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.

JEL classification: J21, J26
Keywords: early-retirement, labor market participation, Czech Republic

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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.[1] Czech government reacted on this development and decreases incentives formed by social security system to early retire. The policy makers expected that this step decreases the number of people who receive the retirement benefits and in the same time it increases the number of contributors to the pension system. These unambiguous advantages make this policy step popular also among many other governments facing the issue of aging.[2]

The policy relevance of this topic is reflected in the current empirical literature. 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 (e. g. Brinch et al., 2001).

[1] According to the projection of the Czech Statistical Office, the share of people aged 60 and more will double in next 30 years.

[2] It needs to be highlighted that the overall fiscal balance is improved unless retirees are proportionally compensated for longer service and unless the employees the labor market and become unemployed or enter disability social help and/or became recipients of support from other social program.

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 (2002) shows that the introduction of earning test, which imposed benefit eligibility constraint for working pensioners, led 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 causal impact of early retirement incentives and participation of older workers.

The retirement incentives can have different forms: explicit and implicit taxation and/or legal 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, three years before they reach statutory retirement age. The policy change became effective in July 2001 and cut the early retirement benefits by approximately 3 % for new claimants. To illustrate this we also compare several incentives measures before and after the reform.

Social security statistics shows that one year after the policy change, the number of new early retirees decreased by half. This suggests the direct impact of this policy step was strong. However, as we describe in the next section older workers face several options how to

become non-employed (retire early[3], become unemployed or enter disability retirement[4]), the causal positive effect of the policy change on the labor supply of older workers is under question.

In order to find the causal impact of the policy step, 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. The eligibility age window for entering early retirement starts at three years before the statutory retirement age. In particular, 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 increased probability of male's participation on the labor market by 2-3 % for those who are eligible for early retirement. This paper is organized as follows. The next section provides detail insight into the social security system in the Czech Republic. The official statistics and simulations of the policy change on individuals are described in the section 3. Section 4 covers data description of treatment and control group. Graphical overview is presented in section 5, econometric methodology is explained in section 6 and results are described in section 7. Section 8 concludes.

2. Institutional Setting

The Czech retirement scheme is standard pay-as-you-go (PAYG) system with mandatory participation for all employees and self-employed as well. 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,

[3] The exact preconditions for early retirement are described in the Act No. 155/1995 Coll.
[4] To enter the disability retirement certain health criteria has to be met. Hence, it is not a free choice of the individual.

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.[5] 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 pension benefits are computed based on a formula that has individual part (percentage adjustment) and part, which is the same for all workers (basic amount). Basic amount is legislatively stated amount of money, which is received by everybody who is old-pension recipient. It can be understood as a minimum pension. The individual part contains 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 calculation base (CB). CB represents the crucial step in Czech pension formula which causes the high degree of redistribution in the 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.

[5] 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.

This formula is applied to any kind of retirement benefits including early-retirement benefits[6]. The early retirement benefits are lower then the standard ones, because they are reduced by the adjustment coefficient (rPYI), which was subject to the policy change. In particular, the "punishment" for the early retirement was before the reform 0.6 % and 0.3 %[7] per each 90 days remaining to standard retirement age before the policy was introduced. The policy step 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 pension benefit and hence it has an influence on the motivation of workers to stay active on the Czech labor market until the statutory retirement age.

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 most likely caused by two effects. The first one is driven by the change in early retirement benefits. The second one is driven by the change in the characteristics of workers who applied for early retirement before and after the policy step changed.

[6] 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.

[7] 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.

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
(5) early retirement-permanently cut	**5 593**	**5 659**	**5 844**	**5 667**	**5 996**	**6 261**	**6 984**
(5)/(2) (in %)	90	87	86	78	80	79	80

Source: MPSV (2006), own computation of averages

The 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 and they could also have different working histories[8], 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 also compute the early retirement benefits before and after the change for individuals with the 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 CZK per month). The cut-down correspond approximately to 1 - 2.5 % of average net wage for male workers in the economy.

[8] Different wage histories and number of years in service, etc.

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.

The ratio of net wage and early retirement benefits (net replacement rate) decreased by 0.9 - 2.4 percentage points. 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 change affected more strongly individuals who face relatively disadvantaged position on the labor market.

Another way how to assess the effect of this policy change is suggested in 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

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

with:

SSW - social security wealth,
S - planning age,
R - planned retirement age,
E - expected age of decease at age S,
$\pi(t \mid S)$ - 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,
δ - discount factor,
c - contribution rate on social security.

Since SSW is very sensitive to many assumptions[9]. We employ the values for the discount factor and the wage growth[10] 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 do not assume any indexation formula. The process of indexation in Czech Republic depends very much on government discretion as it is described in Dušek (2007) and Dušek and Kopecsni (2008).

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

Tab. 3: Monetary incentives before and after the reform (average earner)

Last Age of Work	Replacement Rate - Before	Replacement Rate - After	SSW- Before	SSW- After	Accrual Rate - Before	Accrual Rate - After
57	0.837	0.828	521 199	514 908	0.037	0.041
58	0.870	0.864	541 335	536 974	0.036	0.040
59	0.906	0.903	561 633	559 274	-0.003	0.001
60	0.936	0.936	559 937	559 937	-0.112	-0.112
61	0.964	0.964	503 717	503 717	-0.097	-0.097
62	1.012	1.012	459 384	459 384	-0.139	-0.139
63	1.037	1.037	403 161	403 161	-0.100	-0.100
64	1.105	1.105	366 359	366 359	-0.149	-0.149

Note: SSW – Social security wealth is defined as the sum of all discounted pension benefits and social security contributions. Accrual rate is defined as the relative year to year change in SSW.

[9] Assumption of individual discount rate, future indexation of benefits under PAYG, interest rate path, wage growth etc.
[10] For simplicity we assume the same wage growth for all income groups.

Each row corresponds to the age, in which a worker enters retirement. In this exercise we assume for the sake of simplicity that statutory retirement age is 60. It means that everybody who enters retirement before his 60 is in early-retirement regime and worker is eligible for early retirement benefits in 57.

Comparing the SSW before and after the reform, one can see substantial decrease in SSW for those who enter early-retirement. The second implication of the reform is that SSW had its peak in the 59 before the reform, whereas after the reform the SSW in 60 (statutory retirement age) and in 59 is almost the same. This is also reflected in accrual rate, which shows relative change in SSW if retirement is postponed by one year.

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 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.

Forward-looking approach to assess the incentives formed by the pension system can be studied using the peak value and option value (Coile and Gruber, 2007). Peak value is defined as all discounted benefits from entering the retirement. In fact it is maximized when SSW reaches its maximum. We performed this analysis and it obviously supports the preceding analysis that the reform has increased incentives for the average earner to stay at the labor market. Second approach to assess financial incentives is an option value model (Stock and Wise, 1990). The option value attempts to evaluate the optimal retirement in utility terms and it involve forgone earnings that could have been earned on labor market. It is defined as the change in the utility that results from working to the optimal age, which is

determined by maximizing the lifetime utility over consumption and leisure. The problem of this approach is that one needs to employ certain assumptions about wage profile in the final stage of career.

We employ standard assumption about linear wage profile, which in fact does not have to be realistic assumption. Our results are summarized in Annex 2 and it suggests that according to the option value the optimal retirement age was not changed by the reform and it is at the statutory retirement age. We however leave more detail analysis for further research.

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.

3. Data Description and 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 Annex 3.

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 for 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, see Annex 5. 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

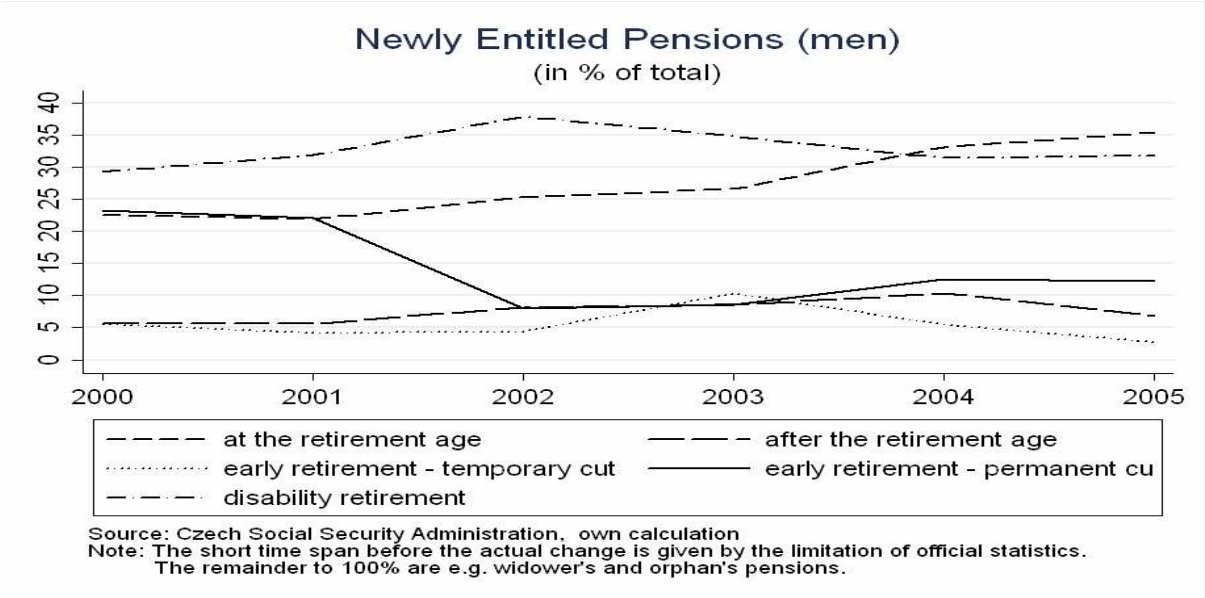
the policy. Relatively broad definition of treatment group allows us to capture all individuals who were eligible for the early retirement and could make decision during entire period of three years before they reach eligibility age. The disadvantage is that within the following period after the policy 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

As we described above, the change in early retirement scheme increase motivation to stay in labor market. As a preview of our results we present official statistics of newly granted pensions (Fig. 1). The share of newly granted pensions for this particular pension scheme dropped significantly (solid line).

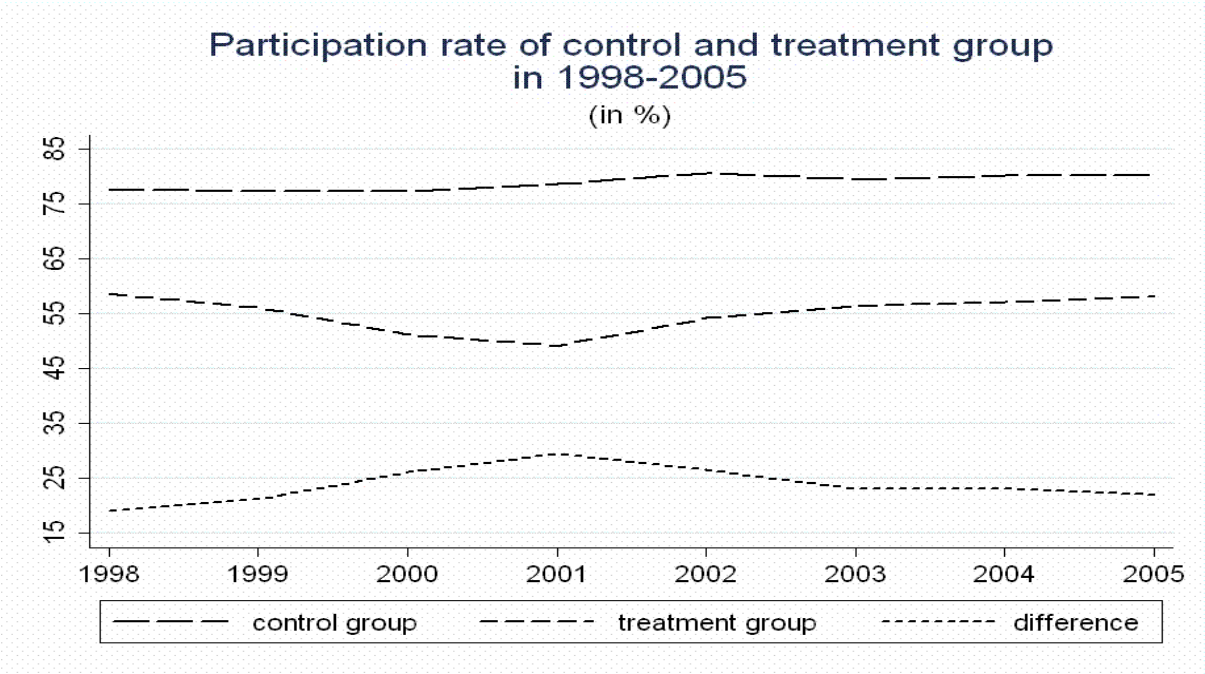
Figure 1



This suggests that this reform could have strong impact on labor market decision. However, the total impact of on participation rate can be questioned, because the share of other option to early-exit could be used as it can be seen in Figure 1.

Further we present behavior of individuals using Labor Force Survey described above. Figure 2 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.

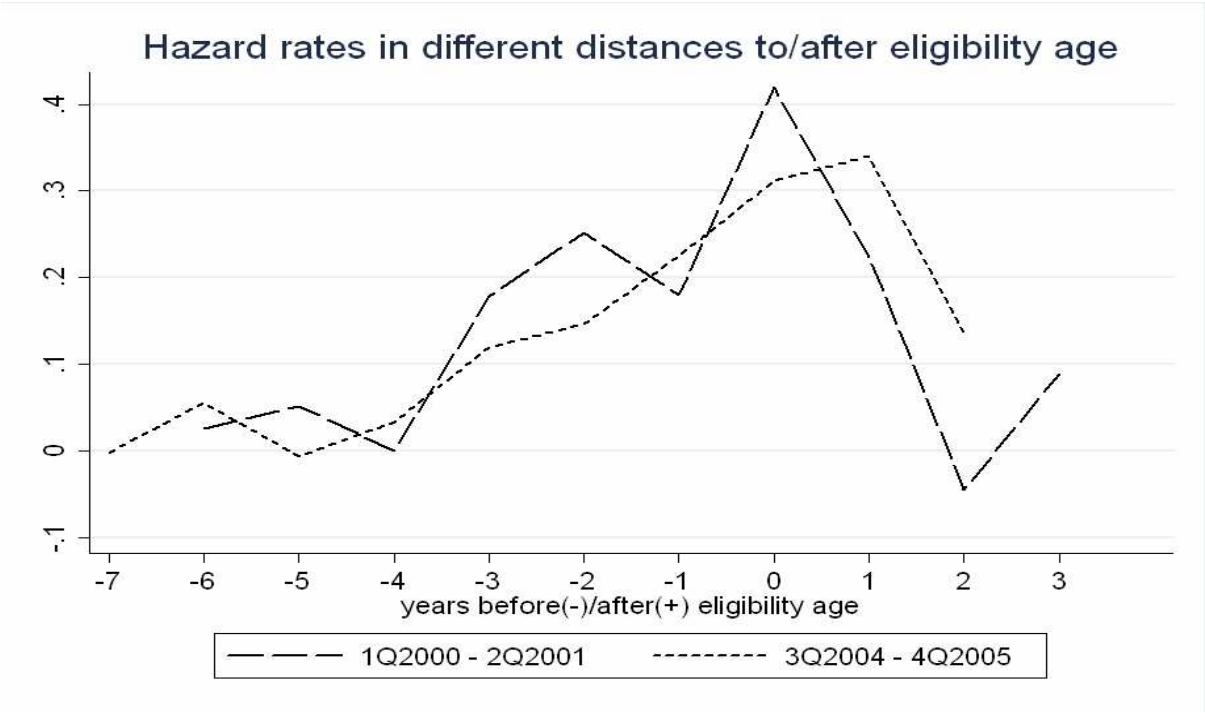
Figure 2



Source: Labor Force Survey, own computation

We also present an alternative indicator – hazard rate – representing the probability of labor force withdrawal due to the retirement. Figure 3 depicts 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 participation rate of workers aged t -1 in given year (Hurt, 1996).

Figure 3



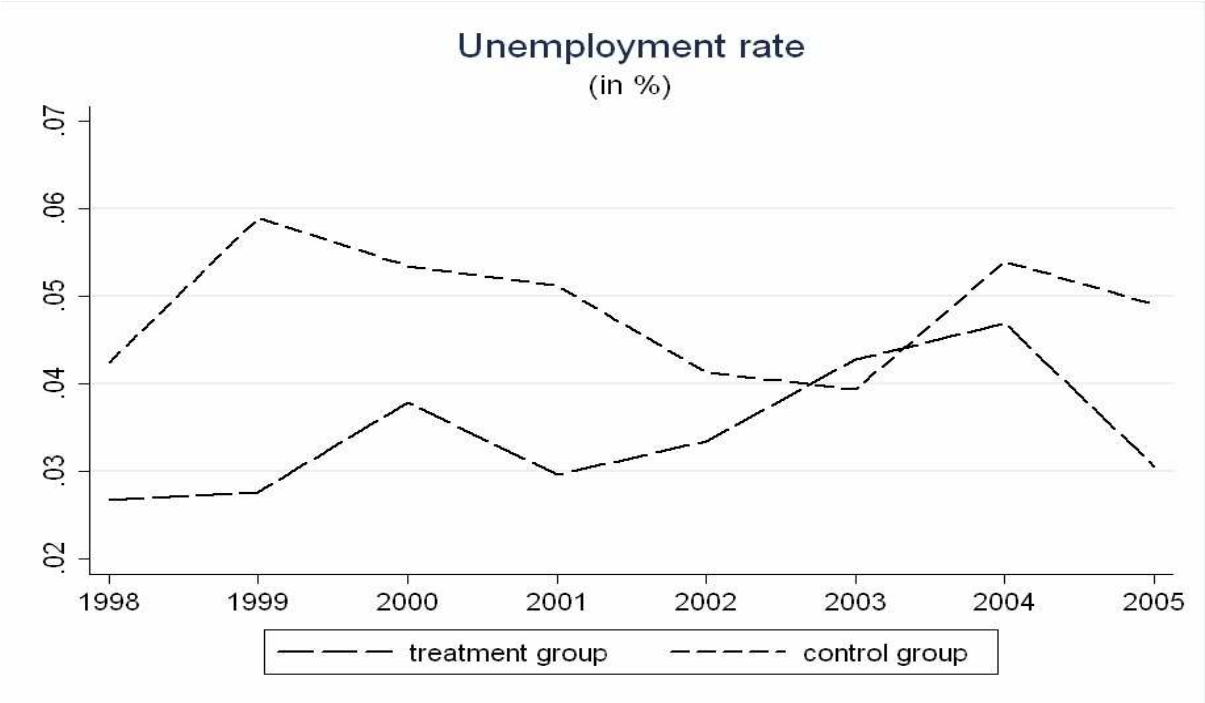
Source: Labor Force Survey, own computation

The line representing 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.

We consider also problem of unemployment that could potentially change over time and therefore question our results. The Figure 4 shows development of unemployment rate over time. The trend in unemployment is not clear, even thought the upward move of unemployment of treatment group right after the policy change. However, one need to be aware that number of unemployed individuals in our sample is relatively small and this change is not most likely statistically significant.

Figure 4



Source: Own computation from Labor Force Survey

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: education,

number of people in the household, marital status, geographical location) and ε_{it} is the error term. This model is estimated by probit model with standard maximum likelihood estimation technique.

The estimated coefficient β_1 captures all differences between treatment and control group that are unrelated to the policy change. The β_2, β_3 and β_4 captures all the period-specific changes that influence the probability to be employed for control and treatment group. β_5, β_6 and β_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 β_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 $AFTER3$: β_5 is not significant in our specification and β_6 together with β_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 4.

Tab. 4: Estimated coefficients from the probit model in three different specifications

Model	(1)	(2)	(3)
OLD*AFTER1	**-0.0159**	**-0.0108**	**-0.0096**
	(0.0180)	(0.0182)	(0.0182)
OLD*AFTER2	**-0.0509*** **	**-0.0340***	**-0.0318***
	(0.0179)	(0.0184)	(0.0184)
OLD*AFTER3	**-0.0457** **	**-0.0354***	**-0.0317**
	(0.0187)	(0.0189)	(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 4. Standard errors are in parentheses. We also performed linear probability estimation with OLS and it does not change the significance of results.
*** p<0.01, ** p<0.05, * p<0.1

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 first half of 2001 year since the law introducing the reform was passed through the Czech parliament at the beginning of 2001 and became effective in July 2001, thus we shorten the baseline period to the length of one year. The results are summarized in Table 5 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 has vanished. However, the result for the specification (1) 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.

Tab. 5: Estimated coefficients from the probit model in three different specifications without first half of 2001

Model	(1)	(2)	(3)
OLD*AFTER1	**-0.0004**	**0.0034**	**0.0031**
	(0.0209)	(0.0211)	(.02104)
OLD*AFTER2	**-0.0361***	**-0.0201**	**-0.0197**
	(0.0196)	(0.0201)	(0.0201)
OLD*AFTER3	**-0.0308**	**-0.0214**	**-0.0193**
	(0.0204)	(0.0206)	(0.0207)
Personal characteristics		X	X
District dummies			X
N	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. Standard errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

The dummies that represent geographical location show high variation in the labor market behavior across different regions in the Czech Republic. For example, the individuals from Karvina region have by 40 % higher chance to be non-active compared to individuals from Prague, even after controlling for all possible observable characteristics.

Our results show that the probability of being inactive (out of labor force) has decreased after the reform came in force. This means that the people have not start to leave the labor force by using other social programs (e.g. disabled pensions), but this leave the possibility to become unemployed and hence this policy change still can have negative impact on the fiscal position. Therefore we decided to run the same probit specification but with the indicator variable of being employed. Results available in Annex 6 show that the results are quite similar to that obtained earlier.

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_1 = 100 %, **rp_2** = 30 %, **rp_3** = 10 % – reduction percentage
rb_j = first and second reduction boarder in yearly terms
IP_j, 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

Annex 2:

Forward looking social security incentives

ret. age	Before the change				After the change			
	Peak value		Option value		Peak value		Option value	
	avg. wage	SD	avg. wage	SD	avg. wage	SD	avg. wage	SD
55	27 764	6 689	10 560	2 671	32 145	7 137	10 560	2 671
56	34 212	4 584	8 080	2 293	38 664	5 015	8 080	2 293
57	40 434	2 522	6 953	1 847	45 029	2 947	6 953	1 847
58	20 298	1 048	3 996	1 252	22 963	1 704	3 996	1 252
59	-1 695	3 436	2 484	306	664	3 205	2 484	306
60	-56 221	10 848	0	0	-56 221	10 848	0	0
61	-44 332	3 409	5 333	1 161	-44 332	3 409	5 582	1 180
62	-56 223	6 237	14 187	2 748	-56 223	6 237	14 653	2 788
63	-36 801	6 750	23 539	4 341	-36 801	6 750	24 220	4 398
64	-47 407	6 681	30 560	6 063	-47 407	6 681	31 228	6 118
65			38 080	7 915			38 742	7 968

Note: SD stands for standard deviation.

Annex 3:

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
# of household members	2.60	1.07	1	11
age	56.90	0.94	55.0	58.8

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
# of household members	2.41	0.97	1	10
age	59.72	0.78	58.25	62.25

Annex 4:

Econometric results of the full baseline model

	Model 1	Model 2	Model 3
old	0.281***	0.275***	0.274***
	(0.0145)	(0.0146)	(0.0147)
after1	-0.0234*	-0.0180	-0.0205
	(0.0135)	(0.0136)	(0.0136)
after2	-0.0135	-0.0110	-0.0106
	(0.0143)	(0.0144)	(0.0144)
after3	-0.0223	-0.0193	-0.0223
	(0.0146)	(0.0147)	(0.0146)
old_after1	-0.0159	-0.0108	-0.00922
	(0.0180)	(0.0182)	(0.0182)
old_after2	-0.0509***	-0.0340*	-0.0318*
	(0.0179)	(0.0184)	(0.0184)
old_after3	-0.0457**	-0.0354*	-0.0317
	(0.0187)	(0.0189)	(0.0191)
apprenticeship		-0.125***	-0.131***
		(0.0130)	(0.0131)
high school		-0.191***	-0.188***
		(0.0108)	(0.0109)
lower tertiary		-0.162***	-0.161***
		(0.0237)	(0.0224)
upper tertiary		-0.250***	-0.243***
		(0.0076)	(0.0077)
unmarried		0.109***	0.118***
		(0.0228)	(0.0231)
widowed		0.0454**	0.0479**
		(0.0199)	(0.0199)
divorced		0.0377**	0.0369**
		(0.0171)	(0.0172)
# of household members		-0.0157***	-0.0161***
		(0.0045)	(0.0046)
92 districts (not reported)			
Observations	50152	50152	50152
Pseudo R-squared	0.07	0.11	0.14

Standard errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Annex 5:

Estimated coefficients from the probit model in three different specifications (yearly periods)

Model	(1)	(2)	(3)
OLD*AFTER1	**-0.0067**	**-0.0033**	**-0.0009**
	(0.0195)	(0.0198)	(0.0199)
OLD*AFTER2	**-0.0689*** **	**-0.0573*** **	**-0.0564*** **
	(0.0201)	(0.0204)	(0.0203)
OLD*AFTER3	**-0.0623*** **	**-0.0435** **	**-0.0366* **
	(0.0198)	(0.0204)	(0.00206)
Personal characteristics		X	X
District dummies			X
N	33842	33842	33842
Pseudo R-squared	0.07	0.11	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.. Standard errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Annex 6:

Estimated coefficients from the probit model in three different specifications (dependent variable – being employed)

Model	(1)	(2)	(3)
OLD*AFTER1	**0.0117**	**0.0054**	**0.0049**
	(0.0188)	(0.0193)	(0.0193)
OLD*AFTER2	**0.0419****	**0.0226**	**0.0196**
	(0.0192)	(0.0198)	(0.0199)
OLD*AFTER3	**0.0467****	**0.0351***	**0.0312**
	(0.0197)	(0.0201)	(0.0203)
Personal characteristics		X	X
District dummies			X
N	50152	50152	50152
Pseudo R-squared	0.05	0.10	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. Standard errors are in parentheses.

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