

# Impact of Early Retirement Incentives on Labor Market Participation: Evidence from a Parametric Change in the Czech Republic

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## Abstract

We investigate the impact of change in the Czech early retirement scheme on the labor force participation of older male workers. Using difference-in-differences method we find that a reduction in early-retirement benefits by 2 - 3 % leads to the approximately same decrease in the probability to be inactive. Our finding implies high elasticity of the older male workers' participation rate. The public policy implication is that a reduction in early retirement benefits can serve as a very effective tool to the increase participation of older men on the Czech labor market.

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## 1. Introduction

As policy makers face the commonly known problem of aging society, the labor supply of older workers becomes more important. Labor market decisions of older workers influence government expenditure on various social programs. For example, the way how incentives to retire are formed is a crucial issue in keeping the pension system sustainable, while population is aging. Governments thus attempt to change the design of social security system in order to respect the demographic changes.

The Czech Republic is an example of aging society<sup>3</sup>. Czech government recently reacted on this development and decreased incentives formed by social security system to early retire. The policy makers expected that this step would decrease number of early-retirement benefits and in the same time it increases the number of contributors to the pension system. These unambiguous advantages make it popular also by many other governments facing the issue of aging. It needs to be highlighted that the overall fiscal balance is improved unless retirees are proportionally compensated for longer service.

The policy relevance of this topic is reflected in the current empirical literature. However, there is no clear answer about the causal impact of retirement incentives on the labor supply of older workers.

The cross country comparison shows strong negative relationship between early retirement incentives and labor force participation (Gruber and Wise, 1999 and Börsch-Supan, 2000). Papers examining changes in national policies suggest that introduction of early retirement benefits as a specific form of retirement incentives decrease labor force participation (eg. Brinch et al., 2001).

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<sup>3</sup> According to the projection of the Czech Statistical Office, the share of people aged 60 and more will double in next 30 years.

Contrary to that, other studies do not find clear evidence about the sensitivity of labor supply of older workers on the changes in the early retirement scheme. For example, Baker and Benjamin (1999) provide evidence from US and Canada which shows relatively modest or non-existing reaction of labor supply on the changes in early retirement scheme. Similarly, Moffitt (1987) finds relatively small effects of Social Security law on the labor supply of older workers in the USA.

There are only few papers about labor supply of Czech workers. The direct evidence concerning labor supply older workers is provided in Galuščák (2002) and Bičáková et al. (2008). Galuščák shows that the introduction of earning test leads to significant and substantial decrease in the participation rate of workers who reached statutory retirement age, whereas Bičáková et al. (2008) estimated the effect of tax changes on labor supply of average Czech workers as relatively modest. There is no direct evidence about the early retirement incentives and participation of older workers.

The retirement incentives can have different forms: explicit and implicit taxation or norms that restrict full-time work in certain age. In our case we investigate the effect of lowering the early-retirement benefits, which are offered as a non-labor income for individuals. The eligibility window starts three years before a statutory retirement age. The policy change became effective in June 2001 and cut the early retirement benefits by approximately 3 % for new claimants. We also compare several incentives measures before and after the reform. In this stage of our research, we compare social security wealth and accrual rate for representative individuals.

Social security statistics shows that one year after the policy change, the number of new early retirees decreased by half. However, as older workers face several options how to

become non-employed (retire early<sup>4</sup>, become unemployed or enter disability retirement<sup>5</sup>), the causal positive effect of the policy change on the labor supply of older workers is under question.

We compare situation before and after the reform, in order to provide clear picture how the labor supply of older workers changed. For that purpose we use difference-in-differences estimation method. The treatment group includes workers who are eligible for the early retirement benefits (at least three years before the statutory retirement age). The control group contains workers who are just before entering the eligibility age window for early-retirement. In particular, a probit model is used for testing whether the policy change affects participation rate of individuals, who are eligible for early retirement, controlling for other characteristics of the individuals.

Our analysis shows that this policy led to the prolonging of employment status of males before they reach official statutory retirement age. This reform resulted in the increase in probability of participation on the labor market by 2-3 % for those who are eligible for early retirement.

This paper is organized as follows. The following part describes the Czech pension system including the discussion about the alternative ways of leaving the labor market. The data description, graphical overview of our methodology and the illustration of development of labor supply during 1998 – 2005 follow. The description of econometric analysis is in the part 5, followed by results, the conclusion is last.

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<sup>4</sup> The exact preconditions for early retirement are described in the Act No. 155/1995 Coll.

<sup>5</sup> To enter the disability retirement certain health criteria has to be met. Hence, it is not a free choice of the individual.

## **1. Institutional Setting and the Change in the Benefits**

The Czech retirement scheme is standard pay-as-you-go (PAYG) system with mandatory participation for all employees and self-employed. The basic features of the Czech pension system were inherited from system ran under the communist regime. There were few legislative changes implemented in the years after the fall of the communist regime, but the basic features remained unchanged. The statutory retirement age is different for male and female workers whose retirement age depends on the number of children raised. Beside this differentiation the retirement age has been prolonging by two months (for males and four months four females) per year after 1996 to the year the men or female was supposed to retire under the former conditions. The retirement age for males in 1996 was set to 60.<sup>6</sup> The retirement age for females without children was 57 and each child raised reduced the retirement age by one year. In the time of the policy change the average eligibility age was approximately 61.

The retirement benefits are computed based on a formula that has individual part (percentage adjustment) and part, which is common to all workers (basic amount). Basic amount is stated by law and is received by everybody who is recipient of retirement benefits. It can be understood as a minimum benefit. The individual part depends on individual specific characteristics such as worker's earning history since 1986 and number of years in service. Wage history which is indexed to current value influences the amount of personal assessment base (PAB) which is basically sum of wages indexed to current value divided by the number of years for which is the PAB counted. PAB is further worked with and is modified by reduction boarders and reduction percentages to a calculation base (CB). CB represents the crucial step in Czech pension formula which causes the high degree of redistribution in the

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<sup>6</sup> After that there is not single retirement age for male population in given year. Exact formulation is that retirement age is prolonged by two months for each initiated age-year after 31.12.1995 before the individual reach the age 60. In practice it means that if a worker is 60 in the February 2000, than his retirement age is sixty plus ten months. Therefore, the men from this example will retire in January 2001.

system. Number of years in service influences the size of adjustment percentage (AP) and therefore the size of percentage of CB which will be counted as the percentage-based assessment (PA) in the pension formula. The longer in service the higher the PA will be and therefore the higher pension benefit. The exact formula can be found in Annex 1.

This formula is applied to every type of retirement benefits including early-retirement benefits<sup>7</sup>. The early retirement benefits are lower than standard ones. The cut is determined by adjustment coefficient (rPYI), which is a coefficient that is employed in the computation of the individual part of a benefit (adjustment percentage).

This adjustment coefficient (rPYI) was subject to the policy change. In particular, the “punishment” for the early retirement was before the reform 0.6 % and 0.3 %<sup>8</sup> per each 90 days remaining to standard retirement age before the policy was introduced. The policy change changed the degree of punishment for early retirement. In fact, both rates that adjust early retirement benefits (0.6 % and 0.3 %) were increased to 0.9 %. For example, considering an individual who retire one year before her retirement age (0.6 % reduction applied before the reform), the adjustment percentage of her benefit decreased after the reform by 1.2 percentage points.

This decrease in adjustment percentage proportionally decreases a benefit and hence it has an influence on the motivation of workers to stay active on the Czech labor market until

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<sup>7</sup> The Czech social security scheme recognizes two types of early-retirement. One is with permanently cut benefits, which allows individuals to retire at most three years before the eligibility age and individual is not allowed to work by that t. The decreased pension benefits are collected for the rest of life. The second is early-retirement with temporary cut benefits which allows retiring at most two years before the eligibility age and is tight to unemployment status for half of the year, at least. The decreased pension benefits are recalculated when the eligibility age is reached and increased to the level as if one would retire in eligibility age. Apart from that, two more ways how to escape the employment status are available: become unemployed and become disabled. However, social support for disabled people is strictly tied to the health situation of an individual and hence cannot be taken for fully free individual’s choice, though can be influenced by an individual’s pressure on doctor’s decision about disability pension.

<sup>8</sup> The special case is an individual, who applies for early-retirement benefits and is aged 60 or more. The permanent punishment is than just 0, 3 % per each 90 days before the standard retirement age.

the statutory retirement age. The impact of this policy step into the level of benefits can be demonstrated on official statistics of the Czech Social Security Administration.

## **2. Social security statistics and net change in benefits**

Table 1 shows drop in the officially newly granted early retirements benefits. The fall was by approximately 10 percentage points of regular pension benefits. This observed change is caused by two effects: first, the change in the cut-down in early retirement benefits, second, by the characteristics of workers who applied for early retirement before and after the policy step changed.

[Table 1 here]

Comparison of newly granted early retirement benefits before and after the reform does not provide clear picture about the effect of the policy on the benefits. It is probable that workers who applied for the early retirement after the reform had stronger preferences toward leisure than workers who applied before the reform. They could also have different working histories<sup>9</sup>, which determine their benefits. Therefore, we attempt to isolate the pure policy change effect from the self-selection effect. For that purpose we create several typical individuals with different wage history, which serves - together with length of service - as a major input for the computation of benefits.

We attempt to compute the early retirement benefits before and after the change for individuals with virtually same characteristics. The only parameter that changes is the degree of punishment, which was subject to the policy change. Our computations show that the net decrease in early retirement benefits was approximately by 2 - 3 % (absolutely by 120 - 250

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<sup>9</sup> Different wage histories and number of years in service, etc.

CZK per month). The cut-down corresponds approximately to 1 - 2.5 % of average net wage for male workers in the economy.

[Table 2 here]

The ratio of net wage and early retirement benefits (net replacement rate) decreased by 0.9 – 2.4 percentage points, differently for number of years remaining to the statutory retirement age and level of wage. Generally, the highest decrease applied to those who wanted to enter the early retirement three years before the eligibility age. Lower income workers were punished relatively more than upper income groups. This is the result of the pension formula: the benefits are relatively higher for low income than for high income workers. It implies that the policy changes affect more strongly people, who face relatively disadvantage position on the labor market.

Another way how to identify the effect of this kind of policy change is suggested by Börsch-Supan (2000). The author stresses the importance of time dimension – how much it is worth to give up one year of retirement in term of a net benefit or social security wealth (SSW) computed as the difference between the expected discounted stream of all future benefits and paid social security taxes which are computed as a percentage of the gross earnings. The SSW formula which states how to compute the social security wealth for an individual at age S planning to retire at age R is

$$SSW_S(R) = \sum_{t=R}^E \pi(t | S) \cdot \delta^{t-S} \cdot B_t(R) - \sum_{t=S}^{R-1} \pi(t | S) \cdot \delta^{t-S} \cdot c \cdot W_t,$$

where:

*SSW* - Social security wealth

*S* - planning age

*R* - planned retirement age

*E* - expected age of decease at age S

$\pi(t | S)$  - probability being alive at age t conditional on being alive at age S

$B_t(R)$  - pension at age  $t$  for retirement at age  $R$

$W_t$  - wage at age  $t$

$\delta$  - discount factor

$c$  - social contribution rate

Since SSW is very sensitive to many assumptions<sup>10</sup>. We employ the values for the discount factor and the wage growth from Coile and Gruber (2007) to keep the analysis consistent with the analysis of peak value (Coile and Gruber, 2007) and option value (Stock and Wise, 1990). In our computation of SSW we don't assume any kind of retirement benefits indexation, because Czech legislation does not prescribe any indexation formula. Hence, the process of indexation depends very much on government discretion (Dusek (2007) and Dusek and Kopecsni (2008)).

Tables 3 and 4 show basic computations of retirement incentives that employ life time budget constraint.

[Table 3]

[Table 4]

Each row corresponds to the last year of working. Last age of work (for simplicity assumed to be 60) represents the year, in which the individual with an average wage<sup>11</sup> reaches the standard retirement age and retires at end of this year. Comparing the two tables according the social security wealth one can see that the individuals with average wage face higher social security for the ages 58 and 59, which are last two years when they are able to claim the early-retirement benefits. Postponing retirement to 59 increases the social security wealth and hence motives the potential retirees to stay on the labor market. The effect of the reform is that the accrual, even though very low, is positive even at age 60, which introduces the motivation to stay on the labor market one more year. This effect depends very much on the

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<sup>10</sup> Assumption of individual discount rate, future indexation of benefits from PAYG, interest rate path etc.

<sup>11</sup> The gross average wage in 2001 was 14000 CZK per month.

wage history. Employees with higher wages contribute to the social system more than is the increase in the future pension benefits and hence their accrual at age 60 is negative both before and after the reform nevertheless is smaller.

Having SSW computed we can show the effect of the reform using peak value defined by Coile and Gruber (2000) and we present it in the similar fashion. Moreover, we present option value which is not presented in terms of money as it is peak value, but in utility units. Option value is computed using standard constant relative risk aversion utility function. Parameters of the function follow Stock and Wise (1990)<sup>12</sup> where parameter  $\gamma$  is a risk aversion and  $k$  allows differentiating in the value of income while retired.

[Table 5]

[Table 6]

From the comparison of peak value tables we can see that the average worker was motivated to shift the retirement decision by one year whereas the above average earning individuals were not motivated to move it forward. In contrast to that worker with lower wage has the optimal age of retirement at 60 under both regimes. So we can see that the impact of the reform depends on the position of the individual in the wage distribution.

Results from the option value approach provide different picture. Although this approach cannot be directly compared to the peak value approach, it shows that the reform didn't have any impact since the option value is minimized at age 60 both before and after the change. If it would show any impact then it would be that the above average earner would be

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<sup>12</sup>  $\gamma = 0,75$  and  $k = 1,5$

motivated to shift her retirement age one year forward. This unambiguity of results is an issue we still face.

Both of above mentioned methods simulates how the Czech pension system forms the motivation to retire. But individuals with strong preferences towards leisure might look for another way how to leave the working status in spite of the early-retirement reform. In the year 2002, after the policy change, the structure of newly granted pensions changed notably (Fig. 1). Note that relatively higher proportion of workers found alternative profitable way of “retirement” – number of disability benefits increase in 2002 by 7 percentage points. These changes were also likely caused by the tightening of the early retirement option. Therefore, whether the total labor supply increased or not, is under question.

The increase of standard pensions’ share in years 2003 and 2004 suggests that part of the male workers was persuaded to stay on the labor market longer due to the policy change in 2001. This is also confirmed by our analysis presented in the following parts of our paper. Since aggregate unemployment is negligible and stable over time, we do not provide the numbers for unemployment for the older workers, even though it can be theoretically additional sort of “early retirement”.

[Figure 1 here]

One of the questions that this reform raised is what margin of labor supply is to be affected, mainly, whether the reform affected extensive or rather intensive margin of the labor supply of older workers. The labor code restricts early-retirement benefits: people who retire earlier (claim early retirement benefits) are not allowed to work at all. This implies that the benefits can be considered as non-labor income option as it is presented in Fig. 2. Our situation (before and after the reform) is depicted as a shift from the point A to the point B. In

this illustration we assume standard quasi-concave utility function, which implies convex indifference curves.

[Figure 2 here]

Fig. 2 shows an individual being indifferent between working and non-working before and after the reform (early retirement benefits before, A, and after B). Utility maximizing individual would in this illustrative example not work before the reform and work after the reform. This simple graphical analysis provides intuition, why we estimate the effect of the policy step on the probability to be employed and not on number of working hours per employee. The next section provides the detail description of our data.

### **3. Data Description and the Definition of Treatment and Control Group**

For the purpose of our research we use Czech Labor Force Survey data from 1998–2005 containing detailed information about labor market status of representative sample of 60 000 individuals and their households. On rotating panel base, individuals and their households are surveyed during five consecutive quarters. Therefore, one fifth of the sample is replaced every single quarter. We choose subsample of males, which are in the age window six to zero years until statutory standard retirement age. Hence our sample includes 50 152 observations for 11 843 individuals. Summary statistics for treatment and control group could be found in Table 7 and 8.

We divide this sample into four time periods – one period before the reform and three periods after the reform. The participation in the survey is restricted to up to five quarters. Within this period, we do not observe sufficient number of changes in the labor market status, thus we treat our sample as repeated cross-sectional data. The reason why we choose only one

period before the policy change is low stability of social security system: the legal system was stable only 2 years before the policy change and approximately four years after the policy change. Our time span also reflects comparability of the data. We define four consecutive periods, each 1.5 years long. The first one is before the policy change (1Q2000 - 2Q2001), second is immediately after the policy change (3Q2001 – 4Q2002), the third is from 1Q2003 to 2Q2004, and the fourth period covers 3Q2004 – 4Q2005. We also try alternative time spans, but it does not change our results significantly. This division of total time span into four periods covers the most institutionally stable period before and after the reform. On top of that, results for several time periods after the reform confirm that the impact of the policy change is the same over time.

The important problem is the actual eligibility age that has been prolonging for two months per year and gives additional noise to our data. To diminish this problem we calculate individual eligibility age as defined by the law. For that purpose we have to approximate the actual age of the respondents in Labor Force Survey, because the survey per se does not provide information about the exact actual age (accuracy is on yearly frequency). Thus, we use only those individuals, for which we observe a change in the age during the period they were surveyed (Galuščák, 2002). Using these individuals we approximate the exact individual age on the accuracy of one quarter and calculate actual individual statutory retirement age. Based on this approximation we can also calculate the number of years to retirement. This makes our analysis more accurate and it allows us to disentangle the effect of the early retirement change from the prolonging the retirement age.

Using the number of years to statutory retirement age we define treatment and control group. The treatment group contains people who are eligible for early retirement: up to three years before their standard retirement age. The younger individuals (more than three years before the eligibility age) are in the control group, because they were not directly affected by

the policy. Relatively broad definition of treatment group allows us to capture all individuals who were eligible for the early retirement and could make decision during entire period of three years before they reach eligibility age. The disadvantage is that within the following period after the policy change the treatment group consists of two types of retirees: men who entered the early retirement in the old system and those who entered already in new system. This is reflected in our analyses and we interpret the results with respect to this fact.

LFS data contains information about individual characteristics that are important for our analysis. For the purpose of our analysis we used the following characteristics: education, family status, number of persons in the household and geographical location. It does not include any information about wages or retirement benefits.

#### **4. Graphical Overview**

The Figure 3 depicts the participation rate of control and treatment groups during 1998 - 2005. The participation rate of treatment group increased between 2001 and 2004 approximately by ten percentage points. The participation rate also increased in comparison with the control group. It suggests that our treatment group was subject to specific shock that did not affect control group. One can observe that this increase has continued at lower rate even during 2Q2003 - 3Q2004. It contains also the effect of the policy change, because in the first period after the policy change, the treatment group still contains older cohorts that entered early retirement before the policy change and are remaining in the treatment group. Due to the data limitation and the institutional set-up, we cannot define treatment group more precisely than 0-3 years before retirement.

[Figure 3 here]

Changes in the behavior of older men that are aged up to three years before their statutory retirement age are also visible in the Figure 4, which shows changes in employment rate in the cohort specification. In this graph one cohort is virtually followed within one period. Each line represents one time period and last 1.5 years (the institutional change occurred in the July 2001). The curve that represent time period just before the policy change is obviously lowest, especially in the interval (-3 to 0).

[Figure 4 here]

Figures 5 and 6 show the increase in employment rate followed by the decrease in the number of pensioners. The incidence rate<sup>13</sup> in treatment group has been dropping sharply since 2001 through 2004 by about 12 percentage points.

[Figure 5 here]

The same trend is clear in Figure 6, in which each line represents one time period. We observe lower incident rate for periods after the policy change in case of the treatment group.

[Figure 6 here]

We also present an alternative indicator – hazard rate – representing probability of labor force withdrawal due to retirement. Figure 7 shows hazard rates, for two periods: before and after the policy change. In the cross-sectional setting, the definition of hazard rate is one minus retention rate, which is the participation rate of workers in age  $t$ , divided by

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<sup>13</sup> Incidence rate represents share of retirees within an age group.

participation rate of workers aged  $t - 1$  in given year (Hurt, 1996). The line that represents the first period before the policy change has two peaks: the first one reflects (around -2, two to three years before the eligibility age) entering the early retirement before the policy change, the second peak (around 0, represents entering to standard retirements. The line for the period three years after the policy change shows substantial change in the behavior of retirees. One can see that the hazard rate smoothed over the number of years before/after retirement. Although the early-retirement frequently occurs, one can not observe any particular peak before the standard eligibility age in the period starting third quarter of 2004. This is most probably the effect of the treatment we study. One can also see that it is also more common to retire after the eligibility age. This is in line with the hypothesis, that workers generally stay longer in their job.

[Figure 7 here]

This graphical overview suggests that our treatment group was hit by external shock around year 2001, which influenced its participation on the labor market. We believe that this shock was with high probability the change in the early retirement setting. This is, of course, not a rigorous analysis, because we cannot say whether the shift in the participation on the labor market is statistically significant. The next sections are thus providing the formal econometric analysis and computation of the increase in the probability to stay in the labor force.

## **5. Methodology of Econometric Analysis**

As an identification strategy we use difference-in-differences (Baker and Benjamin, 1999). The treatment group includes workers who are eligible for the early retirement benefits

(up to at least three years before the actual retirement age). The control group contains workers, who are closer to the statutory retirement age. Time periods chosen for the estimation are following: 1.5 years before the policy change and 4.5 years after the policy change, divided into three periods of equal length. The increase in the total number of early retirement benefits was dramatic in the late 90's. We do not want to mix the previous changes in the social security system into our analysis, thus we use only one period before the policy as a benchmark for our analysis. The basic specification is the following:

$$y_{it} = \alpha_i + \beta_1 OLD_{it} + \beta_2 AFTER1_{it} + \beta_3 AFTER2_{it} + \beta_4 AFTER3_{it} + \beta_5 (OLD_{it} * AFTER1_{it}) + \beta_6 (OLD_{it} * AFTER2_{it}) + \beta_7 (OLD_{it} * AFTER3_{it}) + X_{it} \beta_8 + \varepsilon_{it},$$

where  $y_{it}$  is one if an individual  $i$  is non-active in time  $t$  and it is equal zero, when an individual is active in the same period.  $c$  is a dummy to be in the control group – three to six years before the eligibility age,  $AFTER1_{it}$ ,  $AFTER2_{it}$ ,  $AFTER3_{it}$  are dummy variables for the three consecutive periods (1.5 years long) after the policy change. The period before the policy change is defined as 1.5 years before the policy change became effective,  $X_{it}$  is the vector of observable individual characteristics (basic demographic characteristics: educational level, number of people in the household, marital status, geographical location) and  $\varepsilon_{it}$  is the error term. This model is estimated by probit model with standard maximum likelihood estimation technique.

The estimated coefficient  $\beta_1$  captures all differences between treatment and control group that are unrelated to the policy change. The  $\beta_2$ ,  $\beta_3$  and  $\beta_4$  captures all the period-specific changes that influence the probability to be employed for control and treatment group.  $\beta_5$ ,  $\beta_6$  and  $\beta_7$  are the coefficients of interest. They reflect the impact of the policy

change on the inactivity of the treatment group relative to the control group. The vector of coefficients  $\beta_8$  captures the influence of major demographic characteristics.

## 6. Results

Our final sample contains 50 152 observations, 26 735 from treatment group and 23 417 from control group. The estimated coefficients indicate that the treatment significantly increased labor supply of treatment group. The coefficients have expected sign; however, the first period after the change does not have significant impact on the labor supply. The reason is that our treatment group contains also the people who entered the early retirement during the previous system. Therefore, the pass-through to the participation rate of treatment group is lagged and becomes visible only in periods *AFTER2* and *AFTER3*:  $\beta_5$  is not significant in our specification and  $\beta_6$  together with  $\beta_7$  are negative and significant. After controlling for other observable characteristics, results change mainly in significance of coefficients. The other controls are significant with expected signs: higher education decreases the probability of being non-active. The same effect has the number of household members. We do not include labor market status of spouse, because labor market activity of spouses can be potentially affected also by the reform and thus it is endogenous variable. To reveal magnitude of estimated effects – impact on probability - marginal effects are presented in Table 9.

[Table 9 here]

We estimated three different specifications. The most extended version contains individual characteristics and 61 dummies for districts. In all models this effect remains negative. The marginal effect of the reform on probability to be non-active is close to -0.03,

which can be interpreted as the 3 % drop in the probability to be inactive for workers who are three years before they reach eligibility age. These results show that non-activity significantly decreased in treatment group during 2003 - 2005 relatively to the control group and the period before. Our results also show that there is no significant effect of the policy change in the period immediately after the policy change. This is probably due to the fact that the left hand side variable is a stock (probability to be inactive) and thus the treatment group contain in the first period after the policy change contains a lot of individuals, who entered early retirement before the policy change.

We are also aware of problem with expectation that could influence the behavior of people right before the reform became effective. In our case it would mean that people entered early retirement earlier just because the policy change occurred. This fact would bias our results. We can not fully account for this phenomenon due to data limitation. Thus we did robustness check and we skip the half year before the reform became effective (first part of 2001), thus we shorten the baseline period to the length of one year. The results are summarized in table 9 and suggest that even in this setting the reform decreased inactivity rate among older workers. The size of this effect is however smaller and in the specification (2) and (3) the significance decreased to approximately 10% level. These results could be considered as lower bound of the estimated effect, because those people, who reacted purely on announcement of the reform, would probably enter early retirement later on, in case they behave rationally.

[Table 10 here]

The dummies that represent geographical location show high variation in the labor market behavior across different regions in the Czech Republic (results presented in annex). For example, the individuals from Karvina have by 40 % higher chance to be non-active

compared to individuals from Prague, even after controlling for all possible observable characteristics.

We also attempt to use explanatory variable that indicate change in the labor market status. However, as we already mentioned, we face problem with lack of observations for people who change status during the period they were surveyed (i.e. four or five quarters). We divided our time span into two periods: two years before the reform and two years after the reform. We observed only few changes in labor market status for treatment group: 172 out of 2 541 individuals for two years before the policy change, 113 out of 2 587 after the policy change. We can conclude that these numbers are in line with our hypothesis that by lowering early retirement benefits fewer workers entered the early retirement. However, the number of observations in our sample does not allow any formal econometric analysis in this setting.

## **7. Conclusion and Policy Implication**

Our results confirm that 2-3 % cut in early retirement benefits due to 2001 reform boosted labor participation of males eligible for early retirement by approximately same size. The reform increased the probability of being employed within three years period before a worker reaches the statutory standard retirement age. These results show that the elasticity of extensive margin of labor supply of the Czech older workers is relatively high, although we are not able to calculate the exact value, because we lack the individual data on wages.

Our findings are generally in line with those for example from Germany, where Börsch-Supan (2000) found high sensitivity older workers' employment on the social security system design. Our results also correspond to Galuščák (2002) who found substantially high sensitivity of participation rate on the change in earning test for old workers older than statutory retirement age. In this respect, our results are not fully comparable, because we

examine older workers who are eligible for early retirement and do not reach statutory retirement age.

In our approach, we assume that the difference in the labor supply between older and younger cohorts was not affected by any other shock than the policy change. This is only possible way how to empirically test the public policy intervention affecting whole population in one country.

The extent of our analyses is also limited by data availability. The dataset contains important characteristics about retirement of males and - on top of that - it does not contain wages. Therefore, our analysis does not cover labor supply of females and we do directly estimate the elasticity of labor supply on individual budget constraint. Our results also indicate high differences of labor supply behavior across males with different characteristics (education, geographic location). This might be subject to the additional research.

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## Annex 1: Social security formula

$$P = BA + PA$$

$$PA = CB \cdot AP$$

$$CB = PAB \cdot rp_1 + \max(0, PAB - rb_1) \cdot (rp_1 - rp_2) + \max(0, PAB - rb_2) \cdot (rp_2 - rp_3)$$

$$AP = \text{int}((IP_1 + IP_2 \cdot 0,8) / 365) \cdot (PYI - 90_{per} \cdot rPYI)$$

$$PAB = \frac{\sum_{y=Y-1-\min(30, Y-1-1986)}^{Y-1} AAB_y}{\min(30, Y-1-1986) - EP / 365}$$

$$AAB_y = CB_y \cdot CGGAB_y$$

$$CGGAB_y = \frac{GAB_{2004} \cdot RC_{2004}}{GAB_y}$$

**P** – pension benefit

**BA** – basic amount

**PA** – percentage-based assessment

**CB** – calculation base

**AP** – adjustment percentage

**PAB** – personal assessment base

**rp<sub>1</sub>** = 100 %, **rp<sub>2</sub>** = 30 %, **rp<sub>3</sub>** = 10 % – reduction percentage

**rb<sub>j</sub>** = first and second reduction boarder in yearly terms

**IP<sub>j</sub>**, **j** = 1, 2 – insured period (j = 1) and compensatory insured period (j = 2) counted as 80 per cent of the length before reaching age of 18 (only whole 365 days are included)

**PYI** – percentage for each year of insurance (1.5 %)

**90per** – number of 90 day periods

**rPYI** – reduced percentage for each 90 day period being early retired (**subject of policy change**)

**AAB** – annual assessment bases

**EP** – excluded period

**CGGAB** – coefficient of the growth of the general assessment base

**GAB** – general assessment bases

**RC** – recalculation coefficient

**Y** – year

Table Annex:

Tab. 1: Newly granted pensions (in CZK)

	1999	2000	2001	2002	2003	2004	2005
(1) all pensions	5 991	6 106	6 399	7 055	7 224	7 760	8 391
(2) at the retirement age	6 222	6 485	6 823	7 226	7 512	7 968	8 693
(3) after the retirement age	7 272	7 485	7 916	8 621	9 157	9 410	10 306
(4) early retirement-temporarily cut	5 370	5 513	5 838	5 917	6 224	6 404	6 836
<b>(5) early retirement-permanently cut</b>	<b>5 593</b>	<b>5 659</b>	<b>5 844</b>	<b>5 667</b>	<b>5 996</b>	<b>6 261</b>	<b>6 984</b>
(5)/(2) (in %)	90	87	86	78	80	79	80

Source: MPSV (2006), own computation of averages

Tab. 2: Changes in early retirement benefits due to the policy change

	Years before eligible age T	Absolute decrease Before/after (in CZK/month)	Relative decrease in early retirement benefit Before/after (in %)	Change in terms of net wage (in percentage points)
70% of avg. wage	T - 3	191	- 3	-2.4
	T - 2	133	- 2	-1.6
	T - 1	131	- 2	-1.1
Avg. Wage	T - 3	218	- 3	-1.9
	T - 2	149	- 2	-1.3
	T - 1	152	- 2	-1.3
150% of avg. wage	T - 3	237	- 3	-1.3
	T - 2	162	- 2	-0.9
	T - 1	166	- 2	-0.9

Source: Own computation, based on the official formula published in MPSV (2002).

Note: Benefits are computed for 46 years of service. Net wage is 11 324 CZK in 2001. Three income groups were chosen arbitrarily, 70 % of average wage reflects approximately group of workers with median wage and 150 % of average wage represents managers and high-paid workers in the Czech economy.

Tab. 3: Calculation of incentives before the reform (average earner)

Last Age of Work	Replacement Rate	SSW	Accrual	Accrual Rate	Tax/Subsidy
55		533 869			
56		527 421	-6 448	-0.012	0.044
57	0.837	521 199	-6 222	-0.012	0.042
58	0.870	541 335	20 135	0.037	0.134
59	0.906	561 633	20 298	0.036	0.134
60	0.936	559 937	-1 695	-0.003	0.011
61	0.964	503 717	-56 221	-0.112	0.364
62	1.012	459 384	-44 332	-0.097	0.284
63	1.037	403 161	-56 223	-0.139	0.357
64	1.105	366 359	-36 801	-0.100	0.231
65	1.111	318 952	-47 407	-0.149	0.295

Tab. 4: Calculation of incentives after the reform (average worker)

Last Age of Work	Replacement Rate	SSW	Accrual	Accrual Rate	Tax/Subsidy
55		527 792			
56		521 273	-6 519	-0.013	0.044
57	0.828	514 908	-6 365	-0.012	0.043
58	0.864	536 974	22 066	0.041	0.147
59	0.903	559 274	22 300	0.040	0.147
60	0.936	559 937	664	0.001	0.004
61	0.964	503 717	-56 221	-0.112	0.364
62	1.012	459 384	-44 332	-0.097	0.284
63	1.037	403 161	-56 223	-0.139	0.357
64	1.105	366 359	-36 801	-0.100	0.231
65	1.111	318 952	-47 407	-0.149	0.295

Tab. 5: Forward looking social security incentives before the reform

ret. age	Peak value				Option value			
	low wage	avg. wage	high wage	SD	low wage	avg. wage	high wage	SD
55	34 740	27 764	18 414	6 689	59 043	70 329	87 659	11 769
56	39 297	34 212	28 085	4 584	53 411	64 254	80 859	11 288
57	43 631	40 434	37 454	2 522	48 764	59 128	74 967	10 775
58	22 102	20 298	19 617	1 048	41 973	51 955	67 168	10 359
59	1 466	-1 695	-6 870	3 436	36 044	45 893	60 885	10 213
60	-46 376	-56 221	-72 673	10 848	29 472	38 511	52 197	9 342
61	-41 218	-44 332	-49 485	3 409	29 643	38 580	52 115	9 238
62	-50 566	-56 223	-65 686	6 237	32 633	41 787	55 662	9 467
63	-30 642	-36 801	-47 010	6 750	35 812	45 090	59 172	9 603
64	-41 364	-47 407	-57 557	6 681	36 208	45 640	59 966	9 768
65					36 636	46 245	60 846	9 954

Tab. 6: Forward looking social security incentives after the reform

ret. age	Peak value				Option value			
	low wage	avg. wage	high wage	SD	low wage	avg. wage	high wage	SD
55	40 316	32 145	22 846	7 137	59 043	70 329	87 659	11 769
56	44 873	38 664	32 589	5 015	53 411	64 254	80 859	11 288
57	49 278	45 029	42 100	2 947	48 764	59 128	74 967	10 775
58	26 033	22 963	22 048	1 704	41 973	51 955	67 168	10 359
59	3 539	664	-4 225	3 205	36 044	45 893	60 885	10 213
60	-46 376	-56 221	-72 673	10 848	29 472	38 511	52 197	9 342
61	-41 218	-44 332	-49 485	3 409	29 866	38 828	52 385	9 257
62	-50 566	-56 223	-65 686	6 237	33 062	42 253	56 187	9 506
63	-30 642	-36 801	-47 010	6 750	36 437	45 772	59 936	9 661
64	-41 364	-47 407	-57 557	6 681	36 826	46 307	60 718	9 823
65					37 255	46 907	61 593	10 006

Tab. 7: Descriptive statistics - control group

Variable	Mean	Std. Dev.	Min	Max
non-activity status	0.17	0.38	0	1
elementary	0.09	0.29	0	1
apprenticeship	0.54	0.50	0	1
high school	0.24	0.43	0	1
lower tertiary	0.01	0.10	0	1
upper tertiary	0.11	0.32	0	1
unmarried	0.04	0.21	0	1
married	0.84	0.37	0	1
widowed	0.04	0.20	0	1
divorced	0.07	0.26	0	1
before	0.22	0.42	0	1
after1	0.24	0.43	0	1
after2	0.28	0.45	0	1
after3	0.26	0.44	0	1
household_mem	2.60	1.07	1	11
age	56.90	0.94	55.0	58.8

Tab. 8: Descriptive statistics – treatment group

Variable	Mean	Std. Dev.	Min	Max
non-activity status	0.42	0.49	0	1
elementary	0.12	0.32	0	1
apprenticeship	0.50	0.50	0	1
high school	0.25	0.43	0	1
lower tertiary	0.01	0.09	0	1
upper tertiary	0.12	0.32	0	1
unmarried	0.04	0.20	0	1
married	0.84	0.37	0	1
widowed	0.05	0.22	0	1
divorced	0.07	0.26	0	1
before	0.25	0.43	0	1
after1	0.26	0.44	0	1
after2	0.26	0.44	0	1
after3	0.23	0.42	0	1
household_mem	2.41	0.97	1	10
age	59.72	0.78	58.25	62.25

Tab. 9: Estimated coefficients from the probit model in three different specifications

Model	(1)	(2)	(3)
OLD*AFTER1	<b>-0.0159</b> (0.0180)	<b>-0.0108</b> (0.0182)	<b>-0.0096</b> (0.0182)
OLD*AFTER2	<b>-0.0509***</b> (0.0179)	<b>-0.0340*</b> (0.0184)	<b>-0.0318*</b> (0.0184)
OLD*AFTER3	<b>-0.0457**</b> (0.0187)	<b>-0.0354*</b> (0.0189)	<b>-0.0317</b> (0.0191)
Personal characteristics		X	X
District dummies			X
N	50152	50152	50152
Pseudo R-squared	0.07	0.10	0.14

Note: Coefficients are recalculated into the probability measure (min 0, max 1). The excluded variables are dummies for: control group, one period before the policy change, interaction of control group and all periods. Full results are presented in annex 2. Standard errors are in parentheses.

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Tab. 10: Estimated coefficients from the probit model in three different specifications without first half of 2001

Model	(1)	(2)	(3)
OLD*AFTER1	<b>-0.000350</b> (0.0127)	<b>0.00345</b> (0.0128)	<b>0.00341</b> (0.0129)
OLD*AFTER2	<b>-0.0361***</b> (0.0118)	<b>-0.0201*</b> (0.0121)	<b>-0.0197</b> (0.0122)
OLD*AFTER3	<b>-0.0308**</b> (0.0121)	<b>-0.0214*</b> (0.0123)	<b>-0.0199</b> (0.0124)
Personal characteristics		X	X
District dummies			X
A	46127	46127	46127
Pseudo R-squared	0.06	0.11	0.13

Note: Coefficients are recalculated into the probability measure (min 0, max 1). The excluded variables are dummies for: control group, one period before the policy change, interaction of control group and all periods. Full results are presented in annex 2. Standard errors are in parentheses.

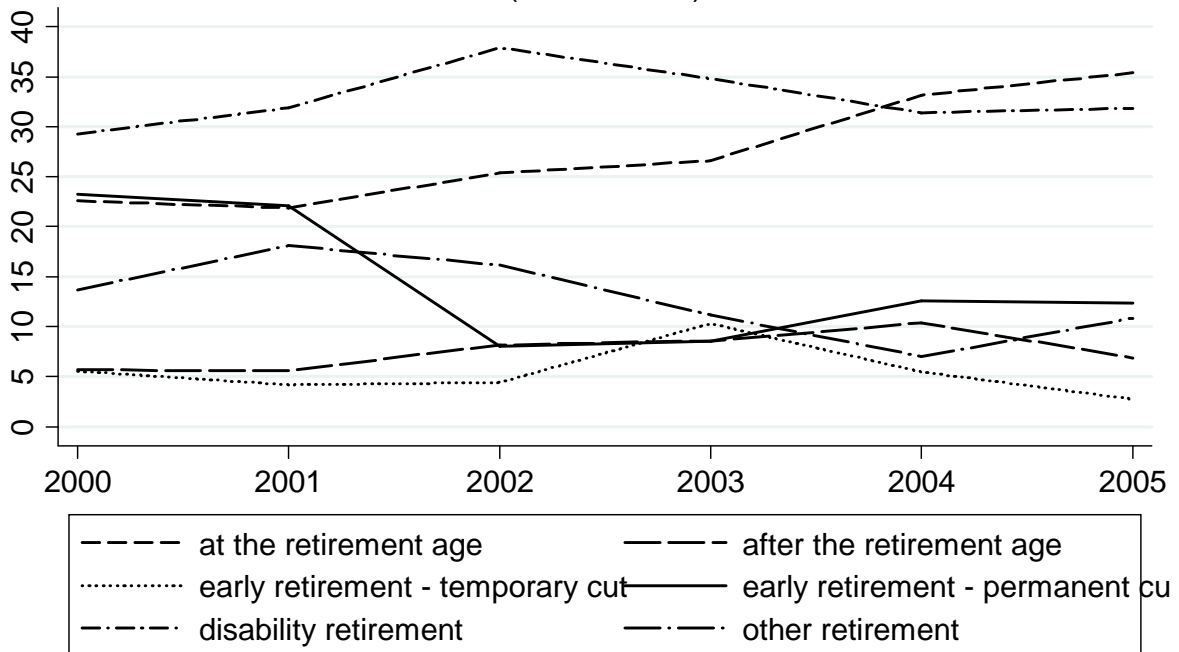
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Tab 11: Econometric results of the full baseline model

	Model 1	Model 2	Model 3
OLD	0.281*** (0.0145)	0.275*** (0.0146)	0.274*** (0.0147)
AFTER1	-0.0234* (0.0135)	-0.0180 (0.0136)	-0.0205 (0.0136)
AFTER2	-0.0135 (0.0143)	-0.0110 (0.0144)	-0.0106 (0.0144)
AFTER3	-0.0223 (0.0146)	-0.0193 (0.0147)	-0.0223 (0.0146)
OLD_AFTER1	-0.0159 (0.0180)	-0.0108 (0.0182)	-0.00922 (0.0182)
OLD_AFTER2	-0.0509*** (0.0179)	-0.0340* (0.0184)	-0.0318* (0.0184)
OLD_AFTER3	-0.0457** (0.0187)	-0.0354* (0.0189)	-0.0317 (0.0191)
edu3		-0.125*** (0.0130)	-0.131*** (0.0131)
edu4		-0.191*** (0.0108)	-0.188*** (0.0109)
edu5		-0.162*** (0.0237)	-0.161*** (0.0224)
edu6		-0.250*** (0.0076)	-0.243*** (0.0077)
unmarried		0.109*** (0.0228)	0.118*** (0.0231)
widowed		0.0454** (0.0199)	0.0479** (0.0199)
divorced		0.0377** (0.0171)	0.0369** (0.0172)
household members		-0.0157*** (0.0045)	-0.0161*** (0.0046)
92 districts (not reported)			
Observations	50152	50152	50152
Pseudo R-squared	0.07	0.11	0.14
Standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

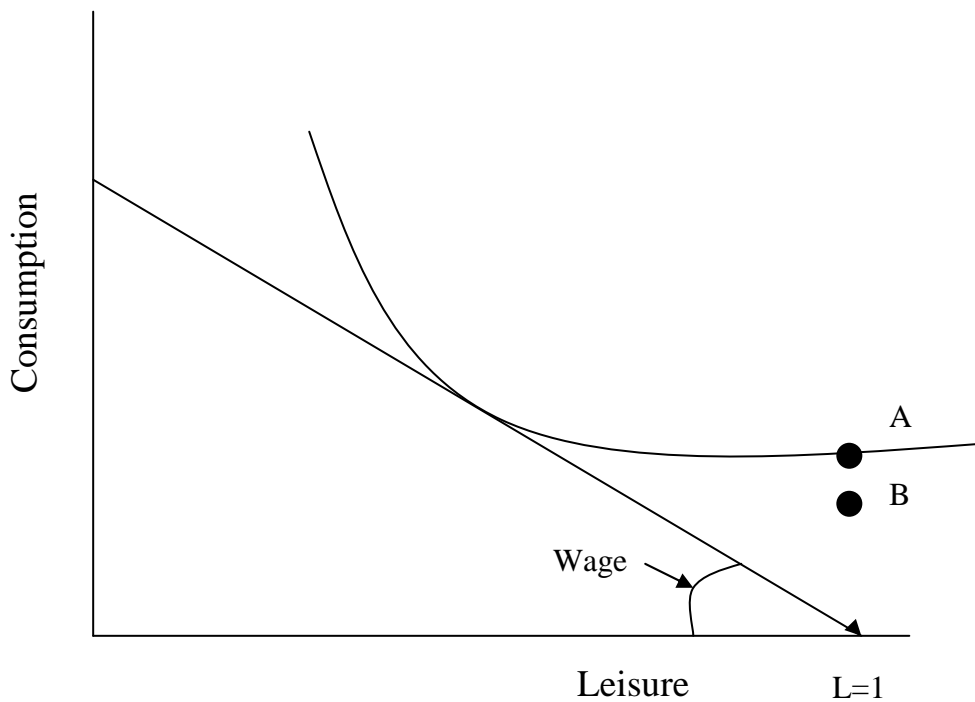
Graph Annex:

Fig. 1: Newly Entitled Pensions (men)  
(in % of total)



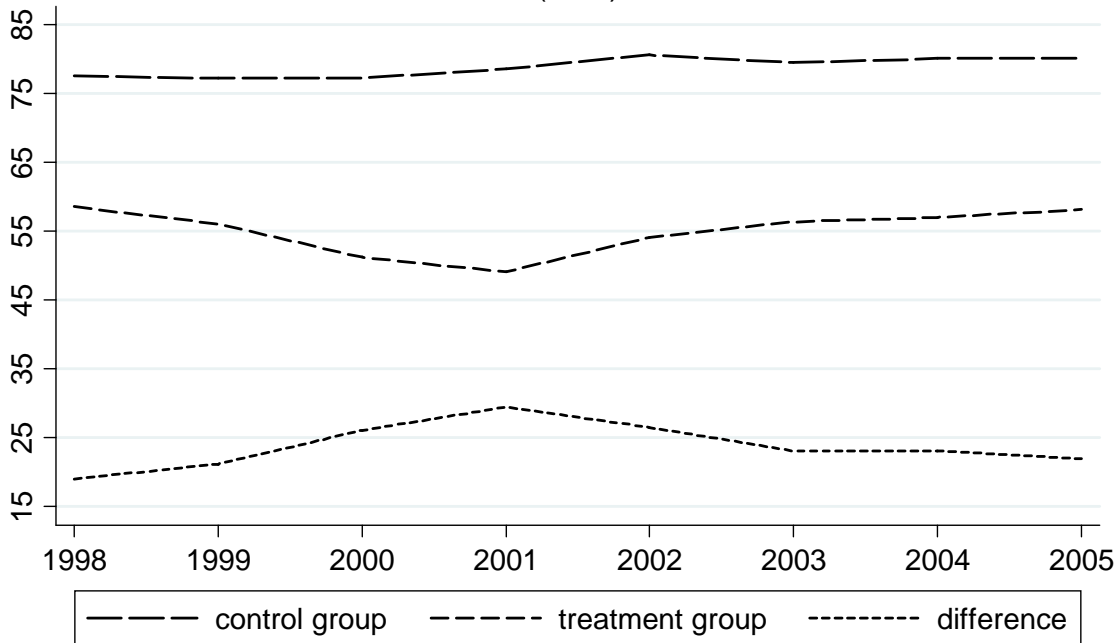
Source: Czech Social Security Administration, own calculation  
Note: The short time span before the actual change is given by the limitation of official statistics.

Fig. 2: Graphical representation of the change in early-retirement benefits



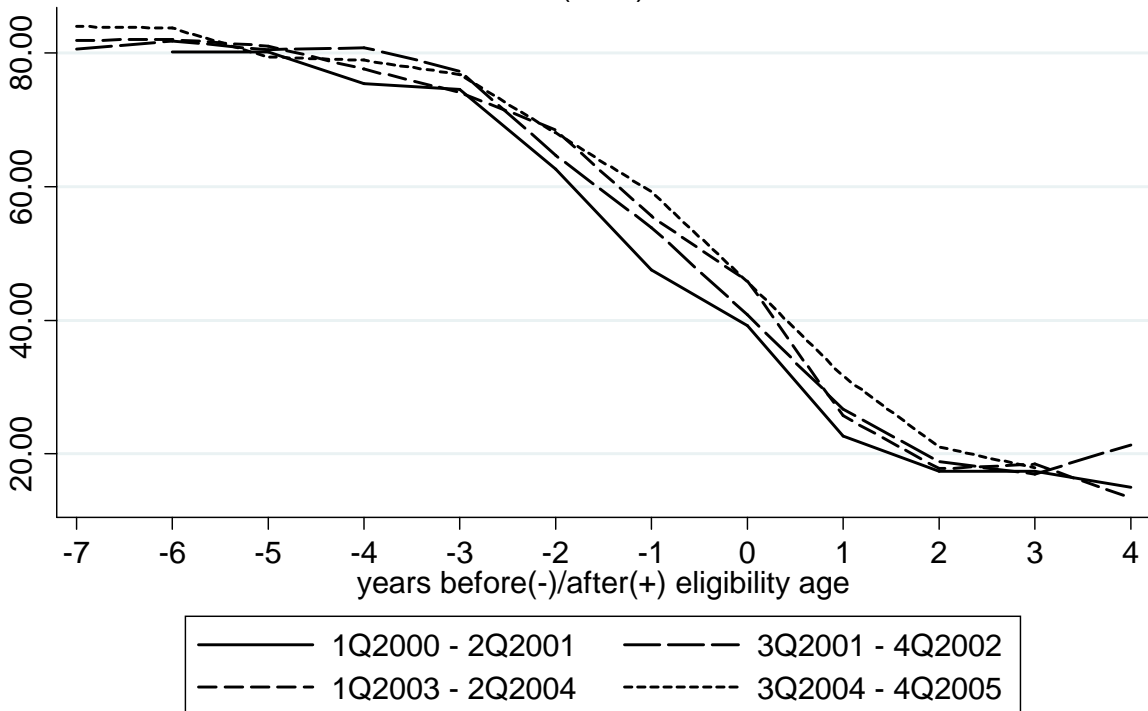
Note: A – non-labor income (early retirement benefit) before the reform, B – non-labor income (early retirement benefit) after the reform. The consumer decides to start working after the decrease in early-retirement benefits, keeping all other factors constant.

Fig. 3: Participation rate of control and treatment group in 1998-2005  
(in %)



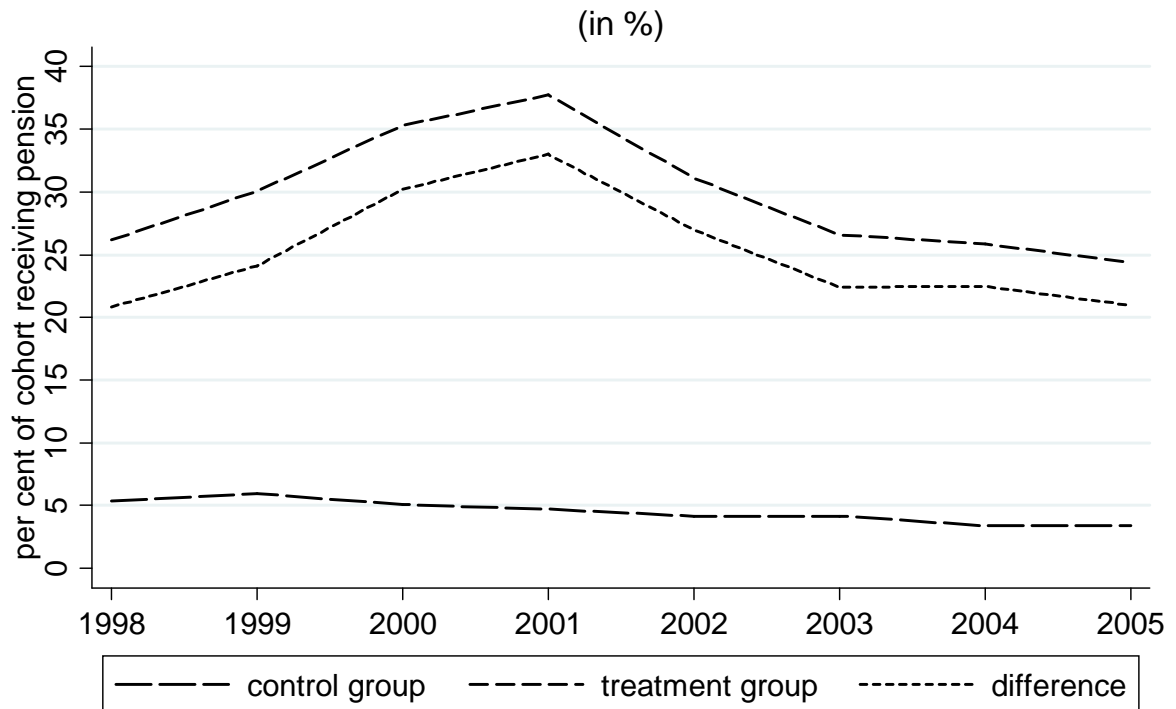
Source: Labor Force Survey, own calculation

Fig. 4: Participation rate in different distances to eligibility age  
(in %)



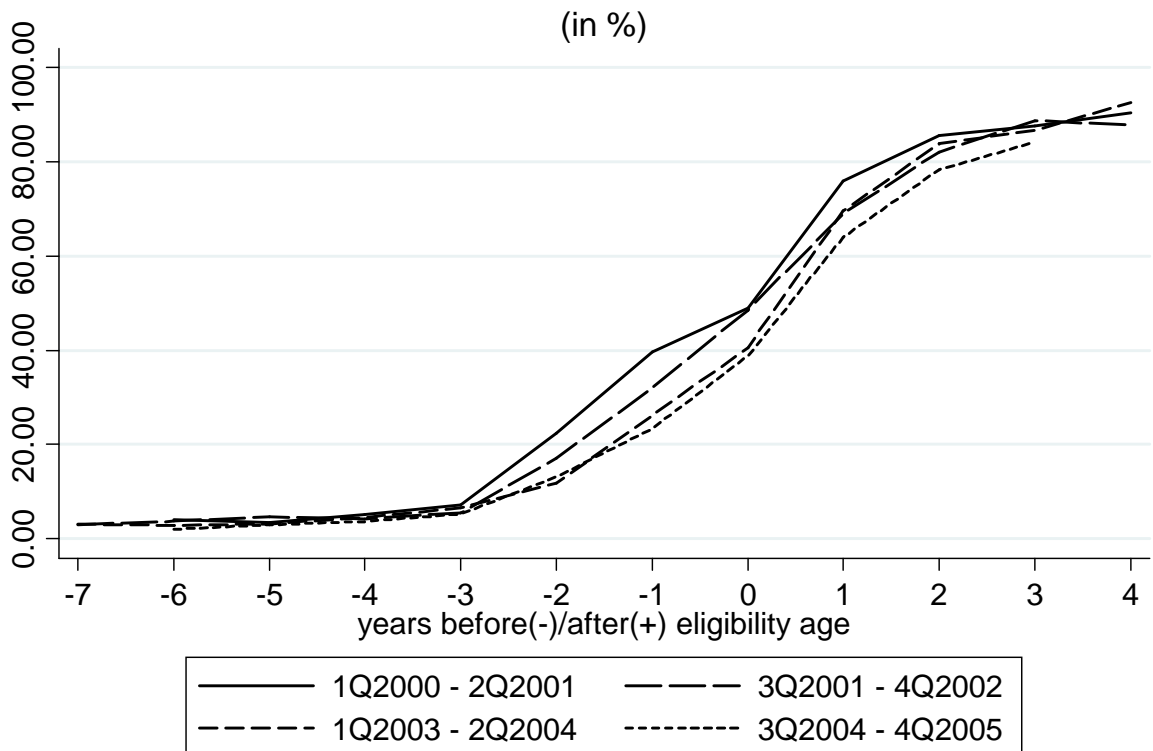
Source: Labor Force Survey, own calculation

Fig. 5: Incidence rate of control and treatment group in 1998-2005



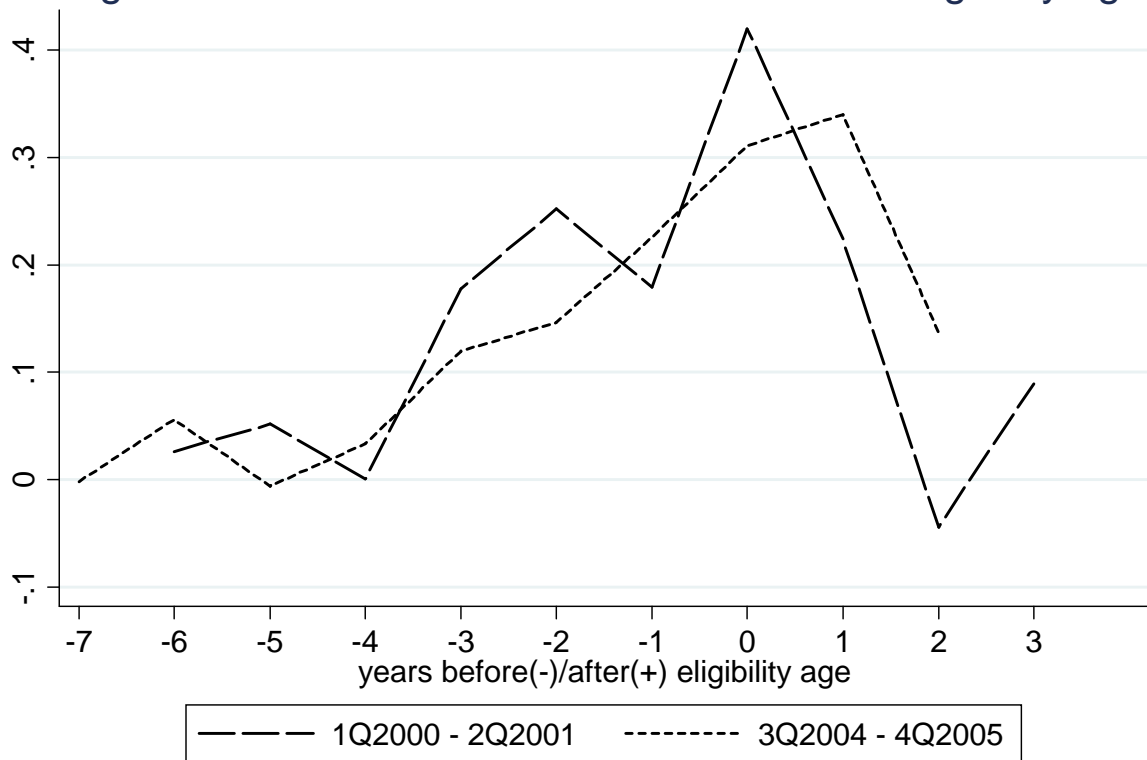
Source: Labor Force Survey, own calculation

Fig. 6: Incidence rate for different distances to eligibility age



Source: Labor Force Survey, own calculation

Fig. 7: Hazard rates in different distances to eligibility age



Source: Labor Force Survey, own calculation