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HOW PROGRESSIVE IS THE CZECH PENSION SECURITY?

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Abstract:

The aim of the paper is to examine the progressivity of the pension security in the Czech Republic using an intragenerational longitudinal approach. Since there is no available Czech panel data we modelled pseudo-panel data on lifetime earnings of employees on the basis of real cross-sectional data. Then the present values of lifetime contributions paid to and lifetime pensions received from the system were derived from the simulated lifetime earnings. The analysis revealed that the Czech pension security redistributes the funds from the higher-income participants to the lower-income ones and from men to women. Furthermore the Gini coefficients confirmed that the scheme reduces income inequality. The results proved that the solidarity principle built in the pension formula prevails over the benefit principle, which is also present in the formula, when the benefit component is relatively more favourable for the rich employees because of the shape of the lifetime earnings function.

Keywords: old age pensions, social security, redistribution, progressivity, lifetime incidence

JEL Classification: H23, H55

1. Introduction

The Czech Republic pension security is a state organised programme providing replacement income from work, *i.e*. pensions to old age retirees, disabled persons, and survivors. Its revenue and expenditure are part of the central government budget, but separated from the other budget items. It is the largest "tax-transfer" programme in the Czech Republic which transfers about 9.1 % of GDP.[1]

The current pension security is pure "pay-as-you-go" system (PAYGO).[2] Both employees and the self-employed are obliged to pay a pension security tax when they work and earn. Next to the employees their employers contribute to the system as well. Contributions are collected as payroll taxes. Persons participating in the system are after the fulfilment of given conditions eligible for pensions which receive over the

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1 Based on the 2009 data.

2 Fundamentals of the security for the old age and a classification of pension schemes see in (Slavík and Rutarová, 2005).

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retirement until they die, for example. This paper deals with the old age retirement portion of the pension security which constitutes about 73.5 % of the programme expenses.[3] In addition, due to availability of data our analysis covers only the employees who consist approximately 85.6 % of the programme participants. Estimated taxes paid by them and their employers amounted to 95 % of the entire revenue of the programme.[4] Finally, probably most of the today retirees are former employees because there were no self-employed before 1990.

This programme serves as a public insurance or a mandatory retirement saving programme on the assumption that the market economy fails to secure an adequate income in the old age. In addition, it is an important instrument how to prevent the old to be poor. Using the Luxembourg Income Study (LIS) data Lefebvre (2007) provided evidence on the redistributive performance of public pension schemes across European countries: he confirmed that social security systems, including public pensions, had lowered the income inequality and poverty in Europe.

The pension security is generally thought to be progressive, *i.e.* redistributing income from the higher-income individuals to the lower-income individuals. The redistribution is implied firstly by the PAYGO mechanism when pensions of the retirees are financed from the payroll taxes currently collected from the earners when the former ones are poorer than the latter ones, measured with their annual incomes. (It is true that the public pensions are a main source of income of the elderly in the European countries.) Furthermore, due to a benefit formula a certain portion of the means is redistributed from more affluent individuals in a cohort to individuals with lower incomes in the same cohort.[5]

Lefebvre (2007) reviews different perspectives from which the distributional impact of the pension security can be examined, *i.e.* "intergenerational perspective", "generational accounting perspective", and "intragenerational perspective". There are two approaches how the last perspective can be handled. An approach, which is easier to implement in analyses, is "a cross-sectional study" which focuses on the way how pensions affect the income distribution of the old, *i.e.* whether pensions reduce inequality of income and alleviate poverty of the elderly. While the "cross-sectional approach" concerns situation at a given period of time, "an intragenerational longitudinal approach" is interested in a lifetime incidence of the public pension system. Such an interest is logical because most individuals transit from the paying of taxes to the receiving of benefits over their life-cycle. To implement this concept the degree of progressivity is measured by the individual´s present value of benefits minus taxes or by a rate of return of the system: if net transfers or the rates of return are negatively correlated with the lifetime earnings then the system is progressive.

3 Based on the 2009 data.

4 See Pojistněmatematická zpráva o sociálním pojištění 2008 [on-line]. Ministry of Labour and Social Affairs of the Czech Republic. Available on http://www.mpsv.cz/cs/1353 [cit. 2011-03-15].

5 The pension security can have also indirect effects on the distribution of income. It may affect labour supply and market earnings, saving or intrafamily transfers (Feldstein and Liebman, 2002).

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There are economists who argue that redistributive impact of government activities should be measured in a long-time horizon [see Harding (1993), Fullerton and Rogers (1995) or Metcalf and Fullerton (2002)]. Since both transitory income fluctuations and lifecycle effects have an influence on the distribution of income at a single point in time, annual incidence studies can overstate the extent of inter-personal income redistribution resulted from the government activities (Harding, 1993). For example, Coronado, Fullerton and Glass (2000), who focused on the intra-generational redistribution, showed that the U.S. social security is highly progressive when the annual incidence is analysed. However, in the long-run perspective the social security is less redistributive, even regressive based on certain assumptions, *e.g.* that mortality probabilities vary according to a lifetime income. Liebman (2002) or Gokhale and Kotlikoff (2002) also preferred the lifetime measures of redistribution of the current pension security system in the USA. If the pension security is interpreted as providing insurance solely against longevity risk thus other differences in payoffs from the pension security can be attributed to redistribution. In particular different lifetime earnings as well as differences in life expectancy according to sex and education are considered as sources of redistribution (Liebman, 2002).

There are a few studies on progressivity of the pension security in the Czech Republic. For example, Lefebvre´s (2007) results put our country among the countries where the social security scheme reduces inequality and alleviates poverty significantly.[6] Unfortunately, there has been no study dealing with incidence over the whole life-cycle so far. Thus we decided to fill the gap and to find out who and how much benefits from the pension security over a lifetime and how this public insurance scheme redistributes among people classified by the lifetime income.

Moreover, we believe that it would be useful to assess the current extent of redistribution and solidarity before the pension security is reformed. A major reform of the pension security due to the adverse demographic prediction is probably unavoidable but still being prepared. However the so called "small reform" happened already in 2011. In 2010 The Constitutional Court of the Czech Republic issued the judgement according to which the Czech pension security was too redistributive and little equivalent, *i.e.* the system did not provide an adequate pension in relation to earnings. Thus the court ordered to the government to extend the benefit principle in the pension scheme – and to weaken the solidarity principle. As a consequence the pension formula coded in the pension security law has been changed which should lead to the increase in pensions (or in a replacement rate) of the top 20 percent of retirees and to the decrease in pensions (or in the replacement rate) of the rest except the bottom 10 percent of participants of the system. Therefore a reduction of the progressivity (redistribution) of the Czech pension security is an anticipated result.

The "small reform" should make the pension security in the Czech Republic more Bismarckian: according to the Lefebvre´s (2007) index of non-contributiveness the Czech

6 The results were obtained with the 1996 data.

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pension security can be characterised rather as Bismarckian.[7] It seems that a shift to the Bismarckian system is a tendency in OECD countries. Using microdata from LIS (period from 1985 to 2000) Krieger and Traub (2008) provided some empirical evidence, but weak, for the increase of the Bismarckian factor and thus the reduction in intragenerational redistribution in the PAYGO pension systems in many OECD countries (the Czech Republic was not included in the dataset).[8] Using empirical analysis and laboratory experiment Krieger and Traub (2008) revealed factors that increased the Bismarckian factor (or decreased intragenerational redistribution) as follows: an increase in the generosity of the pension system, a variance of the income distribution, and an asymmetric increase of the life expectancy in favour of the rich.

Our research investigated extent of the redistribution of the Czech pension security before the "small reform" as well as other changes effective from 2010 using the intragenerational longitudinal approach.[9] The paper proceeds as follows. In the next chapter the method of modelling of the pseudo-panel data is described. Then the lifetime tax paid and the lifetime pension received are derived from the estimated lifetime earnings for all the sample individuals. In the third chapter the results of the analysis of the pension security incidence are presented. We analysed a relationship between the net benefit or the benefit to tax ratio and lifetime income. Moreover, impact on the income inequality was measured using the Gini coefficient. The last chapter concludes.

2. Modelling of the Lifetime Earnings, Pension Security Taxes and Pension Benefits[10]

The analysis of the lifetime incidence is very demanding on input data. Actual individual panel data on incomes, contributions paid and benefits received from the pension security system covering the period from the birth to the death would be ideal. Unfortunately, available data, which researchers can work with, are often far from the ideal conditions. Since mostly cross-section data are available to analysts, the annual incidence studies prevail.

7 The Bismarckian pension system emphasizes the earnings-related component in pensions; the rate of the income replacement is flat in the pure Bismarckian system. An alternative system with the replacement rate decreasing with income rise is called Beveridgean.

8 The more important is the earnings-related part of the pensions, the smaller degree of intragenerational redistribution is supposed.

9 The other changes are a gradual lengthening of the duration of insurance as well as a reference period, and the end of including of study years to the non-contributory periods (the retirement age is also gradually increasing).

10 More details about the modelling of the lifetime earnings, taxes and pensions see in (Klazar and Slintáková, 2008).

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A very useful tool in the absence of the surveyed or administrative longitudinal data is microsimulation model, *i.e.* simulating of lifecycle income profiles for individuals.[11] In addition the microsimulation technique is used to estimate taxes and benefits paid or received by the sample individuals through their life-cycles.[12]

Microsimulation models based on different datasets were used by Coronado, Fullerton and Glass (2000), Liebman (2002) or Gokhale and Kotlikoff (2002) in order to analyse progressivity of the current pension security system or the impact of various reform changes on the pension security system progressivity (all the studies concerned the USA). While Coronado, Fullerton and Glass (2000) or Liebman (2002) used past longitudinal data for individuals or cohorts and then projected future data for their observations, Gokhale and Kotlikoff (2002) produced completely simulated lifetime histories for the sample individuals. (They utilised CORSIM, an extensive dynamic microsimulation model developed by S. Caldwell and his colleagues at Cornell University.) Finally, all the authors simulated the social security payroll taxes and benefits for their sample individuals (*e.g.* Gokhale and Kotlikoff used ESPlanner´s Social Security benefit calculator).

2.1 Simulating of lifetime earnings

Since there is no available suitable source of actual panel data on individuals´ incomes in the Czech Republic we decided to create the pseudo-panel dataset. Studies which constructed pseudo-panel data are reviewed by Sung (2008). He points out that authors of the papers (written between 1993 and 2005) simply brought together aggregate time-series variables which are not convenient for the distribution analysis. Sung (2008) argues that pseudo-panel data for a purpose like that must be micro-based. He demonstrated a construction of the micro-based pseudo-panel dataset under the assumption that the income distribution in each age group is stable over time in statistical sense.

For the simulation we started from actual cross-sectional micro-data on earnings and other characteristics of employees and their employers from Information System on Average Earnings (ISAE hereafter).[13] The 2006 data were processed.

ISAE is a regular sample statistical survey monitoring monetary employee income and working hours. ISAE provides micro-data on more than 3 500 corporations with more than 25 employees, and their employees, *i.e.* approximately 1.3 million individuals (*i.e.*

11 Review of early history of the simulation of the longitudinal data see in (Harding, 1993). Current state of art of dynamic microsimulation models, which enable predict an impact of changes of public pension systems for example, as well as challenges and opportunities for their further development see in (Harding, 2007).

12 The well-known European tax-benefit microsimulation model is EUROMOD.

13 ISAE is elaborated by Trexima Ltd. in charge of the Ministry of Labour and Social Affairs of the Czech Republic. Details are available on their website (http://www.trexima.cz/produkty-a-sluzby/ispv/mzdy). These data are used also by the Czech Statistical Office.

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app. 30 % of the employee population in the Czech Republic).[14] Since the ISAE sample is not representative, and it cannot be weighted based on selected parameters in order to get a representative sample, general conclusions cannot be inferred from results of our analysis. Nevertheless, it was the best source of the micro-data on employees´ incomes in the Czech Republic we could utilise for our purpose.

The aim was to create pseudo-panel data on lifetime earnings for a sample of fictional individuals. The idea of the simulation of the fictional individuals was to divide thousands of real individuals in the ISAE survey into groups specified by characteristics which significantly influence earnings. On the assumption, that there are sufficient numbers of real individuals of different ages in the groups, the groups of real persons can represent the fictional individuals. Furthermore, for the estimation to be of a high quality it was necessary to assume that the variance in incomes of the real individuals with the same characteristics and of the same age is minimal. Finally, we supposed that the shape of lifetime income curves of fictional individuals were stable over time.[15] Then a pseudo income of a fictional individual in a given age can be estimated as an average income of real individuals with the same income-related characteristics and of the given age. A sequence of the average incomes of real individuals of different ages (*e.g.* from age 18 through a retirement age) in the group can be considered as a lifetime earnings of the fictional individual.[16]

The selection of the employee's characteristics, which influence the income, was based on the results of an analysis of a limited sample of micro-data from the ISAE. Based on the one-factor ANOVA we identified the following statistically significant factors that influence the level of income: gender, education, place of employment (*i.e.* Prague as the Czech Republic´s capital or outside Prague), and an occupation. We then estimated a separate earnings regression for each group of individuals characterised by the same values of the gender, education, place, and occupations classification variables. The regression analysis confirmed that ANOVA had determined statistically significant factors which served for specification of the fictional individuals.

The fictional individuals´ lifetime earnings profiles were modelled as follows. To ensure that we get a sufficient number of suitable real individuals, only data for full-time working employees from ISAE were processed. Moreover, since there is

14 There are other sources of statistical data on earnings in the Czech Republic gathered by the Czech Statistical Office, but they provide information about overall sums of earnings on the level of enterprises or organizations, from which it is possible to obtain average earnings as ratios of total earnings to numbers of employees of enterprises or organizations.

15 This means that the fictional individuals have regardless of the year of birth the same shape of a lifetime income profile. In other words a fictional individual who was 20 years old in 2006 should have in 10 years the same income as a 30 years old fictional individual in 2006 (in korunas of 2006). Moreover, the model works well on assumption that income curves applied to various occupations are same.

16 Due to available data our measure of the lifetime income is equal to the employment income only, which is comprised of various monetary components, especially of wages and salaries. Thus the fictional individuals do not have any income from *e.g.* self-employment or property income. Even inheritances, gifts and transfers were not included in the lifetime income in our model.

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a significant variation in incomes between employees working in Prague and those working outside Prague (except those with primary education), the Prague employees were excluded from the analysis. Similarly, data on employees working in the segment "Financial services" were excluded because wages in this segment differ markedly from wages of employees in other industries. Remaining employees were divided into six groups by the variables determined by ANOVA: by gender (2 groups), and by education (3 groups: primary, secondary and tertiary education).[17] We next categorised the employees of the same gender and education by the classification of occupations.[18] For the purpose of our analysis as much sub-groups of occupations were identified as 80 % of the ISAE full-time employees, excluding those working in Prague or in the field of "Financial services". The outcome of the whole procedure described was 331 groups of real employees covered by ISAE whose incomes served for the modelling of lifetime earnings profiles of the fictional individuals.

Once we had the groups of employees of the same gender, education and occupation we ranked the persons in the sets in order of age, and calculated average earnings for the persons of the same age. Since not every person had to work twelve months a year, values of monthly gross incomes of real employees were used in the computations. The persons ranked by age within each group represented the fictional individual in particular years of his/her economic life. The sequence of the average incomes in the group could be then called the pseudo lifetime earnings profile of the fictional individual. Distribution of 331 fictional individuals by gender and education is summarised in Table 1.

Table 1

Distribution of the Fictional Individuals by Gender and Education

Gender / Education level	Primary	Secondary	Tertiary
Women	51	59	40
Men	65	75	41

Source: own calculation

Subsequently we derived the pension security taxes paid during an economic lifetime, and the old age pension received during the retirement period from the simulated earnings for each fictional individual.

17 Individuals with the first stage of the tertiary education (*i.e.* ISCED 5B level according to the International Standard Classification of Education) were included into the group of the secondary education because their wages were close to wages of persons with the secondary education than those with the tertiary education.

18 Classification of occupations KZAM, introduced by the Czech Statistical Office, has been elaborated on the basis of international standard ISCO-88. There are 499 sub-groups of occupations in the KZAM classification.

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2.2 Calculation of the present value of the lifetime pension security tax

We assumed that the fictional sample people worked and retired under the constant system of the pension security which corresponds to the pension security law valid in 2006 or 2007 because 2006 was considered as the final year of the economic lifetime of the fictional individuals, and 2007 as the first year of their retirement. The results are relevant since the pension security law in that time was similar to the law before the changes in 2010 or 2011.

The contributions to the security scheme were calculated following the provisions of the social security law valid in 2006. The present value of the lifetime tax (**TAX**) was calculated as a sum of annual taxes when the annual tax is a percentage share of the annual income [which is a product of the average monthly earnings as modelled above (**y**) and **12**]. The payroll tax was linear because the tax was levied at a flat rate (there was no cap on taxable income in 2006) and because it has no personal deductions or credits: $\mathbf{T_{TAX}}$ is the rate of tax. The final factor in the calculation is a probability to survive $\mathbf{a_t}$:

$$\mathbf{TAX} = \sum_{t=1}^{N} 12 y_t T_{TAX} a_t \tag{1}$$

where **t** is the year of the economic lifetime: **1** is the beginning of the economic lifetime and **N** means the last year of the economic lifetime.

The monthly earnings include a range of monetary components of the employee income, some of them are not taxable. Since it was not possible to exclude these non-taxable components the tax can be overestimated in some cases, but not significantly.[19] Furthermore, we assumed that ratios among wages of employees of different ages in a given year could be an appropriate proxy for a historical growth of wages. That means that the stable shape of the lifetime earnings function over time was supposed, and that nominal earnings of differently old persons living in the present were considered as present values of earnings gained by the fictional individual in the past.[20] Therefore it was not necessary to index earnings from the past to the present value.

A number of years of the economic lifetime (working years), when an employee participates in the pension security as well as contributes to the system, is relevant for a correct estimation of the lifetime tax. In order to fix the number of the working years it was necessary to determine the beginning and the end of the economic lifetime. This was done regardless when the real employees started their working careers. By examining numbers of real employees in the first years of their economic lifetimes we determined the age when a significant share of the population had started to work (because the average earnings would not have been correct otherwise) as follows:

19 On the other hand, the income comprising all the monetary components reflects individual´s well-being more accurately.

20 For example, the present value of the earnings of a fictional individual from 1984, when he was 40 years old, was assumed to be equal to the (average) earnings of real employees of the age of 40 in 2006 with the same characteristics as mentioned above (*i.e.* gender, education *etc.*).

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age of 18 for the employees with the primary education, age of 19 for the employees with the secondary education and age of 23 for employees with the tertiary education. The age prior the age of leaving for the retirement was determined as the end of the fictional individual´s economic lifetime. We assumed all the fictional individuals want to choose the normal retirement age which was in 2006 for men 62 years, and 59 years for women with one child on average. It is evident that the choice of both the beginning and the end years was arbitrary: it depended on the data availability and the need to estimate statistically relevant average earnings. Moreover, we did not simulate any breaks due to *e.g.* maternity, illness or unemployment, in the economic lifetimes of our fictional people.

The pension security statutory tax rates were 6.5 % for employees and 21.5 % for employers. Since we focused only on the retirement portion of the system we adjusted these rates for our calculations. The employee´s tax rate was reduced to 4.55 %, and the employer´s tax rate to 15.05 %.

From the methodological point of view it is correct to analyse all the costs and benefits related to the pension security which are borne by the employees. Based on results of foreign studies we assumed a full shifting of the employers´ tax on employees in the long term as our analysis concerns long-run period and as it is static as well. We did not take into account any dynamic changes in the system of the pension security tax payment.[21] We supposed the fictional individuals to bear the tax paid by the employers because they expect benefits in the form of pensions. As a consequence of the economic incidence of the employers´ tax the estimated lifetime earnings of the fictional individuals are lower than they would be if there was no shifting.

Finally, as not all the individuals live up to the retirement age, and thus they do not contribute to the system for their whole economic lifetime, we added to the calculation of the lifetime tax the variable $\mathbf{a_t}$ that is probability to survive at least until to the year of the economic lifetime **t** given the individual survives until the beginning of the economic lifetime (**t = 1**), see (Berkel and Boersch-Supan, 2004). This probability reflects both gender and education in the Czech Republic according to Mazouch and Fischer (2007).

2.3 Calculation of the present value of the lifetime old age pension

The old age pension was calculated according to the rules valid in 2007. The fictional individuals were supposed to fulfil both conditions in order to obtain the old age pension: to achieve the retirement age and a necessary duration of insurance. The present value of the lifetime pension (**PENSION**), the fictional individual received from the pension security during her/his retirement, is a product of a monthly pension

21 See (Ricardo-Campbell, 1977); (Bell, Jones and Thomas, 2002); (Feldstein and Liebman, 2002); (Tax Foundation, 1966).

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(in the square brackets below) and a number of months spent in the retirement (**M**), adjusted by the probability to survive (**b**):

$$PENSION = [(B_{PENSION} * T_{PENSION}) + BP] * M * b \quad (2)$$

The monthly pension consists of two components. The solidarity principle, which leads to equalisation of pensions, is represented by a flat component, *i.e.* the basic pension (**BP**).[22] The second, earnings-related component should reflect primarily the benefit principle. It is proportional to the basis ($\mathbf{B_{PENSION}}$), which is derived from the earnings, at a certain rate ($\mathbf{T_{PENSION}}$). However, as the earnings served as the basis are reduced, according to the formula described below, the solidarity principle is incorporated partly also in the second component.

The basis ($\mathbf{B_{PENSION}}$) is a monthly average of indexed earnings gained during the so called reference period which is a part of the employee´s economic lifetime. Similarly as in the case of the tax calculation in Chapter 2.2, the modelled earnings can include components which should not be added up to the basis for the pension calculation. Since it was not possible to exclude these components from the calculation, we had to assume that there are no such components included in the earnings. Furthermore, incomes earned by the fictional individuals in particular years of their reference periods did not need to be updated to the year prior the year of leaving for retirement (*i.e.* 2006) because we assumed that the 2006 wages of ISAE real employees of different ages were equal to indexed past wages earned by the fictional individuals in particular years of their careers.

The reference period, during which income earned is considered for the pension basis calculation, was 21 years for our fictional individuals who retired in 2007. The reference period length, provided by the law, started in 1986 and ended in the year of leaving for retirement. The years of the economic lifetime before 1986 were dropped.

The monthly average of the indexed earnings for the reference period must be reduced according to the progressive formula. It means that the basis is calculated as 100 % of income up to the first bend point, plus 30 % of income in excess of the first bend point but less than the second bend point, plus 10 % of income in excess of the second bend point.[23]

The reduced basis is multiplied by a rate ($\mathbf{T_{PENSION}}$) which is a product of 0.015 and a number of years of the economic lifetime when the employee earns and simultaneously pays the tax into the pension security scheme. As stated in Chapter 2.2 the economic lifetime is bounded on one side by leaving the school and on the other side by leaving for the retirement. Assuming the fictional individuals had finished their

22 The basic pension was CZK 1,570 in 2007. It is CZK 2,270 in 2012.

23 The first bend point was 9 600 CZK and the second one was 23 300 CZK in 2007. The "small reform" raised the bend points to 11 061 CZK (44 % of average wage) and 29 159 CZK (116 % of average wage) and added the third bend point equal to 100 548 CZK (400 % of average wage) for the year 2012.

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formal education not later than December 31, 1995, we added up years of schooling as a non-contributory period to the number of years of the economic lifetime.[24]

Based on the simplified procedure of the calculation of the old age pension in 2007 we obtained the present values of monthly pensions for our fictional individuals. Comparison of the actual pensions, to which persons were entitled in 2007, with the averages of our estimated values proved that our modelled earnings are acceptable approximation.

To get the lifetime pension the monthly pension (its present value) had to be multiplied by a number of months of the retirement. A length of retirement depends on time to retire and time of death. As mentioned above all the fictional individuals retired at the normal retirement age if alive. To determine the time of death for particular individuals, we used mortality tables differentiated by gender and education.[25] Duration of the retirement for men and women of different education is shown in Table 2.

Table 2

Duration of Retirement (in years)

Gender / Education level	Primary	Secondary	Tertiary
Women	22.95	25.7	26.2
Men	15.6	19.8	21.7

Sources: Mazouch, J., Fischer, J. (2007), and ČSÚ, Úmrtnostní tabulky [on-line]. Praha: ČSÚ. Available on http://www.czso.cz/csu/redakce.nsf/i/umrtnostni_tabulky [cit. 2008-09-01]

To take into account the fact that not everyone lives up to the retirement age, we adjusted the lifetime pension by the probability to survive at least until the end of the economic lifetime given the individual survives until the beginning of the economic lifetime (**b**). The probability reflects both gender and education according to Mazouch and Fischer (2007). If the individual survives then she/he is assumed to receive the pension during the whole retirement.[26]

The difference between the lifetime pension and the lifetime tax (their present values) was defined as the net benefit of the pension security. Another measure was the ratio of the lifetime pension to the lifetime tax (the pension-tax ratio hereafter). Both the net benefit and the pension-tax ratio were calculated for all the fictional individuals.

24 Different rules for the figuring of the years of schooling as the non-contributory period are applied for people graduated after January 1, 1996. Moreover, any further non-contributory periods were not considered.

25 It would be reasonable to have mortality tables differentiated also by income, because it is said that the rich tend to live longer, however, we did not have such tables at our disposal.

26 Survivor pensions of living spouses were ignored.

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3. Redistribution Analysis of the Czech Pension Security

First we examined net benefits and the pension-tax ratios of the fictional individuals ranked by their well-being in order to find out whose benefits were covered by their own contributions and whose ones had to be financed from contributions of their fellow-citizens. For the purpose of our analysis we constructed a measure of the well-being which captures only earnings relevant for the pension calculation, *i.e*. income earned during the reference period. In addition, the individual earnings (their average) were related to the average wage in 2006 (derived from general assessment base[27]) in order to obtain a well-being index which expresses a position of an individual in relation to the others. In case the well-being index equals one an individual had an average income. In case the index exceeds one, then the individual had a higher than average income and *vice versa*. As it is seen from the figures below the majority of fictional individuals have the index above one. There are three reasons for it: first, the average wage used in the well-being index was derived from the general assessment base, which was lower than an actual average wage, second, the ISAE sample is not strictly representative, and third the nominator of the index corresponds to incomes of the reference period (*i.e.* the second half of the economic lifetime) of the fictional individuals when their incomes were usually higher than the incomes in the first half of the economic lifetime (more details see below).

The relationship between the net benefit from the pension security, expressed as a monetary amount, and the well-being is presented in Figure 1. The pension-tax ratio is related to the well-being in Figure 2. The tax was calculated using the employee´s tax rate, *i.e*. only contributions individuals paid out of their pockets were taken into account in order to show an effect of the system on the employee´s personal budget. Separate curves for males (**M**) and females (**F**) further distinguished by education (**1** = primary, **2** = secondary, **3** = tertiary education) are seen in the figures.

It is obvious from Figure 1 that all our fictional persons are net beneficiaries (*i.e.* they have a positive net benefit) of the pension security if only their tax shares are considered. Due to the progressive formula (*i.e*. setting of the bend points) the maximum ”profit“ (within the group specified by gender and education) is assigned to individuals with income a little above the average. For the higher-income persons the ”profit“ is decreasing. Consistently the pension-tax ratio is more than one for all the persons, and is decreasing within all the range. Furthermore, women are better off than men with the same well-being and education. Even less educated women are better off than more educated men of the same welfare in some cases.

27 General assessment base for benefits in time t corresponds to the average wage in economy in t-2 (after some minor adjustments). Pension benefits and other payments are derived from this variable.

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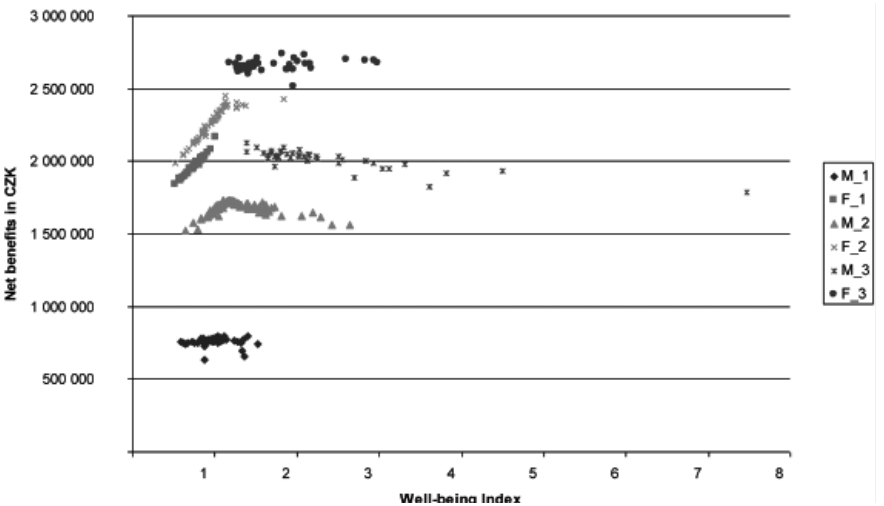
Figure 1

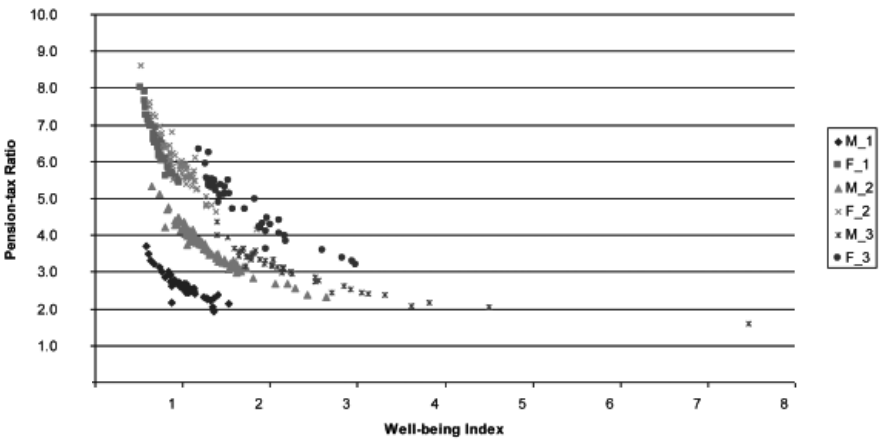
Net Benefit (in CZK) by Well-being (with the employee´s tax rate)



Source: own calculation

Figure 2

Pension-tax Ratio by Well-being (with the employee´s tax rate)



Source: own calculation

Since the employees were assumed to bear the entire burden of the payroll tax, even though a part of it is levied on the employers, the total tax, comprising both employee´s and employer´s shares, should be included in the calculations of the net benefits (and pension-tax ratios). Consequently a different distribution of ”profits“ (and ”rates of return“) can be observed from Figures 3 and 4.

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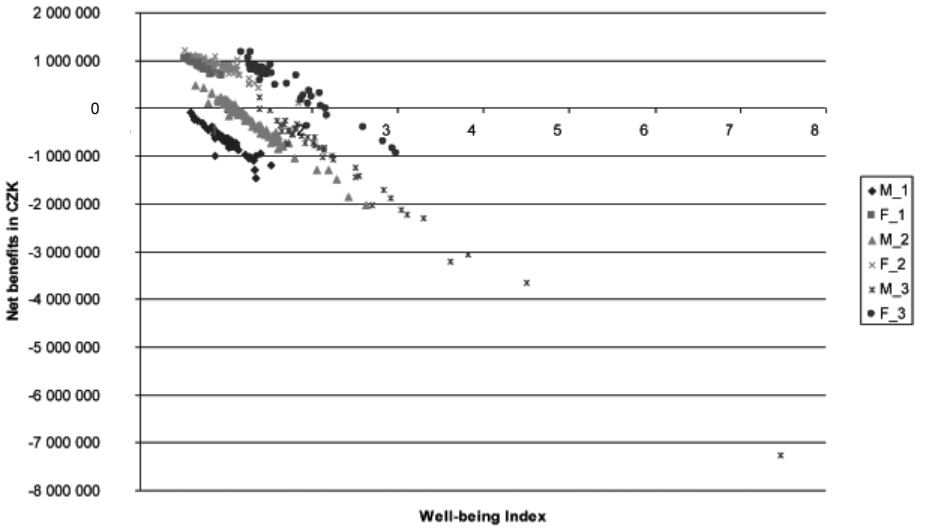
Figure 3

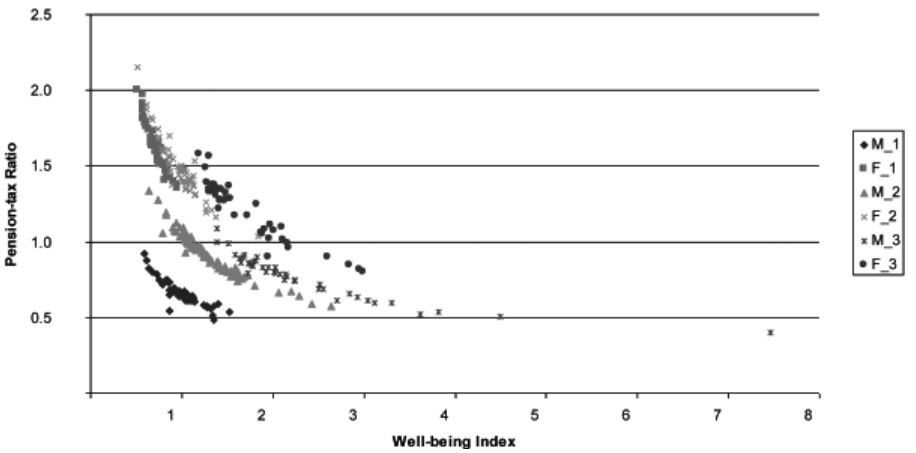
Net Benefit (in CZK) by Well-being (with the total tax rate)



Source: own calculation

Figure 4

Pension-tax Ratio by Well-being (with the total tax rate)



Source: own calculation

Most of men and a few well-educated women turned to be losers (*i.e.* their net benefits become negative and the pension-tax ratios are below one) after the total tax was included. The pension security remained favourable toward the most of women and a few lower-income men with the secondary and tertiary education. Furthermore, the "profit" is decreasing or the "loss" is increasing with the well-being increase.

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Figures 3 and 4 show that the pension security scheme benefits the low-income individuals: their pensions promised by the law must be financed partly from the funds collected from the higher-income individuals. Simultaneously the higher-income individuals do not receive as much as they paid. This outcome is caused by the progressive pension formula reducing earnings, which serve as a basis for the calculation of the pension, while there is a linear relationship between the tax and the earnings. Moreover, the higher earnings are reduced by a higher rate than the lower ones.

Solidarity of men with women through the pension security scheme may be a consequence of the difference in the retirement ages and in the life expectancies.[28] The lower retirement age and the higher life expectancy for women result in a longer period when women receive pensions.

Finally, we hypothesize that a setting of the reference period in combination with the shape of the lifetime income function may affect the redistributive effect of the pension security. The reference period is defined as a period during which income earned is considered for the pension basis calculation; under the 2007 law the reference period corresponded more or less to the second half of an employee´s economic lifetime. To examine impact of the reference period we analysed the shape of the earnings profiles over the lifetime for our fictional individuals with different well-being. We found out that average earnings rise as the individuals get older. Almost all the individuals had higher average earnings in the second half of their economic lifetimes, *i.e.* just during the reference period. However, the growth of earnings in the second half of the economic lifetime was significantly higher for the higher-income individuals or for those with a higher/est level of education; for those with primary education the growth was minimal. In case of the faster growing function of the lifetime earnings of the higher-income persons in the last years of their economic lifetimes the setting of the reference period results in diminution in the redistributive effect of the progressive pension formula. The progressivity of the pension security can also be weakened by the higher probability to live longer of better educated individuals who are supposed to have the higher lifetime earnings. On the contrary the lower-income individuals are less likely to begin to receive the pensions and if they do, they do so for a shorter period of time.

In the next step we measured effect of the pension security on the inequality of our fictional individuals´ lifetime earnings using the Gini coefficient, and Thin-Musgrave index. The Gini coefficient is:

$$G = \frac{\sum_{i=1}^{n}\sum_{r=1}^{n}\left|y_i - y_r\right|}{2n^2\bar{y}} \tag{3}$$

where $\mathbf{n}$ is a number of individuals, $\mathbf{y_i}$ is income of individual $\mathbf{i}$, $\mathbf{y_r}$ is income of individual $\mathbf{r}$ and $\bar{y} = \mathbf{(1/n)} \sum \mathbf{y_i}$.

28 The retirement age should be unified in the future.

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The Gini coefficient was calculated for the distribution of the lifetime earnings before the tax is deducted from the income and pensions are received and added up to the income. Then the Gini coefficient was calculated for the distribution of the lifetime earnings after paying of the tax and receiving of the pensions, *i.e*. the lifetime earnings modelled in Chapter 2.1 were increased by the net benefits. The Gini coefficient was computed for three variants of the lifetime earnings after the supplementing of the net benefit. First the pensions were calculated using the current formula when only income earned during the reference period is relevant. Second the pensions were computed on assumption that earnings from each year of the economic lifetime are considered. The present value of the lifetime tax was determined at the employee´s tax rate in both the two variants. The present value of the lifetime tax calculated at the total rate while the current pension formula was used in the third variant. The coefficients for particular income concepts are reported in Table 3.

Table 3

Gini Coefficients for Income Distribution before and after the Pension Security

	Gini coefficient	EP
Lifetime earnings before	0.2122998	
Lifetime earnings after		
- variant 1	0.18341242	1.036673064
- variant 2	0.18017756	1.040779779
- variant 3	0.17655548	1.045378077

Source: own calculation

According to the Gini coefficients the pension security reduces the inequality of lifetime earnings. Moreover, the Gini coefficient for the second variant suggests than the extension of the reference period would make the lifetime income after the tax payment and benefits receipt even more equally distributed than under the current state (*i.e*. Variant 1). Considering the current pension formula and the entire payment contributed by both employees and employers (*i.e*. Variant 3) the pension security has the largest effect on the income inequality.

On the basis of the Gini coefficients measuring the inequality of the income before and after the pension security the Thin-Musgrave index of effective progressivity was constructed as follows:

$$EP = (1-G_{after}) / (1-G_{before}) \tag{4}$$

The Thin-Musgrave indices of effective progressivity for all the variants are in the last column of Table 3. Value of EP exceeding 1 indicates a progressive effect of the pension security.

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4. Conclusions

The negative correlation between the present values of the net benefits and the lifetime well-being proved that the Czech pension security before the reforms (small or great) has been progressive. That means that the pension security has redistributed the funds collected through the pension security taxes within one generation from the higher-income people to the lower-income ones as well as from men to women. Moreover, the Gini coefficients confirmed that the lifetime incomes after the impact of the social security has been more equal than ”market“ incomes. Our results achieved with the intragenerational longitudinal approach are consistent with those of Lefebvre (2007) who used the cross-sectional approach to analyse the redistributional effect of the social security.

We incline to explain the results of our lifetime incidence analysis by interrelated influence of the pension formula and the shape of the lifelong earnings function. As it is asserted the progressive pension formula turned out to be an important source of the intracohort redistribution. In particular, the flat component of the pension and the reduction of the basis have the solidarity effect. However, the reference period covering just the second half of the economic lifetime, when the higher-income employees have even higher earnings, in comparison with the first half of the economic lifetime than the lower-income persons, counteracts the progressivity of the formula. Furthermore, a certain share of the redistribution provided by the progressive benefit formula can be offset by the higher mortality rates of the lower-educated, and thus lower-income, individuals. Finally, the fact that women receive a pension for a longer period than men – because they retire earlier and live for a longer time – could be a reason underlying the redistribution between men and women.

On the basis of our results we can predict that the lengthening of the reference period will enhance the solidarity of the Czech pension security. Assuming the lifetime income functions will not change, the redistributive effect of the pension security, when earnings for every year of an individual´s economic lifetime are relevant for the pension calculation, would be higher than the redistributive effect of the current scheme because the higher-income individuals will have relatively lower pensions. On the other hand, the increase in the bend points in the pension formula will reduce the degree of the progressivity as it will improve the pensions of the top earners. Moreover, if the rich will live longer they will benefit more from the retirement arrangements and this will make the pension system less progressive.[29] However, even if the Czech pension security became more Bismarckian it could be actually still redistributive because the Bismarckian system tends to obtain a larger political support than the Beveridgean one and thus is more generous (see Lefebvre, 2007).

Limitation of our research is that results were acquired with the pseudo-panel data for the fictional individuals though modelled using the cross-sectional data on real employees gathered by a special statistical survey monitoring various variables

29 For details about the influence of the positive effect of income on life expectancy on the redistribution see (Krieger and Traub, 2008).

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describing the Czech employees including their earnings. We had to simplify reality in that the shape of the lifetime earnings function is stable over time which enabled us to consider the nominal earnings of differently old real persons living in the present as the present values of earnings gained by the fictional persons in the past. Moreover, although we tried to estimate the lifetime taxes and pensions of the fictional individuals as accurate as possible the data did not allow us to take into account all the details of construction of the tax or pension. On the other hand, our calculations involved different probabilities to survive according to gender and education.

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