The 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 a change in the Czech early retirement scheme on the labor force participation of older male workers. Using the difference-in-differences method we find that a reduction in early retirement benefits by 2–3% leads to significant decrease in the probability of being inactive for eligible individuals. The effect for individuals who are on the margin of eligibility for early retirement is much stronger than that for an average eligible individual. Our finding implies high elasticity of 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 increase the participation of older men in the Czech labor market.

1. Introduction

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

The Czech Republic is an example of an aging society. The Czech government has reacted to this development and has decreased the incentives to retire early created by the social security system. Policy makers expect this step to reduce the number of people who receive retirement benefits and at the same time increase 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.

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

Cross-country comparisons show a 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

the introduction of early retirement benefits as a specific form of retirement incentive decreases labor force participation (e.g. Brinch et al., 2001).

By contrast, other studies do not find clear evidence about the sensitivity of the labor supply of older workers to changes in the early retirement scheme. For example, Baker and Benjamin (1999) provide evidence from the USA and Canada which shows a relatively modest or non-existent reaction of the labor supply to changes in the 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 a few papers about the labor supply of Czech workers. Direct evidence concerning the labor supply of older workers is provided in Galuščák (2002) and Bičáková et al. (2008). Galuščák (2002) shows that the introduction of an earnings test, which imposed a benefit eligibility constraint on working pensioners, led to a significant and substantial decrease in the participation rate of workers who had reached statutory retirement age, whereas Bičáková et al. (2008) estimated the effect of tax changes on the labor supply of average Czech workers as being relatively modest. There is no direct evidence about the causal impact of early retirement incentives and the participation of older workers.

Retirement incentives can take various forms: explicit and implicit taxation and/or legal rules that restrict full-time work at a certain age. In our case we investigate the effect of reducing early retirement benefits, which are offered as non--labor income for individuals three years before the statutory retirement age. The policy change became effective in July 2001 and cut early retirement benefits by approximately 3% for new claimants. To illustrate this we also compare several incentive measures before and after the reform.

The social security statistics show that one year after the policy change, the number of new early retirees had decreased by half. This suggests that the direct impact of this policy step was strong. However, as we describe in the next section, older workers face several options regarding how to become non-employed (retire early, become unemployed, or enter disability retirement). The positive causal effect of the policy change on the labor supply of older workers is under question.

2. Identification Strategy

In order to find the causal impact of the policy step, we use the difference-in--differences estimation method, which requires us to find two groups that are as similar as possible, one of which was affected by the policy change and the other was not. The treatment and control groups should not generally differ in sensitivity to any macro shocks. To find such groups we use the fact that the eligibility age for entering early retirement is given by an arbitrarily defined threshold: three years before the statutory retirement age. Thus the treatment group includes workers who are eligible for early retirement benefits (at most three years before the statutory retirement age). The control group contains workers who are just about to enter the eligibility age for early retirement, six to three years before the statutory retirement age. However, this division might be too rough, as the youngest and oldest are too far from each other – up to six years. This might violate the assumption that these two groups are as similar as possible.

To get more precise results we further divide the treatment group into three subgroups. Each subgroup contains workers within an age range of one year. This

division into smaller age groups respects the fact that the most similar workers are those who are just above and below the eligibility age for early retirement. The final control group contains workers who are one year younger than the eligibility age for early retirement benefits. The most similar treatment group to the control group is the one that is just one year older than the eligibility age. This strategy has one important drawback: it restricts the number of observations substantially.

In particular, a marginal probit model and linear probability model are used for testing whether the policy change affects the participation rate of individuals who are eligible for early retirement, controlling for other characteristics of the individuals.

Using the three-year-wide definition of treatment and control group we show that this policy increased the probability of a male participating in the labor market on average by 2–3% for those eligible for early retirement. However, this result appears to be insignificant once we control for the possible expectation effect. In an alternative specification we restrict our control group only to individuals who are less than one year from the eligibility age for early retirement. The treatment group is divided into three consecutive groups according to the distance to the statutory retirement age. Comparing the youngest treatment group with the narrowly defined control group we get two groups of individuals who are as close as possible in age, one of which was affected by the policy change and the other was not.

3. Institutional Setting

The Czech retirement scheme is a standard pay-as-you-go (PAYG) system with mandatory participation for all employees and the self-employed as well. The basic features of the Czech pension system were inherited from the system run under the communist regime. A few legislative changes were implemented in the years after the fall of communism, but the basic features remained unchanged. The statutory retirement age is different for male and female workers; the retirement age of the latter depends on the number of children raised. Beside this differentiation the retirement age has been prolonged by two months for males and four months for females per year after 1996 to the year the male or female was supposed to retire under the former conditions. The retirement age for males in 1996 was set at 60 years.[1] The retirement age for females without children was 57 and each child raised reduces the retirement age by one year. At the time of the policy change the average retirement age for men was approximately 61.

Pension benefits are computed based on a formula that has an individual--specific part (a percentage-based assessment) and a part which is the same for everybody (the basic amount). The basic amount is the amount of money – laid down by law – that is received by everybody who is an old-age pension recipient. It can be understood as the minimum pension. The individual part reflects individual-specific characteristics, such as earning history since 1986 and number of years in service. The wage history is discounted to the current value and then modified by reduction

[1] After that there is no single retirement age for the male population in a given year. The exact formulation is that the retirement age is prolonged by two months for each initiated age-year after December 31, 1995 before the individual reaches the age of 60. In practice this means that if a worker is 60 in February 2000, then his retirement age is 60 plus ten months. Therefore, the men from this example will retire in January 2001.

limits and reduction percentages to a calculation base (CB). The calculation of the CB represents the crucial step in the Czech pension formula and causes a high degree of redistribution in the system. The amount that is lower than the first reduction limit is fully included. However, 30% of the amount between the first and second reduction limit and only 10% of the remainder which is above the second reduction limit are included. The number of years in service proportionately increases (by 1.5% per year) the size of the adjustment percentage (AP) and therefore the size of the percentage of the CB which will be counted as the percentage-based assessment (PA) in the pension formula. The longer an individual is in service, the higher the PA and therefore the higher the pension benefit will be. The exact formula can be found in *Appendix 1*[2].

This formula is applied to every kind of retirement benefits, including early retirement benefits.[3] The early retirement benefits are lower than the standard ones, because they are reduced by an adjustment coefficient (rPYI), which was subject to the policy change. In particular, the "penalty" for early retirement before the reform was 0.6% and 0.3%[4] per each 90 days remaining to the standard retirement age before the policy was introduced. The policy step changed the degree of penalization 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 retires one year before her retirement age (a 0.6% reduction applied before the reform), the adjustment percentage of her benefit decreased by 3.6% after the reform instead of the 2.4% which applied before the policy change.

This decrease in the adjustment percentage proportionally decreases the pension benefit and hence has an influence on the motivation of workers to stay active on the Czech labor market until the statutory retirement age.

Table 1 shows the drop in officially newly granted early retirement benefits. The fall was 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 a change in the characteristics of workers who applied for early retirement before and after the policy step.

The comparison of newly granted early retirement benefits before and after the reform does not provide a clear picture about the effect of the policy on benefits.

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[2] All Appendixes are electronically accessible on the web site of the Czech Journal of Economics and Finance: http://journal.fsv.cuni.cz/.

[3] 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 the individual is not allowed to work after retiring. The decreased pension benefits are collected for the rest of the individual's life. The second is early retirement with temporarily cut benefits, which allows the individual to retire at most two years before the eligibility age and is tied 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 had retired at the eligibility age. Apart from that, two more ways of escaping employment status are available: becoming unemployed and becoming disabled. However, social support for disabled people is strictly tied to the health situation of the individual and hence cannot be regarded as a fully free choice of the individual, though it can be influenced by the individual exerting pressure on the doctor who makes the decision about the disability pension.

[4] This applies to the case where the individual who applies for early retirement benefits is aged 60 or more. For all other cases the permanent penalty is then just 0.6% per each 90 days before the standard retirement age.

Table 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 retirement age	6,222	6,485	6,823	7,226	7,512	7,968	8,693
(3) after 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: MLSA (2006); own computation of averages.

Table 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 p.p.)
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 MLSA (2002).

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

It is probable that workers who applied for early retirement after the reform had stronger preferences toward leisure than workers who applied before the reform, and they might also have had different working histories[5], which determine their benefits. Therefore, we attempt to isolate the pure policy change effect from the sorting effect. For that purpose we create several typical individuals with different wage histories, which serve – 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 virtually the same characteristics. The only parameter that changes is the degree of penalization, which was subject to the policy change. Our computations show that the net decrease in early retirement benefits was approximately 2–3% (CZK 120–250 per month in absolute terms). The cut corresponds approximately to 1–2.5% of the average net wage for male workers in the economy. (*Table 2*)

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[5] different wage histories and number of years in service, etc.

The ratio of the net wage to early retirement benefits (the net replacement rate) decreased by 0.9–2.4 percentage points. Generally, the highest decrease applied to those who wanted to enter early retirement three years before the eligibility age. Lower-income workers were penalized relatively more than upper-income groups. This is a result of the pension formula: benefits are relatively higher for low-income than for high-income workers. This implies that the policy change affected more strongly individuals who face a relatively disadvantaged position on the labor market.

Another way to assess the effect of this policy change is suggested in Börsch-Supan (2000). The author stresses the importance of the time dimension – how much it is worth to give up one year of retirement in terms of net benefit or social security wealth (SSW) computed as the difference between the expected discounted stream of all future benefits and social security taxes paid, which are computed as a percentage of 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 death at age S,

$\pi(t \mid S)$ – probability of 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 – social security contribution rate.

SSW is very sensitive to many assumptions.[6] We employ the values for the discount factor and wage growth[7] 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 since the process of indexation in the Czech Republic depends very much on government discretion, as described in Dušek (2007) and Dušek and Kopecsni (2008).

Table 3 shows the basic computations of retirement incentives employing the lifetime budget constraint for an average earner.

Each row corresponds to the age at which a worker enters retirement. In this exercise we assume for the sake of simplicity that the statutory retirement age is 61. This means that everybody who enters retirement before the age of 61 is in early retirement regime and the worker is eligible for early retirement benefits at 58.

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[6] assumptions regarding the individual discount rate, the future indexation of benefits under PAYG, the interest rate path, wage growth, etc.

[7] For simplicity we assume the same wage growth for all income groups.

Table 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
58	0.837	0.828	699,347	690,703	-0.007	-0.007
59	0.870	0.864	650,158	644,474	-0.076	-0.072
60	0.906	0.903	598,921	595,727	-0.086	-0.082
61	0.936	0.936	545,586	544,716	-0.098	-0.094
62	0.964	0.964	489,416	488,365	-0.115	-0.115
63	1.012	1.012	445,006	443,768	-0.100	-0.100
64	1.037	1.037	389,143	387,718	-0.145	-0.145
65	1.105	1.105	352,270	350,657	-0.105	-0.106

Notes: SSW – social security wealth – is defined as the sum of all discounted pension benefits and social security contributions. The accrual rate is defined as the relative year-to-year change in SSW.

Comparing SSW before and after the reform, one can see a decrease in SSW for those who enter early retirement. SSW before and after the reform are highest at 58. The higher pension after a longer time contributing to the social system cannot compensate for the social security contribution and hence SSW steadily decreases. Therefore, the best decision is to retire as soon as possible, since this maximizes the SSW.

A forward-looking approach to assessing the incentives created by the pension system can be studied using peak value and option value. Peak value (Coile and Gruber, 2007) is defined as all discounted benefits from entering 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 the incentives for the average earner to stay on the labor market. The second approach to assessing financial incentives is the option value model (Stock and Wise, 1990). The option value attempts to evaluate the optimal retirement age in utility terms and involves calculating the forgone earnings that could have been earned on the labor market. It is defined as the change in 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 career stage.

We employ the standard assumption of a linear wage profile, which is not necessarily a realistic assumption. Our results are summarized in *Appendix 2* and suggest that according to both the peak value and the option value the optimal retirement age was not changed by the reform and is 58 in the case of the option value and 56 in the case of the peak value. However, there is one small exception – that of a high earner, whose option value reacts to the policy change and whose optimal retirement age is moved by one year from 59 to 60.

One of the questions that this reform raised is what margin of the labor supply is affected, and in particular whether the reform affected the extensive or intensive margin of the labor supply of older workers. Only the extensive margin is affected, since the labor code restricts early retirement benefits: people who retire earlier (claim early retirement benefits) are not allowed to work at all.

4. Data Description and Treatment and Control Group

For the purposes of our research we use Czech Labor Force Survey data from 1998–2005 containing detailed information about the labor market status of a representative sample of 60,000 individuals and their households. On a rotating panel base, individuals and their households are surveyed during five consecutive quarters. Therefore, one fifth of the sample is replaced every quarter. We choose the sub-sample of males who are in the age window of six to zero years until the statutory standard retirement age. Hence, our sample includes 50,152 observations for 11,843 individuals. Summary statistics for the treatment and control groups can be found in *Appendix 4*.

We divide this sample into four time periods – one period before the reform and three periods after the reform. Participation in the survey is restricted to up to five quarters. Within this period, we do not observe a sufficient number of changes in labor market status, thus we treat our sample as repeated cross-sectional data. The reason we choose only one period before the policy change is the low stability of the social security system: the legal system was stable for only two years before the policy change and approximately four years after the policy change. Our time span also reflects the comparability of the data. We define four consecutive periods, each 1.5 years long. The first is before the policy change (1Q2000–2Q2001), the second is immediately after the policy change (3Q2001–4Q2002), the third is from 1Q2003 to 2Q2004, and the fourth covers 3Q2004–4Q2005. We also try alternative time spans, which should address two main problems. The first problem is the possible bias due to the effect of the announcement of the policy change. The reform was approved by the parliament in the beginning of 2001. We therefore also run regressions omitting the first half of 2001. The period that comes right after the policy change is also problematic. As we use a cross-section of the data, it is obvious that right after the reform we find in the treatment group individuals who entered early retirement just before the policy change. We therefore also run our regressions without the period after the policy change.

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

Using the number of years to the statutory retirement age we define the treatment and control groups. The treatment group contains people who are eligible for early retirement: up to three years before their statutory 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. The relatively broad definition of the treatment group allows us to capture all individuals who were eligible for early retirement and could make the decision during the entire period of three years before reaching the statutory retirement age. However, it also raises the question whether we can really compare two individuals whose age difference is up to six years. We address this problem and construct an alternative control group which consists of individuals with less than one year to eligibility to early retirement. The treatment group is divided into three subgroups according to the length of time to statutory retirement age (each one year long).

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

5. Graphical Overview

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

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

Further, we present the behavior of individuals using the Labor Force Survey data described above. *Figure 2* depicts the participation rate of the control and treatment groups during 1998–2005. The participation rate of the treatment group increased by around ten percentage points between 2001 and 2004. The participation rate also increased in comparison with the control group. This suggests that our treatment group was subject to a specific shock that did not affect the control group. One can observe that this increase continued at a lower rate even during the period from the second half of 2003 to almost the end of 2004. It also contains 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 remain in the treatment group. Due to data limitations and the institutional set-up, we cannot define the treatment group more precisely than 0–3 years before retirement.

In *Figure 3* we can see how the participation rate changes over time in different years to/after retirement age. This quasi-cohort approach shows that the participation rate during the early retirement window (between -3 and 0) is the lowest in the period before the reform was introduced. Moreover, the trend that we observe in *Figure 3* is clearly increasing. The difference between the pre-reform period and the last period studied at one year before the statutory retirement age is 12 percentage points.

We also present an alternative indicator – the hazard rate – representing the probability of labor force withdrawal due to retirement. *Figure 4* depicts the hazard rates for two periods: before and 3–4.5 years after the policy change. In the cross-sectional

**Figure 1 Newly Granted Pensions (men)**
(in % of total)
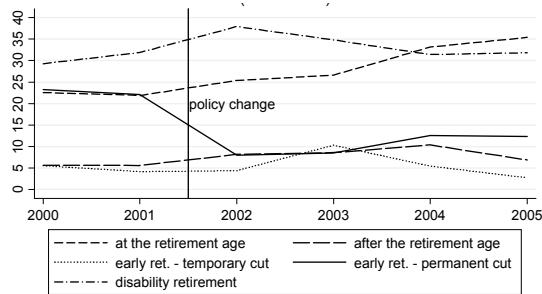
Notes: The short time span before the actual policy change is given by the limitation of official statistics.
The remainder to 100% are e.g. widower´s and orphan´s pensions.

Figure 2 Participation Rate of Control and Treatment Group in 1998–2005
(in %)
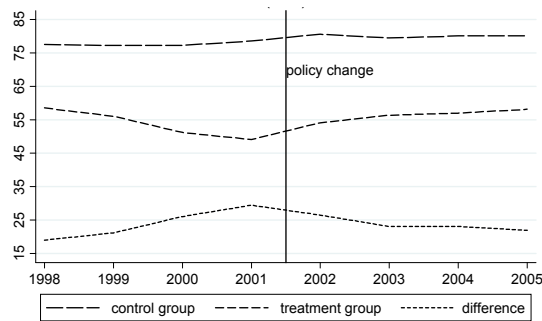
Source: Labor Force Survey, own calculation

Figure 3 Participation Rate of Different Distances to/after Retirement Age
(in %)
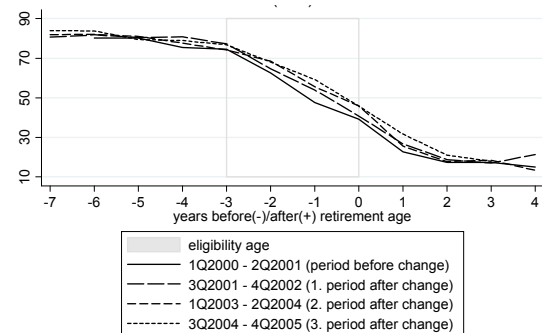
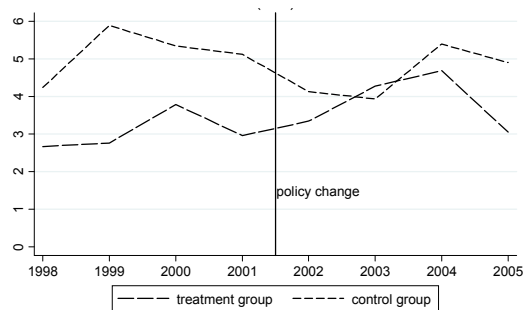*Source:* Labor Force Survey, own calculation

setting, the definition of the hazard rate is one minus the retention rate, which is the participation rate of workers at age t divided by the participation rate of workers aged *t*-1 in the given year (Hurt, 1996).

Figure 4 Hazard Rates in Different Distances to/after Retiremenbt Age

Source: Labor Force Survey, own calculation

Figure 5 Unemployment Rate
        (in %)

Source: Labor Force Survey, own calculation

The line representing the period before the policy change has two peaks: the first one (around -2, two to three years before the statutory retirement age) reflects entering early retirement before the policy change, while the second (around 0) represents entering standard retirement. The line for the period three years after the policy change shows a substantial change in the behavior of retirees. One can see the hazard rate smoothed over the number of years before/after retirement. Although early retirement frequently occurs, one cannot observe any particular peak before the statutory retirement age in the period starting with the third quarter of 2004. This is most probably the effect of the policy change we study. One can also see that it is also more common to retire after the statutory retirement age. This is in line with the hypothesis that workers generally stay longer on the labor market after the reform.

We also consider the problem of unemployment, which can potentially change over time and therefore raise questions about our results. *Figure 5* shows the development of the unemployment rate over time. The unemployment rate is defined for each group separately so that we can control for changes in the labor force in a particular group. The trend in unemployment is not clear, despite an upward movement of unemployment in the treatment group right after the policy change. However, one needs to be aware that the number of unemployed individuals in our sample is

relatively small and this change is most probably not statistically significant. More-over, the dynamics of the increase are slower when we calculate the unemployment rate using the labor force across groups.

This graphical overview suggests that our treatment group was hit by an external shock around the year 2001 which influenced its participation in 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 participation in the labor market is statistically significant. The next sections thus provide a formal econometric analysis and computation of the increase in the probability of staying in the labor force.

6. Methodology of Econometric Analysis

As an identification strategy we use difference-in-differences (Baker and Benjamin, 1999). We start our analysis with a broad definition of the treatment group, which includes all male workers who are eligible for early retirement benefits (at most three years before the actual statutory retirement age). To make the control group comparable, it includes workers between six and three years to the statutory retirement age. The baseline time periods chosen for the estimation are the 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 1990s. We do not want to mix the previous changes in the social security system into our analysis, so we use only one period before the policy as a benchmark for our analysis. The basic specification is the following:

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

where y_{it} is one if an individual i is inactive (out of the labor force) at time t and zero when an individual is active in the same period. OLD_{it} is a dummy for the treatment group. $AFTER1_{it}$, $AFTER2_{it}$, and $AFTER3_{it}$ 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 a probit model with the standard maximum likelihood estimation technique. β_6 and β_7 are the coefficients of interest. They measure the impact of the policy change on the inactivity of the treatment group relative to the control group.

This baseline model is further modified to get more precise results using a narrower control group (a maximum of one year before eligibility for early retirement) and the treatment group is divided into three subgroups according to the distance to the statutory retirement age. The presented specification slightly changes in the extension of our analysis, as the OLD group is divided into three subgroups.

We also address the announcement effect, which could potentially bias our results. The policy was approved by parliament six months before it became effective. Thus, many workers could enter early retirement earlier than they planned. To control for this we develop a strategy in which we omit six months before the policy change and 12 months after the policy change. The reason why we omit 12 months after is to exclude from our treatment group those who enter early retirement just before the policy change. The cost of this strategy is that we omit 18 months and the economic and institutional conditions could have changed. To control for this problem we use time dummies, but we admit that this problem partly persists in the analysis.

7. Results

Our final sample contains 50,152 observations, 26,735 from the treatment group and 23,417 from the control group. The estimated coefficients indicate that the treatment significantly increased the labor supply of the treatment group. The coefficients have the expected sign; however, the first period after the change does not have a significant impact on the labor supply. The reason is that our treatment group also contains people who entered early retirement under the previous system. Therefore, the pass-through to the participation rate of the 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, the results change mainly in the significance of the coefficients. The other controls are significant with the expected signs: higher education decreases the probability of being inactive. The number of household members has the same effect. We do not include the labor market status of spouses, because the labor market activity of spouses can also potentially be affected by the reform and thus it is an endogenous variable. To reveal the magnitude of the estimated effects – the impact on the probability – the marginal effects are presented in *Table 4*.

We estimated three different specifications. The most extended version contains individual characteristics and 76 dummies for districts. In all models this effect remains negative. The marginal effect of the reform on the probability of being inactive is close to -0.03, which can be interpreted as a 3% drop in the probability of being inactive for workers who are at most three years before the statutory retirement age. These results show that inactivity significantly decreased in the treatment group during 2003–2005 relative 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 (the probability of being inactive) and thus the treatment group in the first period after the policy change contains a lot of individuals who entered early retirement before the policy change.

This analysis has two main problems. First, it ignores the announcement effect, which could potentially bias the results. Second, the age difference between the youngest and the oldest individual in the treatment and control groups is six years, which most likely violates the assumptions about which members of the treatment and control group should react similarly to aggregate shocks. To reduce both problems we constructed narrower control and treatment groups and omitted from

Table 4 Estimated Coefficients from the Probit Model in Three Different Specifications. Dependent Variable: Being Inactive

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	50,152	50,152	50,152
Pseudo *R*-squared	0.07	0.10	0.14

Notes: Coefficients are recalculated into the probability measure (min 0, max 1). The excluded variables are dummies for: control group, one period before policy change, interaction of control group and all periods. Full results are presented in *Appendix 5*. Standard errors are in parentheses. We also performed linear probability estimation with OLS and it does not change the significance of the results.

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

the analysis six months before the policy change and 12 months after the policy change, as we do not want to include in our treatment group those who entered early retirement just before the policy change. The control group contains individuals who are less than one year before the eligibility age for early retirement. Those who are eligible for early retirement are divided into three subgroups. The first group contains individuals who become eligible for early retirement and have less than two years to the statutory retirement age. The second treatment group contains those who are two years to one year before their statutory retirement age. The last group contains individuals who are in the last year when they are eligible for early retirement and are less than one year before their statutory retirement age. Under the assumption that the most similar individuals from the treatment and control groups are those on the margin we present the interaction term only for the youngest treatment group. To make our analysis more robust to institutional changes we also omit all individuals who have disabilities and thus could enter disability retirement after the policy change was established.

The results from the alternative specification summarized in *Table 5* show a very strong effect on individuals at the age when they just become eligible (OLD1). The effect of the reform is actually three times stronger compared to the previous analysis with the broad definition of treatment and control group. This alternative specification has a drawback arising from omitting many individuals who were affected by the reform. Specifically, we use only 12,265 observations, compared to over 50,000 in the previous specification. We can also see that older individuals in the treatment group significantly increased the labor supply. However, we cannot fully compare them with the control group, as they are much older.

We also attempted to use an explanatory variable that indicates change in labor market status. However, as we mentioned earlier, we face a problem with a 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 a few changes in

**Table 5 Alternative Specification with Control Group up to One Year
Before the Eligibility Age and Treatment Group Less than One Year
after the Eligibility, Controlling for Announcement Effect.
Dependent Variable is Being Inactive**

Model	(1)	(2)	(3)
OLD1*AFTER2	-0.11***	-0.09***	-0.09***
	(0.024)	(0.025)	(.025)
OLD1*AFTER3	-0.12***	-0.10***	-0.10***
	(0.023)	(0.024)	(0.024)
OLD2*AFTER2	-0.06***	-0.05***	-0.06***
	(0.027)	(0.028)	(0.028)
OLD2*AFTER3	-0.12***	-0.10***	-0.12***
	(0.024)	(0.025)	(0.024)
OLD3*AFTER2	-0.04***	-0.03***	-0.05***
	(0.028)	(0.03)	(0.028)
OLD3*AFTER3	-0.10***	-0.07***	-0.09***
	(0.026)	(0.027)	(0.026)
Personal characteristics		X	X
District dummies			X
N	12,265	12,265	12,265
Pseudo R-squared	0.07	0.11	0.16

Notes: Coefficients are recalculated into the probability measure (min 0, max 1). The excluded variables are
dummies for: control group, one period before policy change, interaction of control group and all
periods. Standard errors are in parentheses. OLD1 is the youngest treatment group – less than one
year after the eligibility, OLD2 – more than one year and less than two years, OLD3 – more than two
years up to statutory retirement age. The period that is omitted from the analysis is 6 months before
the policy change and 12 months after.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

labor market status for the treatment group: 172 out of 2,541 individuals for the two
years before the policy change and 113 out of 2,587 after the policy change. We can
conclude that these numbers are in line with our hypothesis that the reduction in early
retirement benefits caused fewer workers to enter early retirement. However, the num-
ber of observations in our sample does not allow any formal econometric analysis in
this setting.

8. Conclusions and Policy Implications

Our results confirm that the 2–3% cut in early retirement benefits due to
the 2001 reform boosted the labor participation of males eligible for early retirement.
The reform increased the probability of being employed in the three-year period be-
fore a worker reaches the statutory standard retirement age. These results show that
the elasticity of the extensive margin of labor supply of older Czech workers is rela-
tively high, although we are not able to calculate the exact value because we lack
individual data on wages. Nevertheless, the policy change was not purely fiscal im-
proving, since some of the affected people did not continue to work, but rather
switched to unemployment as a substitute for early retirement.

Our findings are generally in line with those, for example, from Germany,
where Börsch-Supan (2000) found a high sensitivity of older workers' employment
to the social security system design. Our results also correspond with Galuščák (2002),

who found a substantially high sensitivity of the participation rate to change in the earnings test for workers older than the statutory retirement age. In this respect, our results are not fully comparable, because we examine older workers who are eligible for early retirement and have not reached the 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 the only possible way of empirically testing a public policy intervention affecting the whole population of one country.

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

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