the scheme for at least the minimal number of required years. The benefit amount is calculated based on the number of years of contribution and the assessment basis of the individual. In the first quarter of 2016, there were 2 376 668 receivers of the retirement pension in the Czech Republic with the average pension of 11 400 CZK. In the same period, the monthly average gross wage was 26 480 CZK, which corresponds to approximately 20 300 CZK after tax (the exact amount depends on multiple parameters). The average benefit received from the mandatory pension scheme represents therefore roughly half of the average wage after tax.

Figure A1.1: Pension insurance expense (left axis, CZK m) and number of retired inhabitants who receive benefits (right axis)

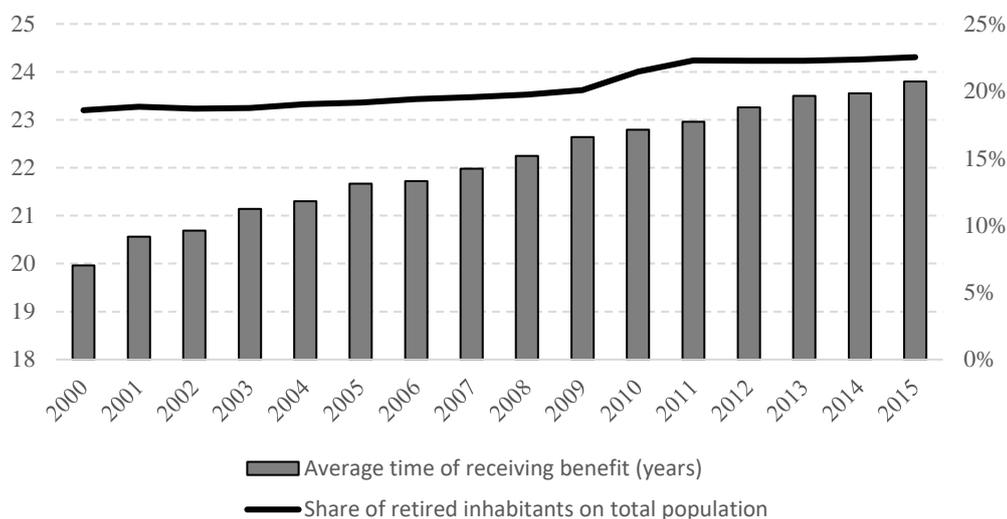


Source: Czech Social Security Administration

Since the year 2000, the number of people receiving the retirement pension from the mandatory pension scheme increased from 1.9 million to almost 2.4 million and the share of retired inhabitants in the population grew 18.6% to 22.5% at the end of 2015. Together with increasing average time of receiving benefit, expenses on the retirement pension insurance steadily increase and put high demands on the pension

insurance scheme budget, which generated a deficit of 33 billion CZK in 2015, which corresponds to approximately 0.7% of national GDP (CSSA, 2016).

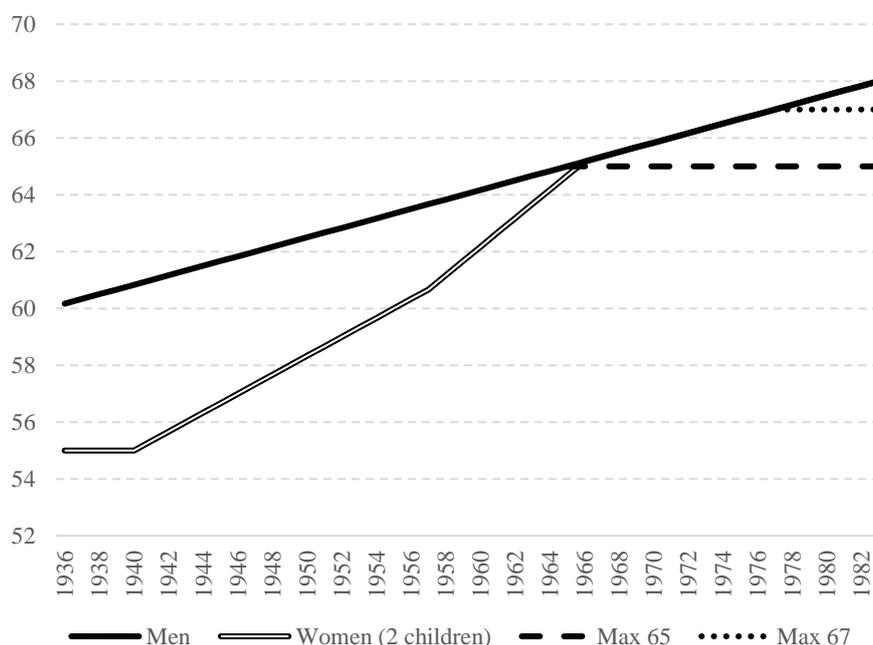
Figure A1.2: Average time of receiving retirement pension benefit in years (left axis), share of retired inhabitants on total population (right axis)



Source: Czech Social Security Administration

As a reaction to the trend of increasing expenses on the retirement pension scheme, which is given mostly by the adverse demographic development, the Czech government already in 1995 imposed measures to mitigate rising expenses. The last policy change transforming the mandatory pension scheme in the more sustainable form was introduced in 2011 as a “Small pension reform”. The imposed measures were especially represented by gradually increasing retirement age and required time of participation in the pension scheme. For participants born after 1936 the planned retirement age converges and gradually increases from 60 years (men) or 55 (women with 2 children). According to the current law, the retirement age should reach 75 years in 2100, however the government plans to impose a ceiling for a maximal retirement age with two scenarios being considered, 65 or 67 years. Whereas before 2010 the minimal required period of insurance to be eligible for retirement pension was 25 years, for participant retiring from 2010 on this requirement every year increases by one year until it reaches 35 years for those retiring after 2018.

Figure A1.3: Retirement age according to the year of birth, with alternative of two age ceilings (65 and 67 years)



Source: Ministry of Labour and Social Affairs

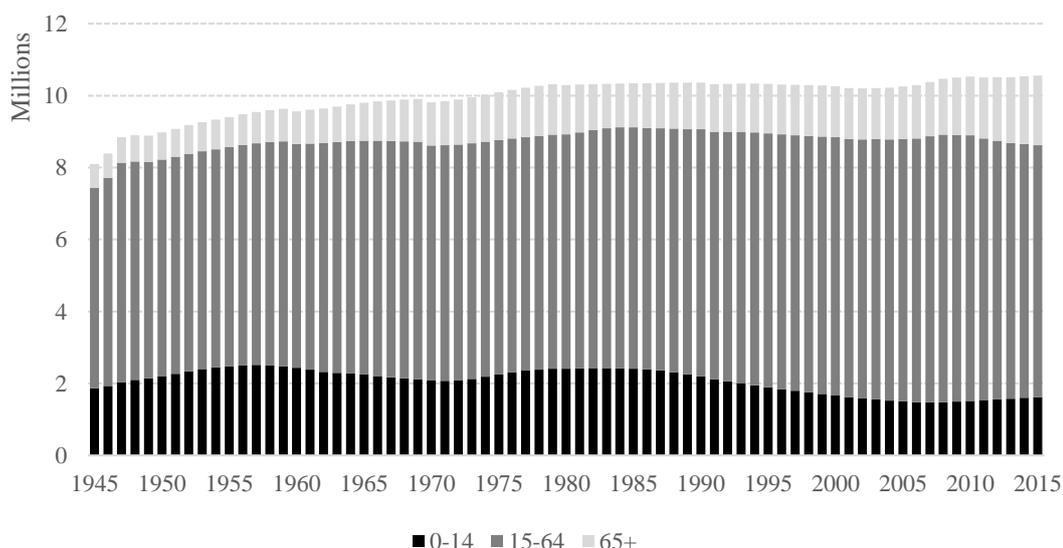
Sustainability of a pension scheme based on the PAYG principle is up to a high extent conditioned by a favourable demographic structure of the population. As the scheme redistributes contributions of active participants continuously, in other words, there are no accumulated funds, the system requires a balanced and stable proportion of contributing participants and those participants, who receive benefits. Nowadays, many developed European countries share a common demographic trend of significantly ageing population. Increasing number of participants receiving benefits and a decreasing share of economically active population put high demands on pension schemes of these countries, especially those that work on the PAYG principle.

In the respect of the ageing population, the Czech Republic is unfortunately no exception. The data from the Czech Statistical Office (CZSO) provide a detailed information about the development of the demographic structure between the years 1945 and 2015. Since the end of the World War II, the number of inhabitants in the Czech Republic has been steadily increasing, reaching approximately 10.553 million at the end of 2015. More interesting information can be obtained by analysing the population by age. We account for the three major categories, 0-14 representing children, 15-64 economically active people and 65+ for people past their economic

activity. Nowadays, the real age boundaries of the second category are probably shifted more upwards thanks to the increasing time spent for education and higher employment of elder people, however the 15-64 range is still generally accepted.

From the data we can see, that the development in the last few decades was in fact very positive for the PAYG financed pension scheme. The share of the 15-64 category was strictly increasing from 1980 (63.2%) until 2006 (71.2%), when it reached the peak. On the other hand, share of inhabitants over 65 years remained relatively low in that time, increasing only by 1.1 percentage points (from 13.3% in 1980 to 14.3% in 2006). From the pension scheme perspective, the period between 1980 and 2006 may be viewed as a time of prosperity, however at the same time a new, much less favourable trend was preset. Firstly, later 80s, 90s and 00s showed a significant decline in the birth rate, resulting in absolute as well as relative decrease of 0-14 category. Whereas in 1980 this population group was supported by strong births from 70s, representing 23.5% of the whole population, its share dropped down to only 14.4% in 2006. Secondly, the improved life quality and healthcare progress in the last decades contributed to an increased life expectancy. According to World Bank, the average life expectancy at birth in the Czech Republic raised from 70 years in 1980 to 78 years in 2014.

Figure A1.4: Population in the Czech Republic 1945 - 2015

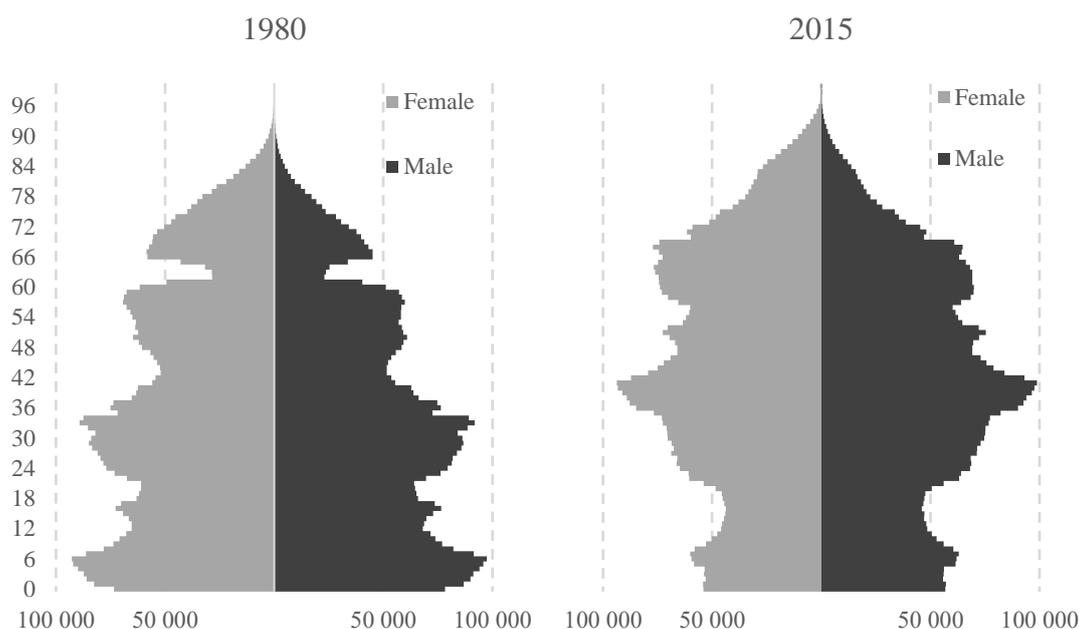


Source: CZSO

Effects of decrease in birth rate, which started to appear in 80s, are going to fully develop in the near future, but the first signs of the change are already visible. After

the 15-64 category peaked in 2006 and 2007, its share started to decline significantly, whereas the 65+ category was supported by people born in the boom after WWII, who finally reached the retirement age. At the end of 2015, children (0-14) represented 15.4% of the Czech population, economically active category (15-64) took 66.3% and people over 65 represented share of 18.3%.

Figure A1.5: Age pyramid of the Czech population in 1980 and 2015



Source: CZSO

CZSO also provides a Projection of the Czech population from the present until the year 2100. The demographic forecast is published every 4 years, the latest available projection was published in 2013. The forecast is elaborated in the three variants, low, middle and high scenario. The middle scenario is considered to represent the most probable development, the low and high variants serve as outer boundaries of the possible development. As inputs, the projection uses three main parameters, which are the total fertility, life expectancy (individually for men and women) and the net migration. The forecast does not account for unexpected events, e.g. war, epidemic or excessive migration.

Table A1.1: Basic Projection parameters (2013)

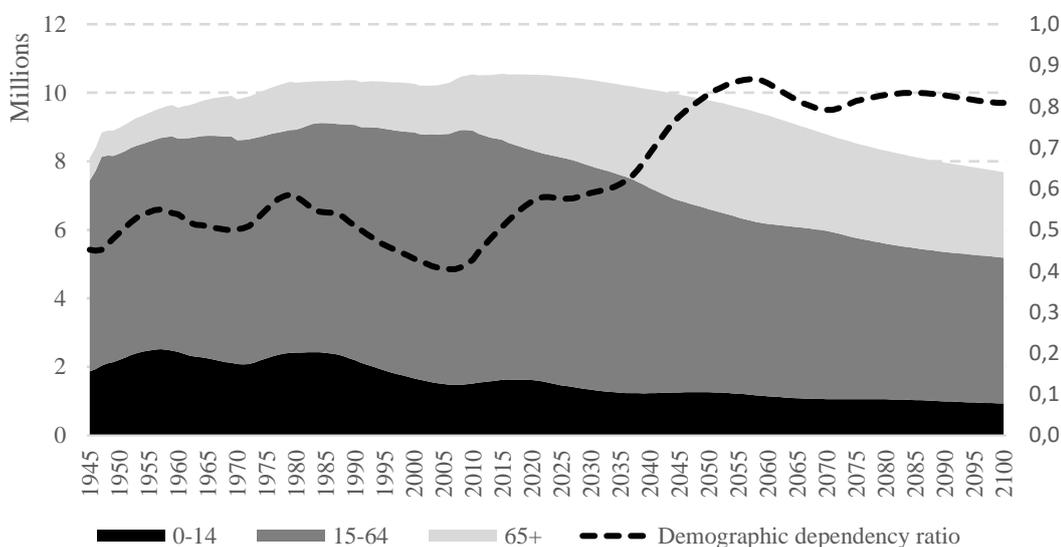
Year	Total fertility			Life expectancy (men/women)			Net migration		
	*real data	low	middle	high	low	middle	high	low	middle
2012*	1.45	1.45	1.45	75.0/80.9	75.0/80.9	75.0/80.9	10 293	10 293	10 293
2015	1.45	1.45	1.45	75.6/81.4	75.8/81.6	75.9/81.8	-996	8 934	18 864
2030	1.45	1.50	1.52	78.2/83.8	79.5/85.1	80.6/86.1	2 226	11 659	21 110
2050	1.45	1.56	1.61	81.1/86.2	83.0/88.0	84.6/89.3	5 571	14 384	23 291
2100	1.45	1.56	1.61	84.2/88.8	86.6/91.1	88.4/92.9	10 350	17 671	25 400

Source: CZSO

A common feature of all the scenarios is that they predict an increasing share of people over 65 years and a decrease of the other two categories, despite the fertility probably rising. Regardless of the scenario chosen, according to the forecast, the Czech population will be inevitably getting older and later also less populous. Let us now stick to the most probable middle scenario and analyse the projection in more detail. The projection assumes at first stagnating, and from 2030 slightly increased fertility (from 1.45 gradually to 1.56 child per woman), increasing life expectancy both for men and women and a stable positive net migration (see the Table A1.1).

Under the middle scenario, the total number of inhabitants will peak around the year 2017 at c. 10.5 million and from this time on, it will start to decrease incrementally. It is estimated, that the population will not fall below 10 million until the half of the 21st century, but *ceteris paribus* in the second half the downturn will accelerate. By the year 2100, the Czech population will be represent approximately by 7.7 million inhabitants, which is less than 75% of the current state.

Figure A1.7: Population in the Czech Republic 1945-2100 (2016-2100 forecasted data, middle scenario)



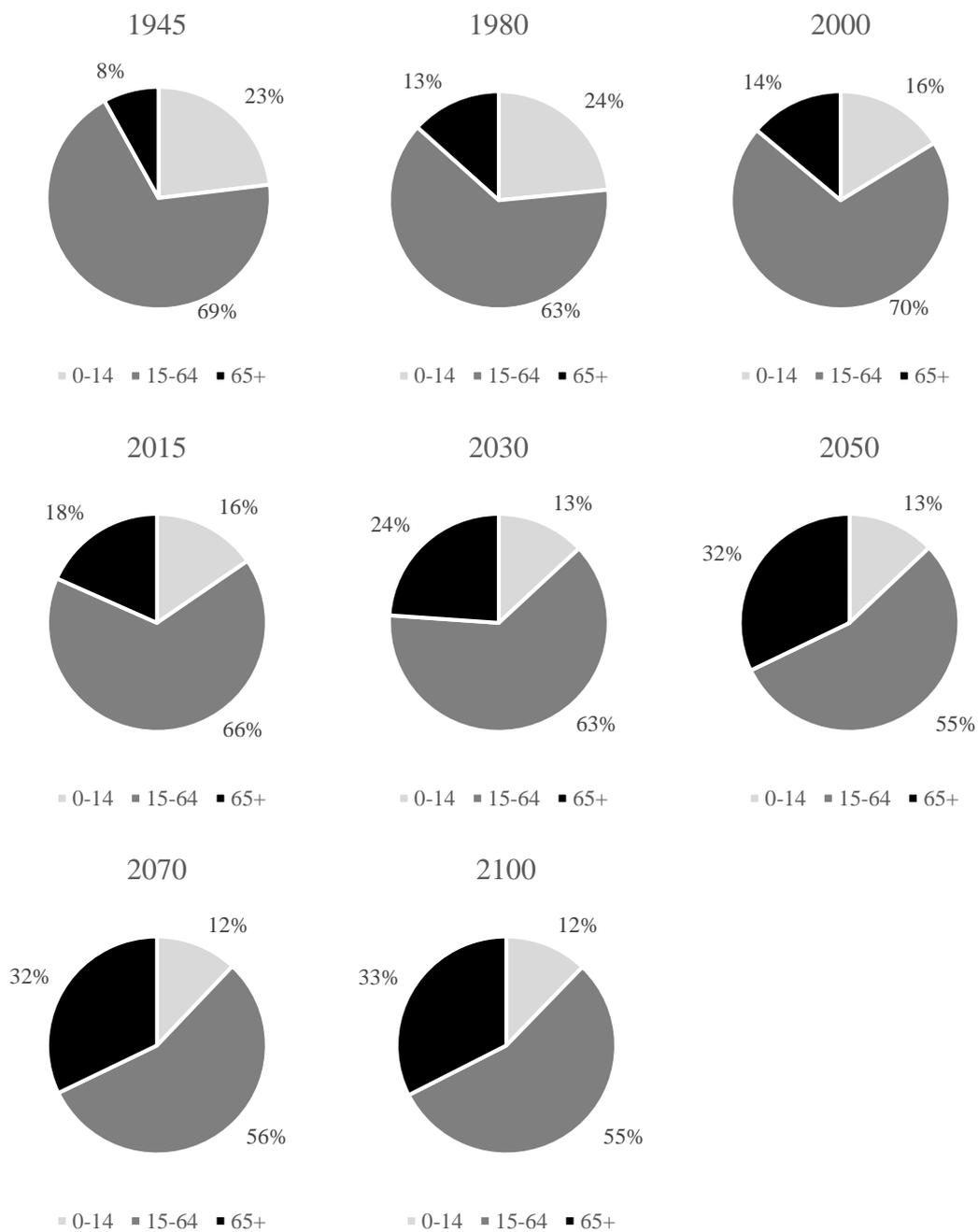
Source: CZSO

The evolution of the age structure is expected to be dynamic namely in the first half of the 21st century, with a significant decrease of active population between 15 and 64 years. The fastest drop will take place by the year 2020, when the population wave from 40s and 50s will retire. Another decrease will restore at the end of 2030s, with another population wave from 1970s ageing. In 2050, there will be approximately 5.34 million people in the category 15-64, which will correspond approximately with 54.6% of the population. Children will account for 12.9% and people over 65 years for 32.5%. That is already a significant change compared to the year 2015. From the point of view of the continuously funded pension scheme, the highest demands on the system budget will arise in the period between 2015 and the beginning of 2050s. In the second half of the century, e.g. from 2050 to 2100, the age structure is going to stabilize and the decline of inhabitants will be equally distributed in all three categories.

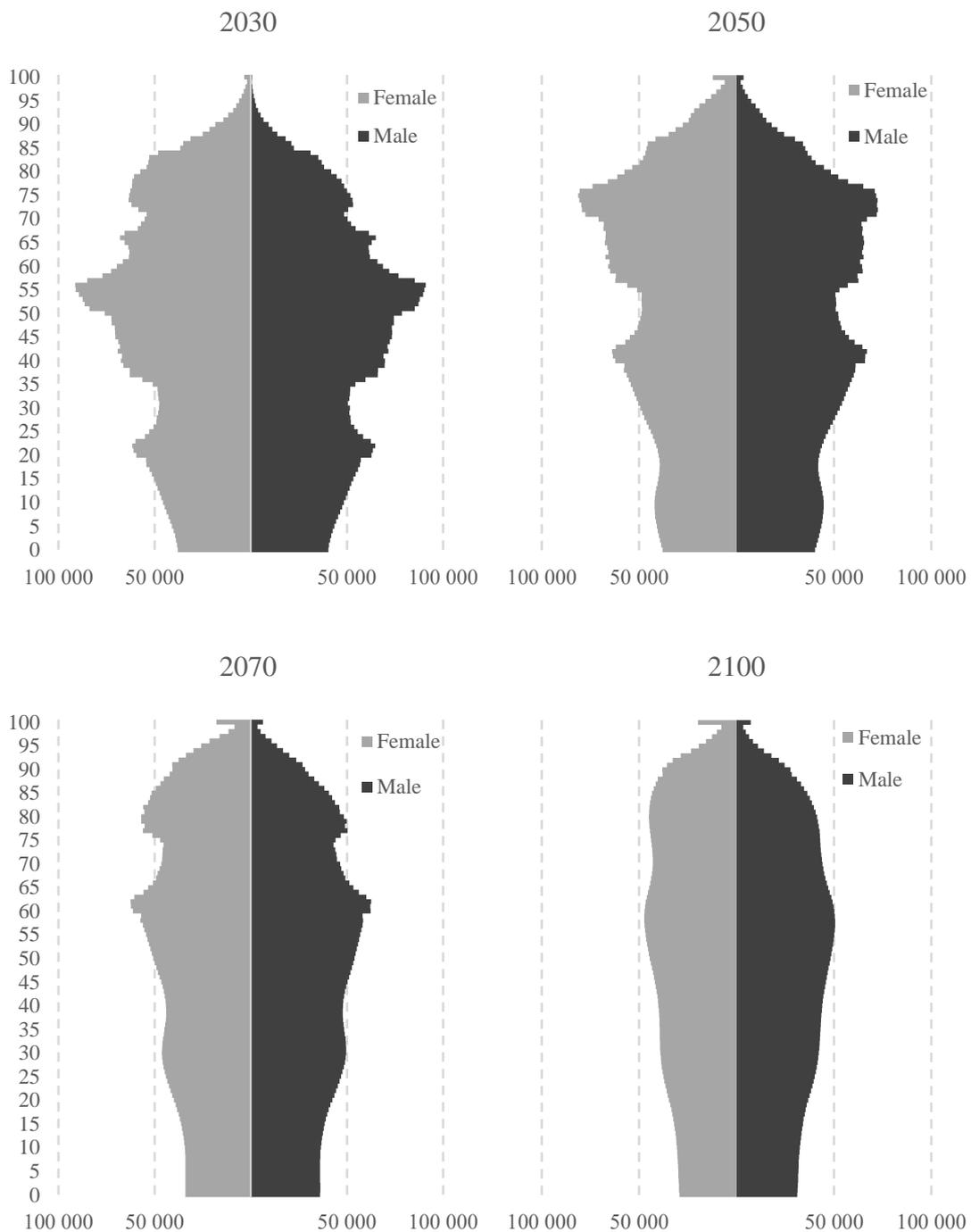
The demographic dependency ratio is computed as a number of inhabitants in 0-14 and 65+ categories divided by 15-65 category and it shows, how many economically dependent inhabitants will fall on one economically active inhabitant. The ratio was steadily decreasing from 1980 until 2006, when it reached the bottom with 40 dependent inhabitants per 100 economically active. The forecast shows, that by the year 2060 this share will increase significantly and culminate approximately at 85 dependent per 100 active inhabitants. In the last 40 years of the prediction, the

demographic dependency ratio will slightly decrease and oscillate around 80 dependent per 100 active inhabitants.

Figure A1.8: Age structure of the Czech population (2016-2100 forecasted)



Source: CZSO

Figure A1.9: Age pyramid of the Czech population- forecast

Source: CZSO

From the demographic forecast, it is also feasible to derive the expected ratio of contributors to the pension scheme and those, who receive benefits. CZSO (2013) predicts, that even though the increase in number of retired inhabitants will be significantly mitigated by the shift in retirement age, number of people receiving

benefits from the pension scheme can rise up to 2.8 million in 2050s, approximately 0.5 million more than in 2015.

Fiala and Langhamrová (2013) performed this estimate for various developments of retirement age. They argue, that the age of 20 years serves in the Czech Republic as a good estimate of a lower bound of the period of economic activity. This life period usually ends with retirement, therefore the upper bound is recognized as the age of retirement. Based on the results of Fiala and Langhamrová (2013), the share of retired inhabitants (those, who reached the retirement age) per 100 of employed inhabitants will record the greatest increase between the years 2030 and 2060, when in the worst scenario, the burden carried by one contributor to the pension scheme will almost double. The results also show an importance of the retirement age for the future development, as every increase of maximal retirement age would considerably mitigate the ageing effects. However, as the retirement age is expected to increase gradually instead of abrupt jump, none of the scenarios is able to efficiently cope with the ageing wave in the first half of the 21st century and increasing retirement age over 70 years would have an effect first after 2065.

The Ministry of Finance together with the Ministry of Labour and Social Affairs in 2013 published an estimate, according to which the deficit of the first pillar of the pension scheme is to going to increase up to 5% of the national GDP, provided that no additional measure is implied.

Various scenarios of the future development of the mandatory pension scheme were also quantified by Schneider and Šatava (2013). They argue, that retaining the current real value of pension scheme benefits is hardly achievable by an adequate increase of contributions, as the excessive economic burden would motivate people to switch their activity into the grey economy. Based on the SILC data they estimate, that without any change in the current pension policy, the benefits paid out of the pension scheme would have to decrease by 10-15% in order to retain the balance scheme budget by the year 2030. However, in order to provide balanced scheme budget after 2050, the benefits would have to decrease by more than 40%.

The general conclusion reached by the analysis of the demographic forecast is that under the current demographic prospects and with the current pension policy, the mandatory pension scheme in the Czech Republic is not fiscally sustainable in the long term. Currently applied measures, such as increased retirement age, will mitigate the effects of ageing, but will not be sufficient to cover the whole funding gap which

is going to considerably deepen after 2030. The most likely scenario of the future development is that the funding gap will be partly covered by the funding from the public budget and partly by reduction of retirement benefit. In this context, more effort will be put to differentiate retirement income of individuals by generating private savings, namely via the subsidized individual pension savings scheme which is provided as a third pillar of the Czech pension scheme.

7.2 Supplementary pension savings scheme

Concurrently with the mandatory pension scheme, a government-subsidized alternative pension scheme instrument was first introduced as a “Supplementary pension insurance” (SPI) in 1994, established by the Act 42/1994, on supplementary pension insurance with the state contribution. The purpose of the third pillar was to motivate inhabitants to increase their savings for the retirement and to also diversify the source of the retirement income. It allowed participants older than 18 years to regularly deposit their pension savings in the private pension fund on the voluntary basis and to receive a state contribution conditioned by the deposited amount. Participants who reached the age of 50 years and at the same time contributed for at least 12 months were eligible to receive a one-time settlement of the accumulated amount. In the first stage, the supplementary savings scheme did not any further tax benefits neither for the participant nor for his employer.

A significant amendment in supplementary pension savings scheme was implemented by the Act 170/1999, which came into force on 1st January 2000. As a result of the amendment, the security of the system was improved by increasing capital requirements of the funds and the newly introduced benefits were supposed to motivate more inhabitants to participate. The state compensation for participants saving below 500 CZK per month increased and there was introduced a benefit in form of tax advantages. Participants saving on average more than 1500 CZK per month were allowed to subtract up to 12 000 CZK from their tax base. Employers, who contributed their employees on their pension savings account, were newly eligible to subtract up to 3% of the assessment basis for the social insurance from their tax base. Moreover, in order to strengthen the long term character of the savings, the age allowing the participant to receive compensation was increased to 60 years or the retirement age. Additional option for participants was to receive the so-called “retirement pension” in the amount of half of accumulated funds, conditioned by at least 15 years of contribution.

The „Large pension reform“, implemented in 2013, did not only introduce the second pillar of the pension scheme, but it also brought various changes to the third pillar. The Act 427/2011, on supplementary pension savings scheme, replaced the supplementary pension insurance (defined by Act 42/1994) by the supplementary pension savings scheme (SPSS). Even though the basic concept of the third pillar pension scheme remained unchanged, several important differences in the scheme administration can be identified.

Similarly to the second pillar scheme, private pension companies had to establish standardized “Participant funds” with various risk profiles available for participants, who effectively entered into a contract with the pension company after 1.12.2012, and for those participants, who decided to transform their earlier signed contracts into the newly established supplementary pension savings scheme. Participant funds introduced different conditions concerning their management and possibilities to receive benefits, including a newly introduced feature of the pre-retirement. In case the participants meet given conditions, they can retire up to 5 years prior to their planned retirement. Pension for this period is covered from their pension savings scheme and the early retirement does not affect the amount they receive when they reach their true retirement age. Pension funds of clients, who decided to continue their contracts signed before December 2012 without switching to the new policy, were preserved and named as “Transformed funds”. The result is, that the third pillar offers savings for two groups participants with different pension scheme policies. The comparison of the newly established Participant funds and Transformed funds is provided in the table below.

Table A1.2: Transformed and Participant funds comparison 2013

	Transformed funds	Participant funds (new)
Eligibility to receive benefit	Up to 60 years (depending on when the contract was entered)	Retirement age / 5 years prior to retirement age in case of pre-retirement
Form of benefit	Single payment / lifelong perpetuity	Single payment / annuity / lifelong perpetuity
“Retirement pension” after 15 years of contribution	Yes	No
Investment strategy	Mandatory conservative	Chosen by participant, from conservative to dynamic
Guarantee of the non-negative nominal return in the calendar year	Yes	No
Fees	0.6% + 15% of returns	0.4 – 0.8% + 10% of returns
State contribution	90 – 230 CZK per month	90 – 230 CZK per month
Tax benefit	Subtract up to 12 000 CZK from the tax assessment basis resulting in tax savings of 1 800 CZK per year	Subtract up to 12 000 CZK from the tax assessment basis resulting in tax savings of 1 800 CZK per year
Possibility of pre-retirement	No	Yes

The introduction of the new policy in 2013 brought significant changes in rules for the state contribution – these changes were effective for all participants in the third pillar regardless the fund they were contributing. The minimal monthly contribution providing eligibility to receive state compensation increased from 100 CZK to 300 CZK and the monthly amount maximizing the state compensation doubled, when it increased from 500 CZK to 1000 CZK. (For details see Table 1.1)

Currently, the last policy change in the supplementary pension savings scheme was introduced in the year 2016. Additional increase in attractiveness of the third pillar serves as a way of compensation for the termination of the second pillar. Participants are allowed to claim their accumulated funds when they reach age of 60 years. Those participants, who decide to receive benefit in the form of annuity rather than a single payment, are exempt from the 15% capital gain tax. Participants can reach a tax benefit up to 24 000 CZK provided they contribute on average at least 3 000 CZK per month. Benefits for employers, who contribute their employees to the pension savings account, were also increased and can reach up to 50 000 CZK. Finally, an

important positive change represents the possibility to establish the pension savings account for children without any age restriction (former policy required participants to be at least 18).

Table A1.3: Transformed and Participant funds comparison 2016

	Transformed funds	Participant funds (new)
Eligibility to receive benefit	Up to 60 years (depending on when the contract was entered)	60 years / 5 years prior to retirement age in case of pre-retirement
Form of benefit	Single payment / lifelong perpetuity	Single payment / annuity / lifelong perpetuity
“Retirement pension” after 15 years of contribution	Yes	No
Investment strategy	Mandatory conservative	Chosen by participant, from conservative to dynamic
Guarantee of the non-negative nominal return in the calendar year	Yes	No
Fees	0.8% + 10% of returns per year	1% + 15% of returns per year
State contribution	90 – 230 CZK per month	90 – 230 CZK per month
Tax benefit	Subtract up to 24 000 CZK from the tax assessment basis resulting in tax savings of 3 600 CZK per year	Subtract up to 24 000 CZK from the tax assessment basis resulting in tax savings of 3 600 CZK per year
Possibility of pre-retirement	No	Yes

8 Appendix 2

Table A2.1: Participation – results (probit), year 2014 alternative models

Y = Participation	2014 alt. 1	2014 alt. 2	2014 alt. 3	2014 alt. 4
Obs. = 14,838	Pseudo R2.: 0.1648	Pseudo R2.: 0.1641	Pseudo R2.: 0.1645	Pseudo R2.: 0.1615
Netinc (ths CZK)	.00052514	.0005648	.00055545	.00074174
	0.0023	0.0014	0.0015	0.0001
Age				
25-29	.36311177	.37511839	.36700555	.40911854
	0.0000	0.0000	0.0000	0.0000
30-34	.54436028	.56193289	.54628895	.59765076
	0.0000	0.0000	0.0000	0.0000
35-39	.70816416	.72871736	.71154107	.77464758
	0.0000	0.0000	0.0000	0.0000
40-44	.75867783	.78332575	.76099819	.83265523
	0.0000	0.0000	0.0000	0.0000
45-49	.80897042	.83671478	.81093453	.88981362
	0.0000	0.0000	0.0000	0.0000
50-54	.89561238	.9192303	.8991235	.97108842
	0.0000	0.0000	0.0000	0.0000
55-59	.99455997	1.0218424	.98776205	1.0424845
	0.0000	0.0000	0.0000	0.0000
60-64	.81145588	.82290448	.79192163	.77058637
	0.0000	0.0000	0.0000	0.0000
65-69	.61395395	.61397417	.59124036	.53047446
	0.0000	0.0000	0.0000	0.0000
70-74	.52685746	.52511981	.50399675	.43799143
	0.0000	0.0000	0.0000	0.0000
75-79	.28003709	.27572911	.25801218	.18719471
	0.0002	0.0002	0.0005	0.0105
>80	-.11541531	-.11826145	-.13807045	-.20657514
	0.1333	0.1247	0.0710	0.0064
Educ				
Maturity & eq.	.31862887	.31998849	.31954456	.32553367
	0.0000	0.0000	0.0000	0.0000
Bachelor & eq.	.48636651	.48899806	.48248566	.47929258
	0.0000	0.0000	0.0000	0.0000
Master +	.38518904	.38385012	.38702435	.38826434
	0.0000	0.0000	0.0000	0.0000
Female	.1459355	.14235673	.14051282	.1163597
	0.0000	0.0000	0.0000	0.0008
Married male	.35142449	.35171468	.35190859	.35374233
	0.0000	0.0000	0.0000	0.0000
Married female	.29438005	.29645195	.29322348	.29573448
	0.0000	0.0000	0.0000	0.0000
Employee	.52683528	.36951947	.63632103	.49094103
	0.0000	0.0000	0.0000	0.0000
Self_empl	.26984277		.39901096	
	0.0001		0.0000	
Hours	.00341943	.00667294		
	0.0066	0.0000		
_cons	-1.5277946	-1.5281504	-1.5071789	-1.4524769
	0.0000	0.0000	0.0000	0.0000

Table A2.2: Participation – results (probit), by years individually

Y = Participation	2010	2011	2012	2013	2014
Coef.	Obs. = 17,158	Obs. = 16,897	Obs. = 15,930	Obs. = 15,241	Obs. = 14,838
P-value	Pseudo R2 = .1619	Pseudo R2 = .1642	Pseudo R2 = .1607	Pseudo R2 = .1619	Pseudo R2 = .1645
Netinc (ths CZK)	.00070971	.00087556	.00097164	.00035683	.00055545
	0.0000	0.0000	0.0000	0.0165	0.0015
Age					
25-29	.49948568	.54797477	.30950371	.37090455	.36700555
	0.0000	0.0000	0.0000	0.0000	0.0000
30-34	.69835215	.72132487	.50221711	.63720064	.54628895
	0.0000	0.0000	0.0000	0.0000	0.0000
35-39	.80224608	.75974385	.58962909	.75596827	.71154107
	0.0000	0.0000	0.0000	0.0000	0.0000
40-44	.82843648	.89448281	.54296429	.65294554	.76099819
	0.0000	0.0000	0.0000	0.0000	0.0000
45-49	.96766361	.99471895	.62597579	.74897168	.81093453
	0.0000	0.0000	0.0000	0.0000	0.0000
50-54	1.0767765	1.0832216	.71033165	.80131122	.8991235
	0.0000	0.0000	0.0000	0.0000	0.0000
55-59	1.215001	1.2149976	.8590505	.97000711	.98776205
	0.0000	0.0000	0.0000	0.0000	0.0000
60-64	.9832863	.99921407	.60866403	.70905977	.79192163
	0.0000	0.0000	0.0000	0.0000	0.0000
65-69	.79400865	.89672686	.49813115	.63480118	.59124036
	0.0000	0.0000	0.0000	0.0000	0.0000
70-74	.5397022	.65462645	.36655511	.48237968	.50399675
	0.0000	0.0000	0.0000	0.0000	0.0000
75-79	.20087328	.3520472	.04864741	.18240943	.25801218
	0.0042	0.0000	0.4899	0.0125	0.0005
>80	-.28420402	-.16468534	-.47286564	-.26084262	-.13807045
	0.0005	0.0319	0.0000	0.0007	0.0710
Educ					
Maturity & eq.	.24711294	.24615461	.28739328	.29781586	.31954456
	0.0000	0.0000	0.0000	0.0000	0.0000
Bachelor & eq.	.27606543	.29214689	.33052246	.35956117	.48248566
	0.0000	0.0000	0.0000	0.0000	0.0000
Master +	.26731186	.27502351	.34648603	.34672226	.38702435
	0.0000	0.0000	0.0000	0.0000	0.0000
Female	.14748592	.19865768	.17523955	.15505262	.14051282
	0.0000	0.0000	0.0000	0.0000	0.0000
Married male	.29212584	.28920156	.29415843	.32495148	.35190859
	0.0000	0.0000	0.0000	0.0000	0.0000
Married female	.20756486	.17271492	.2436362	.23317603	.29322348
	0.0000	0.0000	0.0000	0.0000	0.0000
Employee	.5607807	.60261857	.62267216	.71321361	.63632103
	0.0000	0.0000	0.0000	0.0000	0.0000
Self_empl	.23679488	.35381684	.36461084	.45614122	.39901096
	0.0000	0.0000	0.0000	0.0000	0.0000
_cons	-1.5720098	-1.6420503	-1.3481059	-1.4194854	-1.5071789
	0.0000	0.0000	0.0000	0.0000	0.0000

**Table A2.3: Participation – results (probit), test for change in coefficients
(years 2010 – 2014, with respect to 2012)**

Y = Participation	Year 2010, D: 2012	Year 2011, D: 2012	Year 2013, D: 2012	Year 2014, D: 2012
p-value < 0.001 - ***				
p-value < 0.01 - **				
p-value < 0.05 - *				
Netinc (ths CZK)	.00068565***	.00088052***	.00037632*	.00056718**
Age				
25-29	.49667102***	.54852609***	.37625002***	.36969142***
30-34	.6952983***	.72197281***	.64294948***	.54954921***
35-39	.79823366***	.7606713***	.76301154***	.7155211***
40-44	.82328346***	.89557556***	.66135563***	.7655219***
45-49	.96192442***	.99584579***	.75811376***	.8159178***
50-54	1.0716584***	1.0843619***	.81050267***	.90366251***
55-59	1.2127701***	1.215435***	.97543133***	.99117536***
60-64	.98720384***	.9984106***	.70629099***	.7905126***
65-69	.79999776***	.89545573***	.62784867***	.58734766***
70-74	.54616367***	.65317959***	.47489759***	.49976836***
75-79	.20728993**	.3506213***	.17459176*	.25347471***
>80	-.27743454***	-.16612932*	-.26891716***	-.14246465
Educ				
Maturity & eq.	.24701757***	.24614864***	.29851946***	.3198987***
Bachelor & eq.	.27740586***	.29195536***	.35935385***	.48224569***
Master +	.26793517***	.27483232***	.34689362***	.38706014***
Female	.14927556***	.19828343***	.15231236***	.1389504***
Married male	.29174336***	.28926198***	.3255489***	.35198069***
Married female	.2075136***	.17273801***	.23318787***	.29335474***
Employee	.57320143***	.59999424***	.69689974***	.627066***
Self_empl	.27226834***	.34658742***	.40990396***	.3735246***
D	.22590137***	.28888147***	.05938483	.15074662*
Netinc_D2011	.00029994	.00008098	.00056485**	.00038565
Age_D				
25-29	-.19125886*	-.24317495**	-.0709768	-.06437051
30-34	-.19693661*	-.22418327**	-.14567574	-.05197592
35-39	-.21216168**	-.1762641*	-.1800459*	-.13172457
40-44	-.28406893***	-.3582054***	-.12558526	-.22882915**
45-49	-.33959344***	-.3759034***	-.14023341	-.19684964*
50-54	-.36435314***	-.37977054***	-.10823923	-.20005977*
55-59	-.36692045***	-.36464759***	-.12044291	-.13860003
60-64	-.43108712***	-.4120368***	-.09413882	-.19317191*
65-69	-.37501161***	-.42717373***	-.12270872	-.10338183
70-74	-.25537133**	-.31738694***	-.10079214	-.14767321
75-79	-.23562973*	-.33319897**	-.11822005	-.21947765*
>80	-.27308923*	-.3380809**	-.19587003	-.34496975**
Educ_D				
Maturity & eq.	.04089895	.041435	-.01121156	-.03243326
Bachelor & eq.	.05417719	.03945589	-.02807718	-.15089302
Master +	.0814036	.07347214	.00055805	-.0391217
Female_D	.02370099	-.0228956	.02514109	.03731495
Married male_D	.00423769	.00537838	-.03203456	-.0578212
Married female_D	.03412602	.06994863	.01040345	-.05028464
Employee_D	-.02187653	-.00146882	-.05817333	-.01143629
Self_empl_D	.07888475	.03673422	.00083587	.02146042
_cons	-1.5763818***	-1.6410926***	-1.4130969***	-1.5035934***

Table A2.4: Participation – results (probit), test for change in coefficients
Base: pooled 2010 and 2011; Dreform = after policy change, pooled 2013, 2014

Y = Participation	Coef.	Std. Err. (robust)	z	P>z	[95% Conf.	Interval]
Netinc (ths CZK)	.0007598	.0000971	7.83	0.000	.0005696	.00095
Age						
25-29	.5212017	.0407378	12.79	0.000	.441357	.6010464
30-34	.7066633	.0404578	17.47	0.000	.6273675	.7859591
35-39	.7788445	.040766	19.11	0.000	.6989446	.8587444
40-44	.8572645	.0422665	20.28	0.000	.7744237	.9401053
45-49	.9765317	.0422673	23.10	0.000	.8936894	1.059374
50-54	1.075738	.0416964	25.80	0.000	.9940144	1.157461
55-59	1.214249	.0395315	30.72	0.000	1.136769	1.291729
60-64	.9965707	.0390324	25.53	0.000	.9200685	1.073073
65-69	.853266	.0407442	20.99	0.000	.7754694	.9351839
70-74	.6052735	.0440274	13.75	0.000	.5189813	.6915657
75-79	.2854974	.04915	5.81	0.000	.1891651	.3818297
>80	-.2124942	.0556736	-3.82	0.000	-.3216124	-.1033761
Educ						
Maturity & eq.	.2468676	.0168036	14.69	0.000	.2139332	.279802
Bachelor & eq.	.2878687	.0449156	6.41	0.000	.1998357	.3759016
Master +	.2728561	.0266613	10.23	0.000	.220601	.3251112
Female	.1743772	.0235429	7.41	0.000	.1282339	.2205205
Married male	.2896519	.0237238	12.21	0.000	.243154	.3361497
Married female	.189476	.0212304	8.92	0.000	.1478651	.2310869
Employee	.5946848	.0224516	26.49	0.000	.5506804	.6386892
Self_empl	.3301115	.0282701	11.68	0.000	.2747031	.3855198
D	.1471207	.0478266	3.08	0.002	.0533823	.2408591
Netinc_D2011	-.0002996	.000147	-2.04	0.042	-.0005876	-.0000115
Age_D						
25-29	-.1556602	.0599559	-2.60	0.009	-.2731716	-.0381489
30-34	-.1176364	.0597193	-1.97	0.049	-.2346841	-.0005887
35-39	-.048037	.0598989	-0.80	0.423	-.1654366	.0693626
40-44	-.1535573	.0610771	-2.51	0.012	-.2732661	-.0338484
45-49	-.2007713	.0616764	-3.26	0.001	-.3216549	-.0798877
50-54	-.2304405	.061379	-3.75	0.000	-.3507411	-.11014
55-59	-.2452963	.0591489	-4.15	0.000	-.361226	-.1293667
60-64	-.3005033	.0597159	-5.03	0.000	-.4175444	-.1834623
65-69	-.3197782	.0633415	-5.05	0.000	-.4439253	-.1956311
70-74	-.1926414	.0673262	-2.86	0.004	-.3245982	-.0606845
75-79	-.1480649	.075682	-1.96	0.050	-.2963989	.0002692
>80	-.0681113	.0814961	-0.84	0.403	-.2278406	.0916181
Educ_D						
Maturity & eq.	.0627	.0245256	2.56	0.011	.0146307	.1107694
Bachelor & eq.	.1350674	.0627556	2.15	0.031	.0120687	.2580661
Master +	.0960135	.0384418	2.50	0.013	.020669	.1713581
Female_D	-.0296386	.0337569	-0.88	0.380	-.0958009	.0365237
Married male_D	.0509282	.0343137	1.48	0.138	-.0163254	.1181818
Married female_D	.0716152	.0309586	2.31	0.021	.0109374	.132293
Employee_D	.0052124	.0337443	0.15	0.877	-.0609253	.07135
Self_empl_D	.0843632	.0371258	2.27	0.023	.0115979	.1571286
_cons	-1.610791	.0330364	-48.76	0.000	-1.675541	-1.54604

Probit regression		Number of obs =	64134	Sensitivity	Pr(+ D)	67.13%
		Wald chi2(43) =	12490.31	Specificity	Pr(-~D)	70.71%
		Prob > chi2 =	0.0000	Positive predictive value	Pr(D +)	67.07%
Log pseudolikelihood = -37128.774		Pseudo R2 =	0.1627	Negative predictive value	Pr(~D -)	70.76%
Probit model for participation, goodness-of-fit test				False + rate for true ~D	Pr(+~D)	29.29%
number of observations =	64134			False - rate for true D	Pr(- D)	32.87%
number of cov. patterns =	51202			False + rate for classified +	Pr(~D +)	32.93%
Pearson chi2(51158) =	54927.39			False - rate for classified -	Pr(D -)	29.24%
Prob > chi2 =	0.0000					
				Correctly classified		69.02%

Table A2.5: Contribution – results (OLS), year 2014, alternative models

Y = Contribution (CZK)	2014 alt. 1	2014 alt. 2	2014 alt. 3	2014 alt. 4	2014 alt. 5	2014 alt. 6
Coef.	Obs.: 6,521					
P-value	R-sq.: 0.2403	R-sq.: 0.2391	R-sq.: 0.2390	R-sq.: 0.2387	R-sq.: 0.2384	R-sq.: 0.2371
Netinc CZK	.0135816	.01335104	.01335353	.01307118	.0130187	.01367823
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Age						
30-39	353.52234	344.67125	299.12787	323.07696	314.65131	296.53357
	0.0850	0.0940	0.1363	0.1061	0.1162	0.1380
40-49	1248.1046	1206.6961	1143.27	1177.6217	1152.3126	1158.0515
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
50-59	3281.0089	3222.7237	3157.2941	3191.2776	3164.3645	3143.3338
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60-69	4261.8967	4181.4173	4120.4016	4114.3223	3998.103	3651.2422
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
70-79	4290.5724	4167.5465	4119.7559	4087.3127	3929.2921	3475.6138
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
>80	4020.2942	3873.6533	3838.2047	3802.392	3640.886	3185.1032
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Educ						
Maturity & eq.	1145.1877	1157.5543	1154.4328	1191.9323	1193.6331	1189.9546
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Bachelor & eq.	1283.4088	1258.039	1255.0277	1304.5221	1308.6612	1284.0505
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Master +	2153.0082	2158.469	2151.0588	2203.592	2214.1732	2186.9134
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Female	-275.35163	192.7419	202.22605			
	0.1462	0.1059	0.0895			
Married male	-522.49747					
	0.0043					
Married female	212.28676					
	0.1589					
Employee	-405.96579	-390.26784	-385.85298	-363.67842		
	0.0462	0.0545	0.0571	0.0711		
Self_empl	1348.5251	1351.2528	1346.2928	1327.3475	1338.6763	1483.1447
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hours	17.675907	17.766533	17.875933	16.816667	13.850272	
	0.0006	0.0006	0.0005	0.0010	0.0014	
Married		-119.00183				
		0.3125				
_cons	1214.3481	1027.3204	993.67196	1132.905	938.51634	1305.4829
	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000

Table A2.6: Contribution– results (OLS), by years pooled with dummy

Y = Contribution (CZK)	Coef.	Std. Err. (robust)	t	P>t	[95% Conf. Interval]
Year					
2011	68.12747	61.08076	1.12	0.265	-51.59271 187.8477
2012	590.7786	64.07866	9.22	0.000	465.1824 716.3747
2013	1151.779	65.87574	17.48	0.000	1022.66 1280.897
2014	1425.936	68.87335	20.70	0.000	1290.942 1560.93
Netinc	.0128611	.0002871	44.79	0.000	.0122984 .0134239
Age					
30-39	284.3191	77.04872	3.69	0.000	133.3012 435.3369
40-49	1132.842	79.33678	14.28	0.000	977.3399 1288.345
50-59	2798.863	79.8742	35.04	0.000	2642.307 2955.419
60-69	2887.158	77.32121	37.34	0.000	2735.606 3038.71
70-79	2633.85	89.71187	29.36	0.000	2458.012 2809.688
>80	2379.989	169.4308	14.05	0.000	2047.9 2712.079
Educ					
Maturity & eq.	977.7372	44.24164	22.10	0.000	891.0222 1064.452
Bachelor & eq.	1105.298	128.6796	8.59	0.000	853.0819 1357.514
Master +	1803.793	80.64666	22.37	0.000	1645.723 1961.863
Self_empl	1511.972	98.91506	15.29	0.000	1318.095 1705.849
_cons	527.5765	87.47903	6.03	0.000	356.1149 699.0381

Linear regression	Number of obs =	35491
	F(15, 35475) =	453.23
	Prob > F =	0.0000
	R-squared =	0.2429
	Root MSE =	3958.1



**Table A2.7: Contribution – results (OLS), test for change in coefficients
(years 2010 – 2014, consecutively)**

Y = Contribution (CZK)	Year 2010 D: 2011	Year 2011, D: 2012	Year 2012, D: 2013	Year 2013, D: 2014
p-value < 0.001 - ***	Obs. = 15,251	Obs. = 15,256	Obs. = 14,621	Obs. = 13,858
p-value < 0.01 - **	R-squared = 0.1918	R-squared = 0.2071	R-squared = 0.2179	R-squared = 0.2160
p-value < 0.05 - *				
Netinc	.01201405***	.01222639***	.01313207***	.01309576***
Age				
30-39	240.04954	341.14289*	393.42597*	155.10248
40-49	894.54384***	984.28979***	1345.9098***	1403.0402***
50-59	2610.6667***	2560.0813***	2795.4399***	2948.8859***
60-69	2220.8235***	2410.1962***	2885.6209***	3425.1841***
70-79	1858.888***	2091.4023***	2595.944***	3161.8593***
>80	1398.7204***	2023.4241***	2580.5252***	2507.7614***
Educ				
Maturity & eq.	709.53341***	905.63752***	977.86989***	1179.0886***
Bachelor & eq.	730.05893*	1007.5951***	1298.3303***	1360.0499***
Master +	1491.2388***	1503.4382***	1748.2963***	2175.4624***
Self_empl	2018.7863***	1395.6488***	1317.2605***	1417.5037***
D	618.15901*	608.52038**	921.71005***	858.94393**
Netinc_D	-.00262551**	-.00198913*	-.00266659**	-.00227038*
Age_D				
30-39	139.4863	161.75957	-124.60631	178.61356
40-49	106.19398	450.0118	139.29436	-202.59248
50-59	197.43127	609.90866*	522.07332*	419.15331
60-69	195.3126	709.78663**	841.17574***	675.53166*
70-79	181.7491	575.60576*	788.89814**	449.01486
>80	536.06581	669.05426	296.17385	941.7087
Educ_D				
Maturity & eq.	366.40009**	283.81476*	373.73499*	120.67023
Bachelor & eq.	447.4618	392.23102	343.8825	234.51224
Master +	431.72405	693.12969**	622.96898*	253.69057
Self_empl_D	.71127151	693.54317*	658.79938*	440.88235
_cons	1106.0089***	1024.4298***	1009.8378***	1283.4601***



Table A2.8: Contribution – results (OLS), test for change in coefficients
Base: pooled 2010 - 2012; D = after policy change, pooled 2013 - 2014

Y = Contribution	Coef.	Std. Err. (robust)	t	P>t	[95% Conf.	Interval]
Netinc	.0125996	.0003644	34.58	0.000	.0118854	.0133137
Age						
30-39	317.9059	94.7613	3.35	0.001	132.1709	503.641
40-49	1063.112	98.55266	10.79	0.000	869.9461	1256.279
50-59	2639.501	96.99229	27.21	0.000	2449.393	2829.609
60-69	2499.365	92.31697	27.07	0.000	2318.421	2680.31
70-79	2205.161	105.4222	20.92	0.000	1998.53	2411.791
>80	2071.501	217.6508	9.52	0.000	1644.899	2498.103
Educ						
Maturity & eq.	860.645	53.9235	15.96	0.000	754.9533	966.3367
Bachelor & eq.	1031.719	165.5985	6.23	0.000	707.1407	1356.297
Master +	1570.619	101.8418	15.42	0.000	1371.006	1770.232
Self_empl	1570.777	126.4239	12.42	0.000	1322.983	1818.572
D	253.7473	167.019	1.52	0.129	-73.61507	581.1096
Netinc_D	.0008077	.000591	1.37	0.172	-.0003507	.0019662
Age_D						
30-39	-100.4568	162.4732	0.536	0.536	-418.9094	217.9957
40-49	222.211	166.1216	0.181	0.181	-103.3925	547.8145
50-59	409.1758	170.2338	0.016	0.016	75.51233	742.8393
60-69	1040.741	165.7224	0.000	0.000	715.92	1365.562
70-79	1124.673	190.4219	0.000	0.000	751.4405	1497.906
>80	819.7065	346.1984	0.018	0.018	141.147	1498.266
Educ_D						
Maturity & eq.	328.821	93.6893	0.000	0.000	145.1871	512.455
Bachelor & eq.	300.8163	263.6282	0.254	0.254	-215.9032	817.5357
Master +	619.5956	166.3737	0.000	0.000	293.4979	945.6933
Self_empl_D	-126.1699	202.4773	0.533	0.533	-523.0316	270.6919
_cons	1027.634	97.17614	0.000	0.000	837.166	1218.102

Linear regression	Number of obs =	35491
	F(23, 35467) =	305.36
	Prob > F =	0.0000
	R-squared =	0.2430
	Root MSE =	3958.3

Figure A2.1: Histograms of annual contributions (development 2011 – 2014)

