Incidence Analysis of Pension Security in The Czech Republic[1]

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Abstract

We sought to identify who is a net beneficiary of the pension security scheme in the Czech Republic over a lifetime and how much the public insurance scheme redistributes from rich to poor who are classified by the lifetime income. Since there is no suitable Czech panel data we modelled pseudo-panel data on lifetime earnings of fictional individuals from which contributions paid to and benefits received from the scheme were derived. The analysis showed that the pension security is progressive. Lower-income individuals receive higher net benefit. Moreover, the pension security reduces income inequality and redistributes from men to women.

Key words: pension system, lifetime incidence, Gini coeficient, Thin-Musgrave index.

JEL: H23, H55

1. Introduction

The pension security is a compulsory paygo scheme providing a retirement income in the Czech Republic. Its objective is to ensure an adequate living standard of the citizens especially in old age. The pension security is a part of public budgets in the Czech Republic; a pension security tax is revenue of the state budget and it constitutes about one third of its total revenues. Persons participating in the system are after fulfillment of given conditions eligible to retirement, disability or survivor pension. Both employees and the self-employed participate. It simultaneously means that they are obliged to pay the pension security tax. Next to them the employers contribute to the system as well. In our analysis we presuppose that only retirement pensions are paid out from the pension security scheme, although they actually form about 60 % of all the pensions. In addition, due to available data our analysis focuses on the pension security of employees only.

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The pension security scheme can be considered as an alternative to a retirement savings programme because individuals paying contributions to the system during their economic lifetime are eligible to pensions when they are retired. Both the contribution and the pension are derived from individual´s earnings: while the contribution is proportional to the earnings, the pension is rather regressive. The solidarity principle can be manifested this way besides the benefit principle. As a consequence the benefit formula should lead to redistribution from individuals with higher incomes to individuals with lower incomes.

We analysed the pension security in the context of a life-cycle model. Our goal was to find out who is a net beneficiary of the pension security over a lifetime and how much this public insurance scheme redistributes from rich to poor who are classified by the lifetime income. To accomplish this goal we have calculated the difference (and the ratio) between the present value of a lifetime benefit received from the security scheme, and the present value of a lifetime tax paid to the security scheme and we have analysed the relationship between a net benefit and lifetime income of the individuals involved. Moreover, we have examined effect of the net benefit on income inequality using the Gini coefficient as well as the GE measure.

The analysis of a lifelong incidence is very demanding on input data. Panel data covering a long period are convenient for this type of analysis, for example Panel Study of Income Dynamics (PSID) which was used by [1] or [2]. Estimating wage function or earnings regressions they generated out-of-sample earnings observations in order to complete actual panel data and to obtain lifetime income profiles for the sample individuals covered the period from age 22 through the retirement age.

Another approach was chosen by [3] who used cross-sectional data on the distribution of income within different age groups to model the lifelong incomes. The model of the individual income contains a systematic element which reflects the trend of the mean income in a group and a random element which represents the income mobility. Furthermore, [4] developed a dynamic microsimulation model to simulate necessary factors describing individual´s life cycle. Finally, [5] constructed micro-based pseudo-panel data set under the assumption that the income distribution in each age group is stable over time in statistical sense.

There are no available panel data on lifetime earnings in the Czech Republic so far. Therefore a crucial task of our research was to model necessary data. We attempted to estimate the pseudo-panel data on the basis of cross-sectional data. We used actual data from the Information System on Average Earnings, the survey covering employers and their employees in the Czech Republic (the limited coverage of the survey is a cause why the unit of our analysis is an employee although the self-employed participate in the pension security system as well), and we simulated lifetime earnings for a pseudo-sample of fictional individuals. Subsequently, we derived the pension security tax paid during a economic lifetime, and the retirement pension received during the retirement period from the

simulated earnings for each fictional individual in order to compute each individual´s net benefit of the pension security, and to analyse progressivity of the pension security in the Czech Republic.

As the 2006 data were elaborated, 2006 was considered as the final year of the economic lifetime of the fictional individuals, and 2007 as the first year of their retirement. We assumed that all the fictional individuals participating in the pension security survive the age of retirement and start to draw a pension. Their contributions to the security scheme were calculated according to the legislation valid in 2006 based on the assumption that the income side of the pension security system was during the whole period of economic activity of the fictional individuals given as in 2006. The retirement pensions were calculated according to the rules valid in 2007. Our research thus examines the lifetime incidence of the current pension security scheme in the conditions given by the current earnings level in the economy. In addition, our analysis looks at the long-run redistributive effects within a generation rather than between generations.

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 analysed individuals. In the third chapter the results of the analysis of the pension security incidence are presented.

2. Estimation of the lifetime earnings and the net benefit from the pension security

2.1 Estimation of lifetime earnings

Instead of actual panel data on incomes, taxes and pensions of individuals we used for our analysis modelled data on incomes which served as a basis for estimation of paid taxes and received pensions. For the simulation we started from actual cross-sectional data on earnings and other characteristics of employees from Information System on Average Earnings (ISAE hereafter) which is elaborated by Trexima Ltd in charge of the Ministry of Labour and Social Affairs of the Czech Republic. 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. (Trexima collects also data on non-profit organizations but they were not processed.) 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 is the best source of data in the Czech Republic so far we could utilise for the purpose of our analysis.

The basic idea was to create pseudo-panel data on incomes for fictional individuals based on cross-sectional data on real employees on the assumption that there is a sufficient number of real individuals of different age but with the same characteristics, which significantly influence the income, in the

ISAE sample. In addition, 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. 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 characteristics, and of the given age. A sequence of the average incomes of real individuals of different age (e. g. from age 18 through a retirement age) can be considered as a lifetime earnings of a fictional individual.

Due to available data our measure of the lifetime income is equal to the employee income only which is comprised of various monetary components, especially of wages and salaries. Thus the fictional individuals don´t have any other income during their life cycle, e. g. income from self-employment or property income. Moreover, it is assumed that they do not receive any social benefits during their economic lifetime. Finally, even inheritances or gifts are not included in the lifetime income in our model.

The ISAE gave us one-year income data (i. e. data on 2006 earnings). Therefore the fictional individuals´ lifetime income curves are stable over time in our model. 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 is 20 years old in 2006 should have in 10 years the same income as a 30 years old fictional individual in 2006. Moreover, the model works well on assumption that income curves applied to various occupations are the same.

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 statistical 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 a significant variation in incomes between employees working in Prague and those working outside Prague, 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 with other occupations. Remaining employees were divided into six groups by the variables determined by ANOVA: by gender (2 groups), and by education (3 groups according to International Standard Classification of Education: 1) ISCED 3C level, 2) ISCED 3A, 3B or ISCED 4 or ISCED 5B levels, 3) ISCED 5A

level). We next categorised the employees of the same gender and education by the classification of occupations. There are 499 sub-groups of occupations in the classification. For the purpose of our analysis as much sub-groups were identified as 80 % of the ISAE full-time employees excluding those working in Prague or in the field of „Financial services" were covered in our model. The outcome of the procedure has been 331 real employees data sets which served for the modelling of the fictional individuals´ lifetime earnings profiles. Distribution of the fictional individuals by gender and education is summarised in Table 1.

Table 1 – Distribution of the fictional individuals by gender and education

gender / education	ISCED 3C	ISCED 3A, 3B or ISCED 4 or ISCED 5B	ISCED 5A
women	51	59	40
men	65	75	41

Once we had a data set for employees of the same gender, education and occupation we ranked the persons 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 sequence of the average incomes is the pseudo lifetime earnings profile of a fictional individual. Table 2 (the second column) shows a segment of the pseudo earnings profile of a man educated on the ISCED 3C level, full-time working outside Prague, and using machine tools as his occupation. This fictional person represents 17 319 real men in age from 18 to 65, characterised by these education and occupation. There are numbers of real men whose data were processed to simulate the fictional individual´s lifetime income in the third column of Table 2.

The earnings regression for each pseudo lifetime income profile was estimated as:

$$\mathbf{y_t = a + b\,t + c\,t^2,}$$

where $\mathbf{y_t}$ is average monthly earnings in CZK in age **t**, and **a, b, c** are regression coefficients. The earnings regression of the fictional individual No 306 in Table 2 is:

$$\mathbf{y_t = 4\,596 + 805\,t - 9\,t^2}.$$

Table 2 – Segment of the fictional individual No 306´s earnings profile

Age	Average monthly earnings in CZK*	Number of real employees	Standard deviation in CZK
29	21 784	441	5 683
30	21 974	481	5 849
31	22 158	526	5 691

32	22 117	529	6 054
33	22 555	558	6 434
34	21 655	432	5 586
35	22 225	423	6 975
36	22 007	403	5 811
37	22 279	361	5 776
38	21 755	391	5 765
39	21 732	386	5 684
40	21 499	401	5 830

* 1 EUR was app. 27,5 CZK in December 2006.

The pseudo-panel data on income, obtained by the procedure described above, served as input data for calculation of the taxes paid by the fictional persons to the pension security scheme during their economic lifetimes (see chapter 2.2), and the expected benefits the fictional persons receive from the scheme during retirement (see chapter 2.3).

2.2 Estimation of the lifetime tax

The taxes paid by the fictional individual during her/his economic lifetime were calculated following the provisions of the social security law at the state valid in 2006. The present value of the lifetime tax (**TAX**) was calculated as a sum of annual taxes when an 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; $\mathbf{T_{TAX}}$ is the rate of tax:

$$\mathbf{TAX} = \sum_{t=1}^{N} 12 y_t \mathrm{T}_{\mathrm{TAX}}$$

Since the pseudo data were derived from actual data for year 2006, and year 2006 was the last year of the economic lifetime of our fictional individuals, when they contributed to the pension security system, it was not necessary to index earnings from the past to the present value on assumption that a growth of wages equals a rate of return of capital. For example, the present value of the earnings of our fictional individual No 306´s in 1984 when he was 40 years old is equal to the (average) nominal earnings of real employees of the age of 40 in 2006.

The monthly earnings includes a range of monetary components of the employee income. We believe that substantial amount of the income is taxable, i. e. it is a basis for calculation of the pension security tax. However the total remuneration received from an employer can include also components which are not taxable for the purpose of the tax. Unfortunately, it was not possible to exclude these components from the calculation, and therefore the tax can be overestimated in some cases, but not significantly. On the other hand, the income comprising all the monetary components reflects individual´s well-being more accurately. Moreover, there was no cap on the taxable income in 2006 – the tax was collected on the whole taxable income.

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 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 career. Examining numbers of real employees in the first years of their economic lifetimes we determined the age when a significant share of the population has started to work (because the average earnings would not have been correct otherwise) as follows: for the least educated employees age of 18, for employees with the secondary and upper education age of 19 and for employees with higher education age of 23. The age of retirement, which differs between gender, we determined as the last year of the fictional individuals economic lifetimes. We assumed all the fictional individuals 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 is arbitrary: it is dependent on the data availability and the need to estimate statistically relevant average earnings.

The tax is deducted from the employee income at a rate of 6,5 %. An employer contributes additional 21,5 % of the income. We assumed that the rates of the tax has not changed during the entire period of the working life of our fictional individuals and were at the 2006 level. This assumption can be defended in case when analysing incidence of the current pension security system. (It would be impossible to calculate with historical rates, especially for the period before 1993 when the current system of social security was implemented in the Czech Republic.)

It is questionable whether to use only the employee share of the tax or the combined employee and employer portions which total 28 % of the employee income. From the methodological point of view ([6], [7]) it is correct to analyse all the costs and benefits related to the pension security which are borne by the employees. In the short-run period we can expect no shifting of the employers tax as possibilities to react to a change are limited. In the long-run period, however, the tax levied on the employers can be passed backwards and borne by the employees. Analyses of the economic incidence on the employers tax are for example based on an indirect method when the employment before and after the change in the tax is observed. If labour costs change due to the change in the tax statutorily

levied on the employers then decrease of the employment is a prove of (a partial) substitution effect, i. e. employees decreased their supply of labour. This proves that their supply curve is not fully non-elastic and therefore they managed to protect themselves from the tax shifting. In case of no change in the employment the labour supply is non-elastic and thus employees bear the whole additional tax. However, even with some degree of labour supply elasticity it is possible that the tax is fully passed on employees because it is plausible to assume that the tax burden is to some extent compensated in the form of future benefits from the pension security. Therefore employees´ endeavour to defend themselves before the shifting is weakened and they are disposed to working more for a lower remuneration.

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. 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. We assumed that the fictional individuals bear the tax paid by employers because they expect benefit in the form of a pension. (We ignored that the employer´s portion of the tax was deductible against the income tax.) Nevertheless, we did both calculations of the net benefit of the pension security. The analysis which uses the tax rate 6,5 % shows effect of the system on employee´s personal budget. The analysis which uses the entire amount of the tax (28 %) gives the information on the total impact of the system.

In table 3 we see average present values of the lifetime taxes for women and men by level of education. The tax was calculated with the 6,5 % rate. There is evident positive relationship between the tax and education. Moreover, men pay more than women.

Table 3 – Average present value of the lifetime tax in CZK

gender / education	ISCED 3C	ISCED 3A, 3B or ISCED 4 or ISCED 5B	ISCED 5A
women	458 674	577 049	894 651
men	663 387	818 811	1 314 501

2.3 Estimation of the lifetime pension

Our calculation of the old age pension followed the provisions of the social security law at the state valid in 2007. The present value of the lifetime pension (**PENSION**), a fictional individual receives from the pension security in old age, is a product of a monthly pension and a number of months spent in the retirement (**M**):

$$\mathbf{PENSION = [(B_{PENSION} \times T_{PENSION}) + BP] \times M.}$$

The monthly pension consists of two components. The solidarity principle is represented by a fixed amount of a basic pension (**BP**) which leads to equalisation of pensions (the basic pension was 1 570 CZK in 2007). Moreover this principle is also incorporated in the second component which should be proportional to the earnings at a certain rate ($\mathbf{T_{PENSION}}$) and thus should reflect primarily the benefit principle. The earnings serve as a basis for the pension calculation. However the basis ($\mathbf{B_{PENSION}}$) is derived from the earnings using a regressive formula (see below).

The basis is a monthly average of indexed earnings gained during so called decisive period which is a part of an employee´s economic lifetime. The earnings to be considered for the basis calculation were modelled as described in chapter 2.1. Similarly as in the case of the tax calculation in chapter 2.2 the earnings can include some 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. On the other hand, the advantage of our pseudo-panel data based on the actual 2006 cross-sectional data is that incomes earned by employees in particular years of their economic lifetime did not need to be indexed to an average wage in the year prior the year of leaving for retirement (i. e. 2006).

The decisive period, during which income earned is considered for the pension basis calculation, is 21 years for our fictional individuals who retire in 2007. The decisive period length, provided by the law, starts in 1986 and ends in the year of leaving for retirement. The years of the economic lifetime before 1986 are dropped. Moreover, the decisive period should not include days when an employee doesn´t earn, for example when he/she is ill, unemployed or caring for a child. Since ISAE survey doesn´t provide information about these days, we ignored them. However the bias of the pensions calculated for our fictional individuals caused this way may be minimal because of using average values of earnings to model the pseudo earnings.

In order to obtain a proper basis for the pension calculation, the monthly average of the indexed earnings for the decisive period must be reduced according to the regressive formula. It means that the basis is calculated as 100 % of income up to the first bend point (i. e. 9 600 CZK), plus 30 % of income in excess of the first bend point but less than the second bend point (i. e. 23 300 CZK), plus 10 % of income in excess of that second bend point. For example, if income is 25 000 CZK, the basis is:

$$\mathbf{B_{PENSION} = 9\,600 + 0.3\,(23\,300 - 9\,600) + 0.1\,(25\,000 - 23\,300) = 13\,880\ CZK.}$$

Next, 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 employee earns and simultaneously pays the tax into the pension security scheme. These years are observable directly from the modelled data. These years are increased by days when a person doesn´t work or earn for certain reasons (e. g. illness, unemployment or maternity leave). As stated above, these days were ignored. Another period, which is added up, are years of education. These years were modelled and included into the number of years relevant for the

rate determination: it is 3 years for individuals with education on level of ISCED 3C, 4 years for individuals with level of ISCED 3A or 3B or 4 or 5B, and 7 years for individuals educated on level of ISCED 5A.

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. Their averages are summarised in Table 4. Average monthly pensions to which persons were actually entitled in 2007 are in the last column of Table 4. Comparing the actual pensions with the averages of our estimated values can prove that our modelled earnings are acceptable approximation.

Table 4 – Average present value of the monthly pension in CZK

gender / education	ISCED 3C	ISCED 3A, 3B or ISCED 4 or ISCED 5B	ISCED 5A	Actual pension in 2007 (average)
women	8 631	9 274	11 368	9 162
men	9 924	10 613	12 195	11 083

To get the lifetime pension, a fictional individual receives from the pension security in old age, the monthly pension (its present value) has to be multiplied by a number of months of retirement. A length of retirement depends on time to retire and time of death. To determine the time of death for particular individuals, it would be reasonable to have mortality tables differentiated also by income because it is said that the rich tend to live longer. However, what we had at our disposal were mortality tables differentiated only by gender. Therefore we had to assume that all our fictional women (men) have the same life expectancy. In addition, we assumed all the fictional individuals retire at the normal retirement age. As a result, all the fictional men live and receive an old age pension for 17 years, and all the fictional women 23 years. Table 5 presents average present values of the lifetime pensions for women and men by level of education.

Table 5 – Average present value of the lifetime pension in CZK

gender / education	ISCED 3C	ISCED 3A, 3B or ISCED 4 or ISCED 5B	ISCED 5A
women	2 589 447	2 782 333	3 410 412
men	2 977 134	3 183 933	3 658 627

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 is 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 in order to analyse relationship between them and well-being of the individuals (see chapter 3.1), and to examine impact of the net benefit on the income inequality (see chapter 3.2).

It must be mentioned that the net benefit calculated in our analysis is to some extent biased. First, we assumed that only old age pensions are paid from the pension security. In fact there are other benefits that can be financed by the tax (e. g. widow or disability pensions) and it can be hypothesized that the tax could be lower if only the old pensions were paid out. Since we did not reduced the tax rate the estimated lifetime taxes paid by our fictional individuals are overestimated, and thus their net benefits are underestimated. Second, the incidence was estimated under the assumption that the individuals live up to a certain age. For the individuals who die earlier the estimated lifetime pensions or the net benefits from the pension security are overestimated and vice versa.

3. Incidence analysis of the pension security

3.1 Analysis of the net benefit or the pension-tax ratio

First, we have analysed the relationship between the lifetime tax or lifetime pension and individual´s well-being. A simple measure of the well-being is the lifetime earnings. However for the purpose of our analysis we constructed a measure which captures only earnings relevant for the pension calculation, i. e. income earned during the decisive period. Moreover, the individual earnings (their average) have been related to the average wage in 2006 and thus this measure is able to express a position of an individual in relation to earnings of the others. In case the well-being index equals one an individual has an average income. In case the index exceeds one, then the individual has a higher than average income and vice versa.

The relationship between the lifetime tax and the well-being index is illustrated in Figure 1. As a logical outcome of the tax formula the lifetime tax computed with the modelled data is positively proportional to the lifetime earnings. Moreover, a lifetime tax to well-being ratio is almost the same for all the fictional individuals regardless of their incomes. The variability in the lifetime tax of individuals with the same well-being is caused by that fictional individuals with the same average income earned during the decisive period (which was relevant for the well-being index construction) do not have to have the same average income earned during their entire careers which was relevant for the calculation of the tax. In Figure 1 we see both the tax deducted from an employee´s income at rate of 6,5 % and the total tax including the employer´s share (see the steeper line).

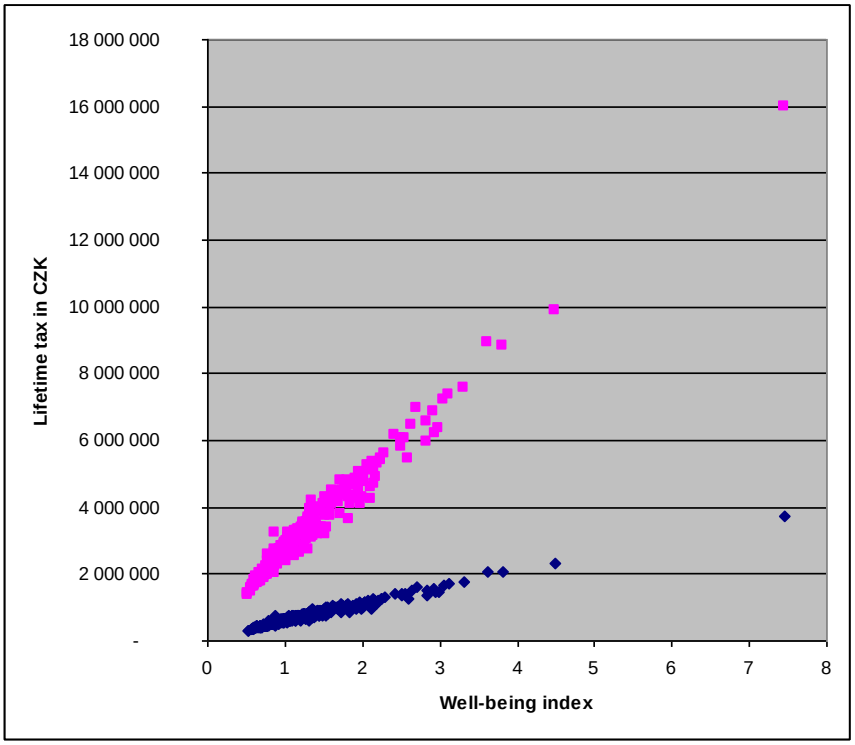

Figure 1 – Lifetime tax in relation to well-being

Figure 2 is analogous to Figure 1. It shows the relationship between the lifetime pension and the well-being. As a result of our computation, the lifetime old age pension is also positively proportional to the well-being. However pensions of individuals with earnings little above the average wage or less increase faster than pensions of higher-income persons. The significant break in the curves is consequence of the regressive pension formula. Moreover, women get more than men with the same well-being because they receive the pension for a longer period (see the upper curve).

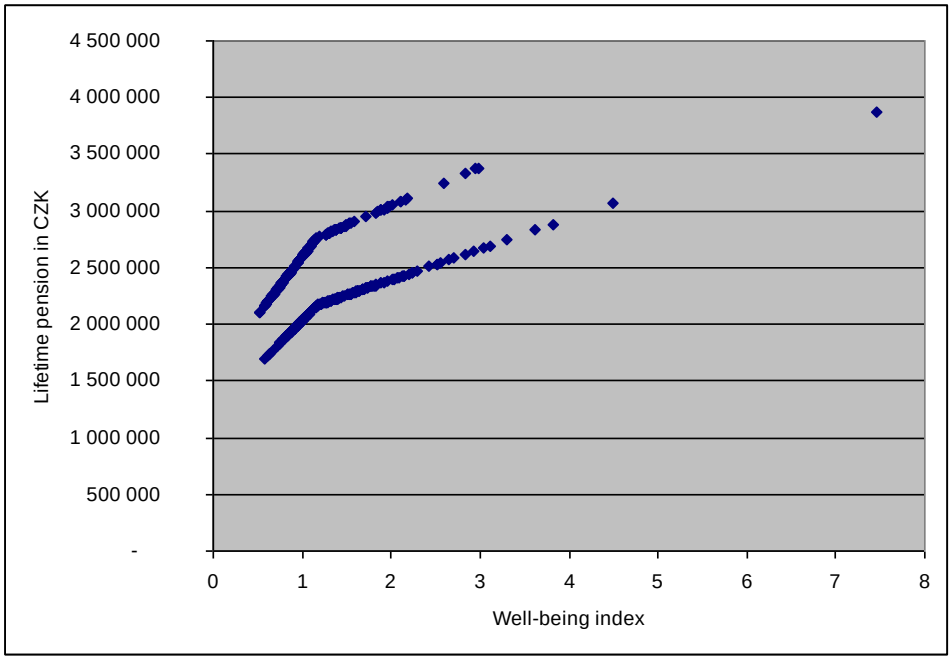

Figure 2 – Lifetime pension in relation to well-being

The relationship between the net benefit from the pension security, expressed as a monetary amount, and the well-being is presented in Figure 3. This have been done separately for women (with higher net benefits) and men. The tax was calculated using the rate of 6,5 %, i. e. Figure 3 shows a financial effect of the pension security on individuals´ budgets.

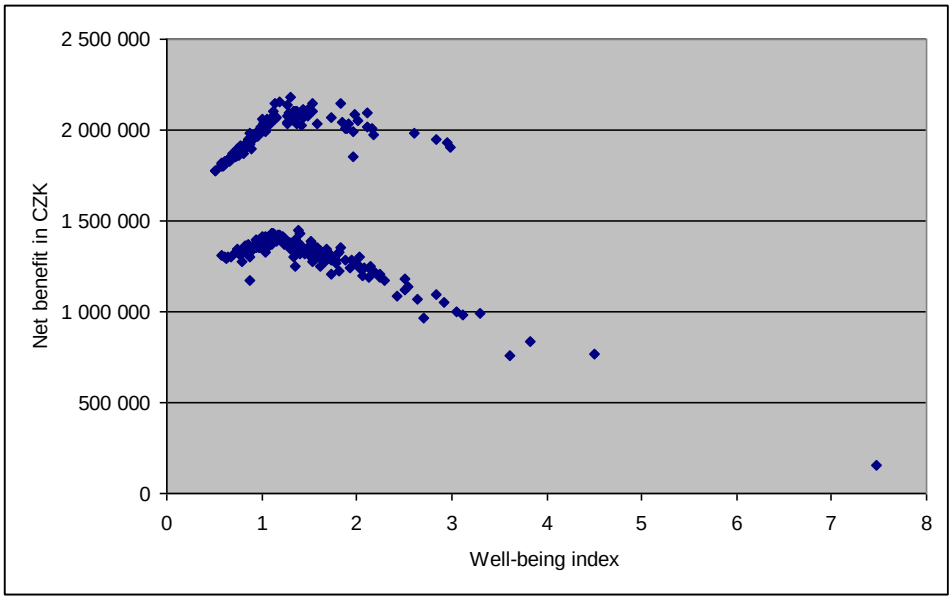

Figure 3 – Net benefit in CZK in relation to well-being (tax rate of 6,5 %)

Figures 4 and 5 illustrate the relationship between the pension-tax ratio and the well-being. Again, women with a higher ratio are represented with the upper curve. While the ratio in Figure 4 was calculated with the tax rate of 6,5 %, the ratio in Figure 5 was calculated using the rate of 28 % (i. e. the total tax comprised of both employees and employers shares).

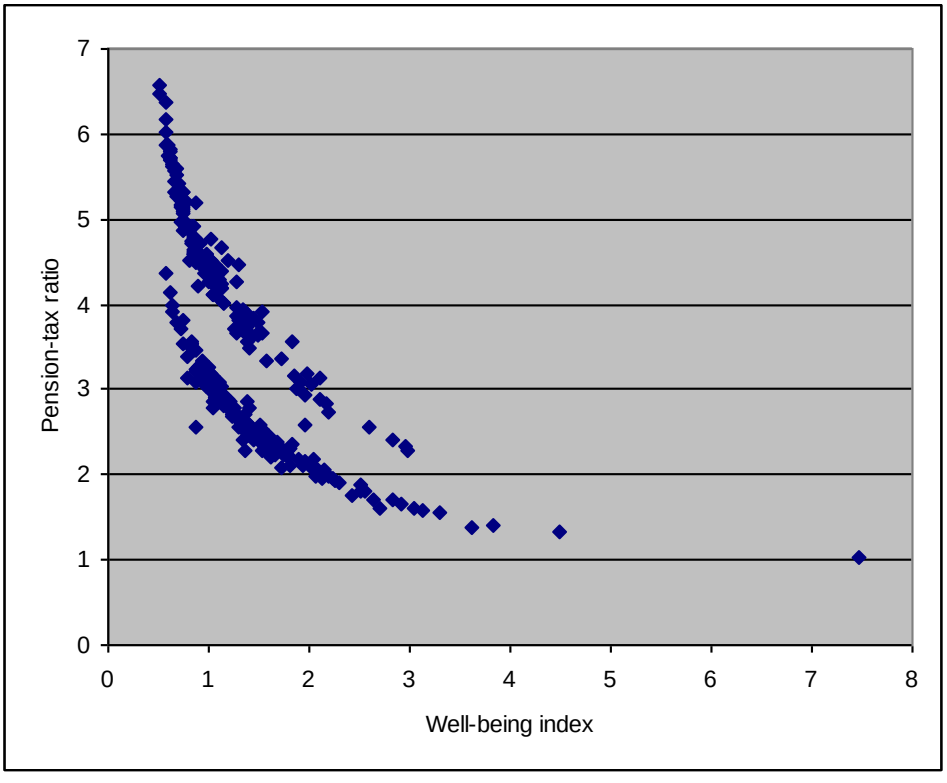

Figure 4 – Pension-tax ratio in relation to well-being (tax rate of 6,5 %)

It is obvious from Figures 3 and 4 that all our fictional persons are net beneficiaries of the pension security. If only their tax shares are considered, all of them have positive net benefit, i. e. all of them received more than the present values of their lifetime taxes are. Consistently the pension-tax ratio is above one for all the persons.

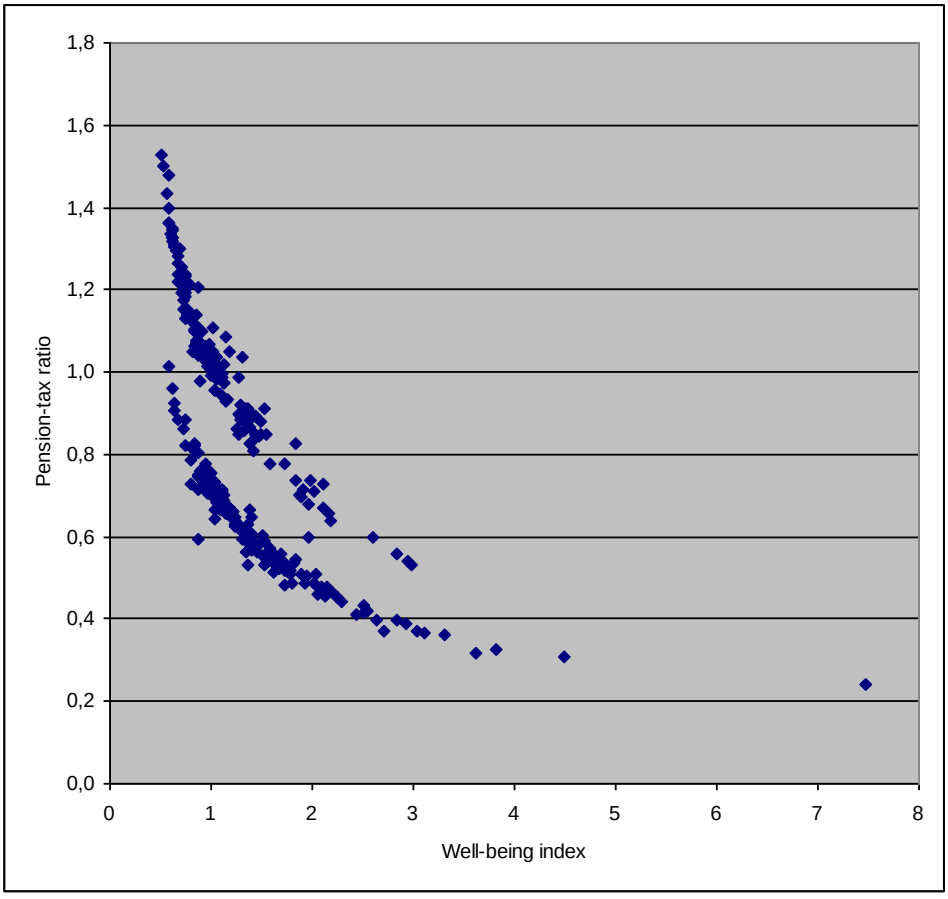

Figure 5 – Pension-tax ratio in relation to well-being (tax rate of 28 %)

If we consider the total tax (i. e. including also the tax paid by employers on the assumption of the full shifting on employees) in our calculations then the incidence of the pension security looks different. In Figure 5 we see that most of the men (the lower curve) have the pension-tax ratio less than one. This means that the lifetime taxes paid on behalf of them were higher than the lifetime pensions they received (i. e. the net benefit is negative when considering the tax rate of 28 %). This situation is similar for women with income equivalent to app. 1.1 times the average wage and higher. For women with income lower than 1.1 times the average wage the pension-tax ratio is higher than one. Only this group of fictional individuals receives from the pension security system more than the present value of the lifetime contributions which were paid on behalf of them.

Furthermore, from Figure 3 we can observe that the net benefit from the pension security, concerning an individual´s budget, increases as the well-being increases up to the level somewhere between the average wage and a double average wage. The net benefit of those with income higher than this break point decreases as the well-being rises. Figures 4 or 5 show that the relationship between the pension-tax ratio and well-being is negative. The poor individuals have the highest ratio while the rich have the lowest one. The ratio is logically higher in case we used the tax rate of 6,5 % than that of 28 % (compare Figures 4 and 5).

The analysis of the net benefit or the pension-tax ratio provides information about financial sustainability of the pension security, too. From the strict point of view of employees the system alone would not be financially sustainable within one generation: the pension formula is too generous in comparison with an individual´s contributions (on assumption that all the individuals live up to the retirement age and receive the pension for a given period). However if the employers portion of the tax is added up, the system switches to surplus: the pensions can be fully financed through the collected tax in our model of fictional individuals. It is fair to admit that a total revenue of the pension scheme in our model exceeds total pensions. The difference is caused by the design of the tax formula because the tax should be a source to cover other kinds of pensions besides the old age pensions. (Furthermore, the pensions of currently retirees are actually financed from the tax paid by currently working generation, and the financial sustainability is rather assessed on an annual basis. Then inter-generation redistribution is of interest.)

The analysis of the relationships between the well-being and the net benefit or pension-tax ratio revealed that the pension security redistributes the means collected through the pension security tax within one generation from the richer to the poorer individuals. Moreover, when considering the entire tax it seems that the pension security redistributes the means from men to women, especially poor women. For example Figure 5 shows that women with well-being twice as high as the average wage have the same pension-tax ratio as the average-wage men.

The result of the incidence analysis, i. e. the fact that the poorer are better off, is caused by using of the regressive pension formula. Application of the formula results in a reduction of earnings which serve as a basis for the calculation of the pension. Moreover higher earnings are reduced by a higher rate than lower earnings. Figure 2 graphs that a pension of an individual with income below the breaking point (which is a little above the average wage) grows more quickly than a pension of an individual with income above the breaking point. On the other hand the tax formula leads to the linear relationship between the earnings and the tax (see Figure 1). This result of our analysis proves the presence of the solidarity element in the pension security in the Czech Republic. Expected redistributive effect of the pension security scheme has been verified this way.

Solidarity of men with women through the pension security scheme may be a consequence of the difference in the retirement ages for the genders. (The retirement age should be unified in the future.) In addition the life expectancy is significantly dependent on the gender: it is higher for women. A lower retirement age and a higher life expectancy result in a longer period of pension receiving for women who have generally lower incomes than men.

Finally, we hypothesized that a setting of the decisive period in combination with a shape of the lifetime income function may affect the redistributive effect of the pension security. The decisive period is defined as a period during which income earned is considered for the pension basis calculation. Under 2007 law the decisive period took 21 years. It corresponded more or less to the second half of an employee´s economic lifetime. To examine impact of the decisive period we analysed shape of earnings profile over a 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 have higher average earnings in the second half of their economic lifetimes, i. e. just in the decisive period. However the growth of earnings in the second half of the economic lifetime is higher for higher-income individuals.

In case of the faster growing function of the lifetime earnings of higher-income persons in the last years of their economic lifetimes the setting of the decisive period, which is equal to this high earnings period, result in diminution in the redistributive effect of the regressive pension formula. The solidarity element is weakened on behalf of the equivalence element which is also built in the pension formula. However we can expect dampening of the equivalence element in future because a gradual extending of the decisive period is already included in the particular law. 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, will be higher than the redistributive effect of the current scheme because the higher-income individuals will have relatively lower pensions.

3.2 Analysis of impact of the pension security on income inequality

To measure effect of the pension security on the inequality of our fictional individuals´ lifetime earnings we used both the general formula of the GE inequality measures and the Gini coefficient, or Thin-Musgrave index respectively. The Gini coefficient is:

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

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

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 coefficent 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. Three variants of the net benefit added up to the lifetime earnings were computed. The pensions were calculated using the current formula when only income earned during the decisive period is relevant in the first variant of the net benefit. The pensions were computed on assumption that earnings from each year of the economic lifetime are considered in the second variant of the net benefit. The present value of the lifetime tax was determined at the 6,5 % rate in both the two variants. However the present value of the lifetime tax was calculated at the rate of 28 % in the third variant of the net benefit while the current pension formula was used. Coefficients for particular income concepts are reported in Table 6.

Table 6 - Gini coefficients for income distribution before and after the pension security

	Gini coefficient	EP
Lifetime earnings before	0,21241080	
Lifetime earnings after		
- variant 1	0,18041284	1,040627728
- variant 2	0,17876777	1,042716469
- variant 3	0,17315486	1,049843167

According to the Gini coefficients the pension security reduces the inequality of lifetime earnings. Moreover, the Gini coefficient for the second variant of the net benefit suggests than the extension of the decisive period, income earned during which is relevant for the pension calculation, would make the lifetime income after the tax payment and benefits receipt even more equally distributed than under the current state. Considering the current pension formula and the entire payment contributed by both employees and employers on behalf of the employees 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:

$$EP = (1-G_{after}) / (1-G_{before}).$$

The Thin-Musgrave indices of effective progressivity for all the variants are in the last column of Table 6. Value of EP exceeding 1 indicates a progressive effect of the pension security.

The inequality of the lifetime earnings before and after the pension security was measured also by the general formula of the GE inequality measures:

$$GE(\alpha) = \frac{1}{\alpha^2 - \alpha}\left[\frac{1}{n}\sum_{i=1}^{n}\left(\frac{y_i}{\bar{y}}\right)^{\alpha} - 1\right]$$

where **n** is a number of individuals, $\mathbf{y_i}$ is income of individual **i**, and $\bar{y}$ = **(1/n)** $\sum$**yi**. The value of GE(α) ranges from 0 to ∞. Zero means an equal distribution. The higher value of the GE(α) the more inequal distribution is. The parameter α represents the weight given to the inequality in different tails of the income distribution. The measure with lower values of α is more sensitive to changes in the lower tail of the distribution and vice versa. Using α = 0,2 in our calculations we put emphasis on the lower tail of the distribution.

Results of measurement using the GE, summarised in the second column of Table 7, are consistent with the Gini coefficient results – they also suggest the decrease in the inequality of the lifetime earnings.

Table 7 – GE indices for total, between-group, and within-group income inequality

	GE_{total}	$GE_{between}$	GE_{within}	$GE_{between}$ / GE_{total}
Lifetime earnings before	0,07301038	0,01429097	0,05871941	20 %
Lifetime earnings after				
- variant 1	0,05308388	0,00757722	0,04550665	14 %
- variant 2	0,05214388	0,00676996	0,04537392	13 %
- variant 3	0,04904040	0,00630677	0,04273363	13 %

To examine the impact of the pension security more precisely we analysed the income inequality using the decomposed GE inequality measure. The decomposition by population sub-groups can reveal how income inequality between particular groups of individuals and income inequality within these groups contribute to the total income distribution of the whole population of individuals. We divided our population into two groups of individuals according to their gender on assumption that women and men have different earnings.

Both the GE indices for the inequality between the genders and the GE indices for the inequality within the groups are in Table 7. As values of the GE indices for the variants of the lifetime earnings

including the net benefit are lower than the GE index value for the before-security income the pension security reduces both the between-group and within-group inequality. Furthermore, in the last column of Table 7 we see how much the between-group inequality contributes to the total inequality (100 minus the between-group contribution is the within-group inequality contribution to the total inequality). It is evident that the inequality within the groups of women and men prevails over the inequality between the groups. Effect of the pension security is decrease in the between-group inequality contribution which means that average incomes of women and men after the tax payment and the pension receipt got closer to each other.

4. Conclusion

Goal of the pension security scheme in the Czech Republic is to provide an adequate income in old age. All the employees are obliged to contribute a percentage of their earnings to the pension security fund during their working years. An additional portion is contributed by their employers. When the employees retire they are eligible for a pension. Both the tax contributed and the pension received are derived from the earnings. While there is a linear relationship between the tax and the earnings the pension is regressive with respect to amount of earnings. That is why it is correct to expect that the means collected through the pension security are redistributed from higher-income individuals to lower-income individuals.

To examine who pays and receives how much over an entire life we calculated the net benefit defined as a difference between the present value of the lifetime pension and the present value of the lifetime tax (or the ratio of the pension to the tax) for each individual in the sample. Subsequently we analysed the relationship between the net benefit (or the pension-tax ratio) and the lifetime well-being in order to classify beneficiaries or losers by their income. Moreover, it was a method to estimate a redistributive effect of the pension security within a generation of individuals. Finally, we measured inequality of the lifetime earnings before the tax is deducted and pensions are received, and inequality of the lifetime earnings after paying of the tax and receiving of the pensions to be able to assess progressivity of the pension security.

A lifetime-based analysis requires long-term micro-data on income, taxes, and pensions as well as other important information about analysed individuals such as their age of retirement or death. Since there is no panel-data set suitable for this analysis in the Czech Republic we chose to model pseudo-panel data for fictional individuals using cross-sectional data for real employees gathered by a special statistical survey monitoring various variables describing employees including their earnings.

An idea of the simulation of the fictional individuals was to divide thousands of real individuals in the survey into groups specified by gender, education level and occupation on assumption that those are factors which significantly influence earnings. Persons ranked by age within each group represent a

fictional individual in particular years of his/her economic life. A sequence of average earnings of the persons of the same age creates then the lifetime earnings profile of a fictional individual. An advantage of modelling of the lifetime earnings this way is that the income earned in the past years does not need to be indexed in order to obtain its present value. On assumption that a shape of the lifetime earnings function is stable over time, nominal earnings of differently old persons living in the present are considered as present values of earnings gained by a person in the past. If earnings, which serve as a basis for calculation, are known it is possible to derive present values of both the lifetime tax and the lifetime pension. To estimate the present value of the lifetime pension it is necessary to assign the age of retirement and age of death to each fictional individual. Our model is simplified to the extent that all the fictional individuals leave economic life at the normal retirement age, which differs between women and men, and they have the same mortality probability, differentiated again only by gender.

Our analysis of the fictional individuals revealed that on a lifetime basis all the individuals are net beneficiaries of the pension security scheme if considering only the tax that they are obliged to pay to the scheme. However, the present value of the lifetime pension as a percentage of the present value of the lifetime tax decreases as an individual´s well-being increases. The lower-income individuals´ pensions are multiple of their contributions. Furthermore, when taking into account the entire payment on behalf of the individuals, which includes also the employers tax, almost all the men and higher-income women become net losers. Only lower-income women receive more benefit than they and their employers contributed to the pension security scheme. Measured by the Gini coefficient or the GE index the pension security scheme reduces inequality of the distribution of the fictional individuals´ lifetime earnings. Moreover, it results in approaching of average incomes of women and men.

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. Based on the current pension formula the pensions are regressively linked to the earnings. On the other hand the regressivity of the formula is dampened by that only income earned during the second half of the economic lifetime is relevant for the pension calculation, and by that higher-income employees have higher these later earnings. Nevertheless the lower-income persons are rather better off as a consequence of the current pensions provision.

Furthermore, it is plausible to expect that the measured progressivity of the pension security would be diminished to some extent if we used different probability of death for individuals different in their income or at least education. On assumption that higher-income or more educated people tend to live longer or lower-income or less educated persons die sooner, it could be expected that the present value of the lifetime pension of rich individuals would be relatively higher or the value of the lifetime

pension of poor individuals would be relatively lower. However, the assumption that women receive a pension for a longer period than men, because they retire earlier and live longer, reflects reality more accurately. This fact could be a reason underlying the redistribution between men and women.

References

[1] FULLERTON, D., ROGERS, D. L. (1991) *Lifetime vs. Annual Perspectives on Tax Incidence* [on-line]. Working Paper No 3750. Cambridge (USA): NBER. Available on http://papers.nber.org/papers/w3750.v5.pdf [cit. 2004-07-10]

[2] CORONADO, J. L., FULLERTON, D., GLASS, T. (2000) *The Progressivity of Social Security* [on-line]. Working Paper No 7520. Cambridge (USA): NBER. Available on http://www.nber.org/papers/w7520 [cit. 2004-01-07]

[3] CAMERON, L., CREEDY, J. (1994) Taxation and Redistribution of Lifetime Income. In Creedy, J. (ed) *Taxation, Poverty and Income Distribution*. Edward Edgar

[4] HARDING, A. (2003) *Lifetime Income Distribution and Redistribution (Contributions to Economic Analysis)*. North Holland

[5] SUNG, M. J. (2008) Construction and Applications of a Micro-Based Pseudo-Panel Data Set [on-line]. In *64th Congress of the International Institute of Public Finance* [online]. Maastricht: IIPF. Available on https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=iipf64&paper_id=65 [cit. 2008-09-19]

[6] GRUBER, J. (1997) The Incidence of Payroll Taxation: Evidence from Chile. *Journal of Labor Economics*, Vol. 15, No. 3

[7] Tax Foundation (1966) *Economic Aspects of the Social Security Tax* [on-line]. Research Publication No. 5. Available on http://www.taxfoundation.org/news/show/1774.html [cit. 2008-09-19]