

Extended Unemployment Benefits and Early Retirement: Program Complementarity and Program Substitution

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Preliminary. Comments Welcome.

Abstract

We study how extended unemployment benefits for older workers affect (i) the incidence of early retirement and (ii) the pathways through which worker exit the labor market. In many countries, early retirement schemes consist of special rules for older workers in unemployment-insurance (UI-) and disability-insurance (DI-) programs. In Austria around 1990, workers aged 55+ had relaxed access to DI-benefits. To identify the impact of extended UI-benefits we exploit the regional extended benefits program (REBP) which granted regular UI-benefits for up to 4 years to workers aged 50+ in certain regions of the country. We find that the REBP dramatically increased the incidence of early retirement. For workers aged 50-54, we identify a program complementarity effect: more generous UI-benefits induce workers to exit the labor market by sequential take-up of UI- and DI-benefits. For workers aged 55-57, we identify a program substitution effect: more generous UI-benefits reduce take-up of DI-benefits. A simple early-retirement model allows us to address the welfare consequences of the Austrian early retirement policy using the sufficient-statistics approach. We conclude that Austrian early retirement rules around 1990 were too generous; and the REBP was a suboptimal policy.

Keywords: Early retirement, unemployment, policy reform, disability

JEL Classification Numbers: J14, J26

1 Introduction

Once hit by unemployment, it is typically much harder for older workers than for prime-age workers to find a new job. For this reason, many countries have set up early retirement schemes. These schemes often grant preferential treatment to older workers in unemployment-insurance (UI-) and disability-insurance (DI-) programs. While such schemes are in place in many countries, their implications for labor supply and early retirement are not well understood. Moreover, many recent labor market and pension reforms have adopted changes to welfare programs to bring displaced older workers back to work and to increase the effective retirement age. It is therefore of high importance to understand how the combined UI- and DI-rules impact on labor supply and retirement choices of older workers.

The aim of this paper is twofold. *First*, we study the causal impact of early retirement incentives on (i) the incidence of early retirement and (ii) the particular pathways through which workers exit the labor market. We focus on Austria where we can study increased early retirement incentives generated through more generous UI-benefits and how they interact with DI-benefits. Under Austrian rules of the late 1980s and early 1990s, Austrian workers aged 55+ had relaxed access to DI-benefits,¹ and workers aged 50+ were eligible for 1 year of regular UI-benefits.² Between June 1988 and July 1993, some workers were eligible to much more generous UI-benefits under the Regional Extended Benefits Program (REBP). The REBP granted regular UI-benefits up to 4 years to workers living in certain regions of the country. Comparing the behavior of unemployed workers living in REBP regions to workers in non-REBP regions allows us to identify the causal impact of more generous early retirement rules on the incidence of early retirement and the particular pathways by which workers leave the labor market.

We find that the REBP had a dramatic effect on the incidence of early retirement. The probability that an unemployment entrant aged 50 to 54 retires early is 17 percentage points higher among individuals eligible to the REBP. Among workers who became unemployed between ages 55 and 57 the incidence of early retirement is 10.8 percentage points higher for REBP-eligible individuals. Concerning the early retirement pathways it turns out that, among unemployment entrants aged 50 to 54, *program complementarity* – the sequential take-up of UI- and DI-benefits – is important. Of the 17 percentage point increase in early retirement, 12.6 percentage points are associated with DI take-up following the UI-spell. In contrast, for unemployment entrants aged 55 to 57, *program substitution* – higher UI- but lower DI take-up – is important. Of the 10.8 percentage points excess retirement of this age group, comprises of an increase in 23.1 percentage points of individuals who stay on UI-benefits until they get a public pension and a reduction of 12.7 percentage points in DI take-up following the UI-spell.

The *second* aim of this paper is to explore the welfare consequences of the Austrian early

¹Access to disability insurance became more restrictive in 1996, when the minimum age of relaxed access to disability insurance was increased from 55 to 57. For an analysis of this policy change see Staubli (2011).

²In August 1989, the duration of regular UI-benefits for workers aged 50+ was increased from 30 weeks to 52 weeks.

retirement rules using the sufficient statistics approach proposed by Chetty (2006a) building on the work of Baily (1978). We set up a simple model that makes precise the impact of more generous UI-benefits on the incidence of early retirement among older displaced workers and how more generous UI-benefits affect the pathways through which workers retire early. The model establishes a simple rule for optimality of more generous UI-benefits for older displaced workers. This rule accounts for both program complementarity and program substitution. Using our empirical estimates, we can explore the welfare implications of the increased early retirement incentives induced by the REBP. We find that the Austrian retirement rules of the late 1980s and early 1990s were too generous. Local optimality would require a degree of risk aversion of 1.73 which seem excessively high. We therefore conclude that the REBP was a suboptimal policy.

Studying early retirement in Austria is a particularly interesting case for studying the early retirement decision. First, policy makers in Austria have used early retirement schemes disproportionately to mitigate labor market problems of older workers over the past decades. As a result, the effective retirement age of Austria has decreased to somewhat less than 59, well below the OECD average.³ Second, while early retirement schemes created larger incentives for older workers to leave the work force than in many other countries, the Austrian early retirement system works qualitatively similar to most other countries. Hence understanding the Austrian situation is of more general interest.

Our paper is related to a small literature studying how the broader set of welfare state programs impact on the labor supply decisions of older workers. This is different from the larger literature that studies the isolated effect of (or reforms to) a single programs on labor supply and/or early retirement. Papers that study the interaction/spillover effects of the unemployment insurance and disability insurance systems for the early retirement decision include Karlström et al. (2008), Kyrrä (2010), Bloemen et al. (2011), and Staubli (2011). Karlström et al. (2008) study how a DI reform in Sweden affected labor supply of older workers. It turns out that stricter DI rules increased take-up of unemployment and sickness benefits, but did not increase employment rates. Kyrrä (2010) provide more favorable evidence from Finland where a series of reforms that changed the age-thresholds for UI and partial retirement and tightened medical criteria for DI eligibility. As a result of these reforms, the effective retirement age increased by almost 4 months. Staubli (2011) studies the effect of a reform in Austria that increased the age at which older individuals have relaxed access to DI from age 55 to age 57. The results suggest a significant decline in disability enrollment and a somewhat weaker increase in employment. The Austrian DI reform also produced non-negligible spillover effects to UI and sickness insurance benefits. Our study differs from the above ones by its focus on the impact of an UI rather than DI reform; and by its focus on unemployed workers. A recent paper by Bloemen et al. (2011) is closest to our paper. They look at how a reform to UI in the Netherlands that increased search requirements for the older unemployed affected their transition rates to employment, early retirement and sickness/disability benefits. It turns

³According to OECD (2006), in 2004 the average effective retirement age among males ranged from 58 years in Hungary to 74 years in Mexico. The effective retirement ages in US, UK, Switzerland, Germany and France were 63, 62, 66, 61, and 59.

out that stricter search requirements increased not only employment rates but also DI take up. In contrast to Bloemen et al. (2011) our papers focuses on the impact of changes to the maximum duration of UI benefits rather than on search requirements. Moreover, since the Austrian REBP treated the various labor market regions differentially, our empirical strategy is based not only on contrasts before and after the policy change but also on a cross-regional comparisons of eligible and non-eligible individuals.

A further related literature studies the interaction between DI and UI programs. Autor and Duggan (2003, 2006) document the rise in disability payrolls in the U.S. that happened despite improving health conditions in the population. Autor and Duggan (2003) show that less strict screening, declining demand for less skilled workers, and an increase in the earnings replacement rate are the most plausible candidates to explain the rise in DI take up. Petrongolo (2009) studies the impact of the UK JSA reform of 1996 that imposed stricter job search requirements and additional administrative hurdles for UI benefit claimants. It turns out that the fall in UI benefit recipients was associated with higher take-up of DI benefits. Furthermore, rather than increasing the transition to regular jobs, the reform temporarily decreased the outflow to employment.⁴

The paper is organized as follows. In the next section we review the institutional background of Austria. In particular, we discuss the various pathways to early retirement that the Austrian welfare state offers to older workers and the rules associated with the regional extended benefit program. In Section 3 we describe our data and provide some preliminary descriptive evidence of the impact of the REBP. Section 4 lays out our identification strategy. In Section 5 we discuss our main results. In Section 3 we develop a theoretical framework for optimal early retirement and develop various testable hypothesis concerning the impact of an UI reform. Section 5 summarizes our main results and draws some policy conclusions.

2 Institutional Background

2.1 Austria's Public Pension System

There are three types of government-provided benefits in Austria that are important for the labor market withdrawal of older unemployed: old-age pensions, disability pensions, and unemployment benefits. Disability and old-age pensions provide the main source of retirement income and replace on average 80 percent of the last net wage up to a maximum of approximately 2,900 euros per month. Both pensions are subject to income taxation and mandatory health insurance contributions.

⁴Related to this paper is the work on UI benefits duration extensions of older workers by Kyrrä and Wilke (2007), Kyrrä and Ollikainen (2008), and Lalive (2008). Winter-Ebmer (2003), Lalive and Zweimüller (2004a, 2004b), and Lalive (2008) analyzed the labor market effects of the REBP change and discussed potential endogeneity issues. Chen and van der Klaauw (2008), Staubli (2011), de Jong et al. (2011) (DI screening and eligibility) and Gruber (2000) and Autor and Duggan (2003) (DI benefits) investigated labor supply effects of DI parameters. Finally, spillover effect in other social programs were analyzed by Garrett and Glied (2000), Schmidt and Sevak (2004), Bound et al. (2004), and Duggan et al. (2007).

Under the rules in place during the 1990s, an old-age pension could be claimed at any age after 60 for men and 55 for women, conditional on having 35 contribution years or 37.5 insurance years. Insurance years comprise both contributing years (periods of employment, including sickness, and maternity leave) and qualifying years (periods of unemployment, military service, or secondary education). Eligibility criteria were relaxed for individuals who have been unemployed for at least 12 months in the past 15 months. They only need 15 contribution years to qualify for an old-age pension at the early retirement age of 60 for men and 55 for women.

Disability pensions in Austria play an important role for early retirement, because access to a disability pension is relaxed at age 55.⁵ In particular, below that age threshold applicants are generally eligible for benefits if a medically determinable impairment reduces the capacity to work by at least 50 percent in any occupation in the economy. Applicants above age 55 are classified as disabled if their capacity to work has been reduced by more than 50 percent in the same occupation. As a consequence of this relaxation in eligibility criteria, disability enrollment rises significantly beginning at age 55. Because men first become eligible for old-age pensions at age 60 as opposed to 55 for women, labor market withdrawal through the disability insurance is particularly common among older men.

The unemployment insurance systems plays an important role in the labor market exit of older workers not only because older unemployed enjoy relaxed access to an old-age pension but also because they are eligible for extended unemployment benefits. Unemployment benefits replace around 55 % of the last net wage and are not taxed. Regular unemployment benefits can be claimed for a limited period based on previous work history. Individuals who have worked 1 year or more in the last 2 years receive benefits for 20 weeks, while those with at least 3 years of employment in the past 5 years receive benefits for 30 weeks. Job losers aged 50 and older who have paid unemployment insurance contributions for 9 years or more in the last 15 years can claim unemployment benefits for 52 week.⁶ Job losers who exhaust the regular unemployment benefits can apply for unemployment assistance. These means-tested transfers last for an indefinite period and can be at most 92% of regular unemployment benefits.⁷

In addition, unemployed men aged 59 or older and unemployed women aged 54 or older can claim special income support, provided they had contributed to the pension system for at least 15 out of the previous 25 years. Special income support is equivalent to an unemployment spell in legal terms, but with 25 percent higher benefits. Benefits are paid for a period of 12 months to bridge the gap until individuals become eligible for an old-age pension. The rules are more generous for workers in the mining sector who can claim special income support for up to 5 years at age 55 for men and age 50 for women. Special income support can be combined with regular unemployment benefits

⁵In 1996, the age limit for relaxed access to DI-benefits was raised to age 57, for an evaluation of this policy change, see Staubli (2011). All individuals that are considered in the empirical analysis below, were subject to pre-1996 DI-benefit rules.

⁶Before August 1989, the potential unemployment duration was 30 for all individuals above age 50. See Lalive et al. (2006) for a detailed description of the policy change and its impact on the unemployment duration of job losers.

⁷In 1990, the median unemployment assistance benefits were about 70% of the median unemployment benefits Lalive (2008).

and unemployment assistance. That is, eligible unemployed can claim unemployment benefits up to age 54 for women and age 59 for men followed by special income support.

2.2 Heterogeneity in Replacement Rates

The amount of an old-age pension is determined by the “assessment basis” and the “pension coefficient”. The assessment basis corresponds to the average earnings of the best 15 years after applying an earnings cap in each year. The pension coefficient corresponds to the percentage of the assessment basis that is replaced by the old-age pension. The pension coefficient increases with the number of insurance years up to a maximum of 80 percent (45 insurance years). Disability pensions are calculated in the same way as old-age pensions. (Special rules apply to applicants below age 55.) Postponing a disability or old-age pension claim by one year increases the replacement rate by roughly 2 percentage points.

Regular unemployment benefits are a function of annual earnings one or two years before unemployment entry (depending on the starting month of the unemployment spell), subject to a minimum and a maximum. The gross replacement rate declines with previous earnings from a maximum of around 60 % for low-income earners to approximately 40 % for high-income earners. On top of regular unemployment benefits, family allowances are paid.

Notice that unemployment benefits depend only on earnings in the previous job, while disability and old-age pensions are based on the entire work history. Hence the replacement rate of disability and old-age pensions can be very different from the replacement rate of unemployment benefits. For example, a job loser with high previous earnings relative to his or her life-time earnings will have relatively high unemployment benefits and relatively low disability or old-age pensions, and vice versa. As a consequence of the heterogeneity in replacement rates, job losers who are similar in observable characteristics may have very different incentives to retire early through a particular pathway. This aspect will be of central importance in our theoretical model and the empirical analysis below.

To illustrate the heterogeneity in replacement rates, we split our sample of job losers (described in more detail in Section 3 below) into quartiles according to their UI and DI net replacement rates (see Section 3.1 for details on the construction of the sample). As Table 1 illustrates, there is a large dispersion of UI- and DI-replacement rates among older job losers. For example, the median replacement rate for 50-54 year old job losers in the bottom quartile of the UI replacement rate distribution is almost constant (i.e. it varies between 53.5 % and 55.3 %) but the median DI replacement rate varies between 48 % (column 1) and 90.5 % (column 4). Table 1 also shows that the number of unemployment entrants in each cell is large, suggesting that the correlation between previous earnings and life-time earnings is not very strong.

Table 1

2.3 The Regional Extended Benefit Program and Retirement Pathways

The Regional Extended Benefit Program (REBP) is rooted in the strong protectionism of Austria's heavy industry. After World War II, Austria nationalized its iron, steel, and oil industries, and related heavy industries to preclude Soviet appropriation. After the mid-1970, the state-run company Österreichische Industrie AG, in charge of administrating the nationalized firms, faced shrinking markets due to the international oil and steel crisis, low productivity, and outdated smokestack industries. At the beginning the resulting financial losses were covered by governmental subsidies, but in 1986 a speculation scandal in the steel industry triggered the abolishment of the protectionism, introduced privatization, and the implementation of a restructuring plan. This process caused layoffs and downsizing of production plants, particularly in the steel sector.

To protect older workers against bad labor market conditions in the steel industry, the Austrian government enacted the REBP in June 1988. The program extended the potential unemployment duration from 52 weeks to 209 weeks for a subgroup of workers. To become eligible for the benefit extension an unemployed worker had to satisfy each of the following criteria at the beginning of the unemployment spell: i) age 50 or older, ii) continuous work history (15 years of employment in the past 25 years), iii) location of residence in one of the eligible regions for at least 6 months prior to unemployment entry, and iv) start of new unemployment spell after June 1988 or spell in progress in June 1988.

The REBP was initially implemented in 28 of about 100 labor market districts. Lalive and Zweimüller (2004b) show that eligible regions were characterized by a relatively high share of employment in the steel sector, but there were no differences between regions in terms of unemployment. In December 1991 a reform took place that abolished the benefit extension in six of the originally 28 regions. We label the set of treated regions that were excluded after the reform as “TR1s”. In the remaining 22 regions the REBP was in effect until August 1993 when it was abolished entirely. We label the regions that kept eligibility after the reform as “TR2s”. The regions that were never entitled to the REBP are labeled as “CRs”. The 1991 reform also tightened eligibility criteria, as individuals had to be not only residents, but also previously employed in a REBP region. Figure 1 plots the regional distribution of TR1s, TR2s, and CRs. The Figure illustrates that treated regions are all located on a contiguous area in the Eastern and Central parts of Austria.

Figure 1

The introduction of the REBP changed the incentives for early retirement for older unemployed, as shown in Figure 2. Prior to the REBP older job losers could withdraw from the labor force at age 58 and bridge the gap until the eligibility age for an old-age pension by claiming unemployment benefits for 12 months followed by special income support for 12 months. With the introduction of the REBP eligible unemployed could effectively withdraw through the unemployment insurance system at age 55. However, job losers above age 55 also have the option to retire early via disability insurance, since eligibility criteria for a disability pension are significantly relaxed after age 55.

Figure 2 also shows that the REBP led to important changes in the early retirement incentives for unemployed men below age 55. In particular, prior to the REBP job losers below age 55 could withdraw from the labor market at age 54 by claiming unemployment benefits for 12 months followed by a disability pension. During the REBP this option was already available to job losers aged 51 and older. To investigate the impact of the REBP on the retirement transition of older unemployed, in the next section we present a dynamic model of retirement behavior with multiple retirement pathways. Later we will use the model to derive a formula that allows us to calculate the welfare gain from extending the duration of unemployment benefits for older workers.

Figure 2

3 Data and Descriptive Evidence

3.1 Data

To examine how extended UI-benefits for older workers affect the incidence of early retirement and the particular early retirement pathways, we combine register data from two different sources. The Austrian Social Security Database (ASSD) provides very detailed longitudinal information dating back to 1972 on the labor market history and earnings for the universe of private sector workers in Austria (Zweimüller et al., 2009). The second source is the Austrian unemployment register, which contains information on socio-economic characteristics including the place of residence.

Our main sample consists of all male job losers aged 50-57 at the beginning of the unemployment spell who enter unemployment from a job in the non-steel sector in the time period 1/1985 until 12/1987 and in the time period 6/1988 until 12/1995. These spells are followed up until end of 2006. We focus on men because women are already eligible for an old age pension at age 55 (as opposed to age 60 for men), which is also the age for relaxed access to a disability pension. Hence, our empirical design is useful to understand program complementarity and substitution for males but it is less appropriate in the case of females. We exclude unemployment spells starting between 1/1988 and 5/1988 because ongoing spells were also eligible for the REBP. Excluding these spells guarantees that the before-period is not affected by the REBP. In our observation period 196,364 unemployment spells were started by men in the age group 50-57. From these, we drop 41,130 unemployed men with less than 15 employment years in the past 25 years. Only job seekers who satisfy this criteria are eligible for the REBP.⁸ Because the Austrian labor market is characterized by large seasonal employment fluctuations (Del Bono and Weber, 2008), we also exclude 87,920 men who were recalled by their previous employers to eliminate job seekers on temporary layoffs who are not searching for a job. The final sample thus comprises 67,314 unemployment spells.

Table 2 presents summary statistics on job seekers entering unemployment before (1/1985–12/1987), during (6/1988–7/1993), and after the REBP (7/1993–12/1995) by region of residence.

⁸This contribution requirement also guarantees that job seekers in our sample will be eligible for special income support at age 59 and for an old-age pension at age 60.

A comparison of exit destinations before, during, and after the REBP illustrates the impact of the program on early retirement behavior of unemployed men. Specifically, before the REBP the probability to retire early is 7.8 percentage points higher in treated regions (41.5%) relative to control regions (33.7%) because job losers in treated regions are more likely to exit unemployment by claiming a disability pension. Here early retirement comprises exits to disability pensions and old-age pensions (including special income support) as well as censored spells. The difference in the probability to retire early increases to 31.3 percentage points during the REBP. The increase in the incidence of early retirement during the REBP is driven by more unemployed men claiming disability and old-age pensions. After the abolishment of the program, the difference in the incidence of early retirement between treated and non-treated regions decreases again to the pre-REBP level. Note also the upward trend in the incidence of early retirement and disability over the whole period, suggesting that labor market conditions over the observation period deteriorated in treated and non-treated regions.

A comparison of background characteristics shows that job losers in treated regions are more likely to work in blue-collar occupations and tend to be less educated than job losers in control regions. These differences partially explain the higher probability to claim a disability pension in the treated regions before and after the REBP. Table 2 also illustrates that during the REBP the unemployment inflow increases in treated regions relative to control regions. Specifically, the ratio of unemployment spells in treated regions versus non-treated regions is roughly 1 to 4 before the REBP. This ratio increases to approximately 1 to 2.5 during the REBP. Winter-Ebmer (2003) finds that this increase occurs because firms used the REBP to get rid of high-tenured and expensive older workers. This result is consistent with the statistics in Table 2, given that during the REBP job losers in treated regions earn higher wages and have more tenure compared to job losers in non-treated regions.

Table 2

3.2 Descriptive Evidence

To assess the impact of extended UI on incidence (and channels) of early retirement graphically, Figures 3-5 plot the fraction of transitions (from unemployment) into different exit states by age of UI-entry and region of residence before, during, and after the REBP.

Figure 3 illustrates that the REBP had a strong effect on the incidence of early retirement among eligible unemployed. More specifically, there is a drastic increase in transitions to early retirement at ages 50-57 in treated regions during the program was in effect. The regional difference in transitions to early retirement during the REBP amounts to almost 30 percentage points for the age group 50-55 and is somewhat smaller for the age group 56-57. For the age group 58-59 there are only small regional differences during the REBP because unemployed men in this age group can rely on regular unemployment benefits and special income support to retire early. Also for the age group 45-50 there are almost no regional differences in transitions to early retirement, as these individuals were not eligible for the REBP.

Figure 3

Figure 4 shows the corresponding picture for transitions from unemployment into disability pensions. As the middle panel of Figure 4 illustrates, the higher incidence of early retirement for the age group 50-54 is driven by an increase in transitions to disability pensions. For this age group the regional difference in transitions to disability pensions during the REBP amounts to around 20 percentage points. This is an example of program complementarity. That is, the increased generosity of unemployment insurance during the REBP strengthens the sequential take-up of multiple programs. For the age group 55-57, there is also clear evidence for a program substitution effect. Specifically, there is a decline in transitions to disability pensions during the REBP in treated regions relative to control regions and a significant increase in transitions to old-age pensions, as illustrated in Figure 5.

Figure 4

Figures 3 and 4 also show that transitions to early retirement and disability pensions tend to be slightly higher in the treated regions after age 50 before the implementation of the program and after its abolishment. These differences are likely to reflect underlying differences in the structure of the workforce between treated and non-treated regions. In particular, Table 2 shows that job losers in treated regions work more often in blue-collar occupations and are less educated on average. Both factors are likely to increase the risk of experiencing a career ending disability.

Figure 5

Figure 6 illustrates how transitions into early retirement, disability pensions, and old-age pension for the age groups 50-54 and 55-57 developed over time in treated and non-treated regions. For both age groups there are only small regional differences in transitions to different exit states before the REBP started. In the second half of 1988, the period when the program started, transition rates start to diverge. For the age group 50-54 transition rates to early retirement, disability pensions, and (to a smaller extent) old-age pensions increase in REBP-regions relative to non-REBP regions. For the age group 55-57, there is a decline in transitions to disability pensions and a disproportionate increase in transitions to old-age pensions so that overall transitions to early retirement increase. After the second half of 1993, when the program was abolished, the effects of the REBP are reversed and regional differences in transition rates are relatively small again.

In sum, these figures provide evidence that the REBP increased the incidence of early retirement among eligible unemployed. The observed changes in transition rates are consistent with our theoretical predictions: for the age group 50-54 there is program complementarity, as transitions to disability pensions and old-age pensions increase during the REBP. For the age group 55-57 there is both program substitution and program complementarity, as transitions to disability pensions decline and transitions to old-age pensions increase during the program.

Figure 6

4 Identification Strategy

Our identification strategy to estimate the causal effect of extended UI-benefits on early retirement relies on the REBP which generated quasi-experimental variation in the duration of UI-benefits across Austrian regions. We use a difference-in-difference (DD) approach. The first difference is over time, since the program was in effect only from June 1988 to July 1993. The second difference is across geographic areas; only older job seekers living in one of the 28 selected regions were eligible for the benefit extension. Because the REBP was only in effect for a limited period of time, we are able to test whether the policy effects of introducing and abolishing the REBP were symmetric.

A third difference would be age because only unemployed aged 50 or older were eligible for the REBP. However, as Figures 3-5 illustrated, few unemployed workers below age 50 enter early retirement by claiming a disability pension or an old-age pension. A comparison between job losers below and above age 50 would therefore not be very informative to identify the effect of extended UI benefits on transitions from unemployment into early retirement.

The difference-in-difference comparison is implemented by estimating regressions of the following type:

$$y_{it} = \alpha + \beta TR1_i + \gamma TR2_i + \delta D_t + \eta A_t + \pi(D_t \times TR_i) + \mu(A_t \times TR_i) + \lambda_t + X'_{it}\theta + \varepsilon_{it}, \quad (1)$$

where i denotes individual and t is the start date of the unemployment spell. The outcome variable y_{it} is a dummy, which is equal to 1 if an individual leaves unemployment into the exit state of interest and 0 otherwise. We distinguish between three different types of exits: early retirement, disability pension, and old-age pension. The variables $TR1$ and $TR2$ are dummy variables that indicate whether or not an individual lives in treated region 1 or treated region 2 to control for region-specific trends; TR is an indicator taking the value 1 if an individual lives in a treated region; D is an indicator taking the value 1 if the unemployment spell started after the REBP was in effect (June 1988); A is an indicator taking the value 1 if the unemployment spell started after the REBP was abolished (January 1992 in TR1s and August 1993 in TR2s); λ_t is a vector of year fixed effects to control for changes in macroeconomic conditions; and X_{it} is a vector of background characteristics to control for observable differences that might confound the analysis (age fixed effects, marital status, blue-collar status, education, work experience, years of service, sick leave history, last wage, previous industry, and quarter of inflow).

The coefficients of interest are π and μ which measure the effect of the REBP on older job losers in treated regions relative to control regions in the years when the program was in effect relative to before its implementation (π) and in the years after which the program was abolished relative to during the program (μ). Clearly, if the introduction and abolishment of the REBP have symmetric effects on the outcome variable of interest we have $\pi = -\mu$.

Equation (1) is estimated separately for the age groups 50-54 and 55-57 because our model predicts that the impact of the REBP on transitions out of unemployment to be very different for

both groups. In particular, job losers in the age group 50-54 may use the REBP to bridge the gap until age 55 at which conditions for disability classification are relaxed. Job losers in the age group 55-57, on the other hand, can directly apply for a disability pension under the relaxed eligibility criteria, but may use the REBP instead to bridge the gap until age 60 when they become eligible for an old-age pension.

To explore the impact of the policy reform for each age separately, we generalize this identification strategy to an interaction term analysis:

$$\begin{aligned}
y_{it} = & \alpha + \sum_{j=50}^{59} \beta_j(d_{ijt} \times TR_i) + \sum_{j=50}^{59} \gamma_j(d_{ijt} \times D_t) + \sum_{j=50}^{59} \delta_j(d_{ijt} \times A_t) \\
& + \sum_{j=50}^{59} \pi_j(d_{ijt} \times D_t \times TR_i) + \sum_{j=50}^{59} \mu_j(d_{ijt} \times A_t \times TR_i) + \lambda_t + X'_{it}\theta + \varepsilon_{it}, \quad (2)
\end{aligned}$$

where d_{ijt} is a dummy that indicates whether individual i is age j at the start date of the unemployment spell t . Each coefficient π_j and μ_j captures all variation in the outcome variable specific to individuals of age j in the treated region (relative to the control regions) when the program was in effect (π_j) and after the program was abolished (μ_j), using variation in the duration of unemployment benefits over time.

The central identifying assumption is that there are no omitted time-varying and region-specific effects correlated with the program. Lalive and Zweimüller (2004b) show that entitled regions were characterized by a strong concentration of employment in the steel sector, which casts doubts on the assumption that the REBP is an exogenous policy. Therefore, we focus on job losers not previously employed in the steel sector. However, this strategy will still yield biased results if treated and non-treated regions have different trends even in the absence of the REBP.

The graphical analysis from the previous section suggests that labor market trends in treated and non-treated regions are similar given that there are no substantial differences in transition rates from unemployment into other states prior to the inception of the REBP and after its abolishment. To examine the existence of differential trends across regions in more detail, equation (1) is generalized by replacing $(D_t \times TR_i)$ and $(A_t \times TR_i)$ with a full set of treatment times half-year interaction terms:

$$y_{it} = \alpha + \beta TR1_i + \gamma TR2_i + \delta D_t + \eta A_t + \sum_{j=1985h1}^{1995h2} \pi_j(d_j \times TR_i) + \lambda_t + X'_{it}\theta + \varepsilon_{it}, \quad (3)$$

in which d_j is a dummy that equals 1 in half-year j and 0 otherwise and λ_t is a vector of half-year fixed effects. Here, we set TR equal to 0 in $TR1$ s after December 1991. Each coefficient π_t can be interpreted as an estimate of the impact of the policy change in a given half-year on the treatment group relative to the comparison group. The interaction terms prior to 1988 and after the first half of 1993 provide tests for anticipatory behavior and differential trends.

Another concern is that there were idiosyncratic shocks to the labor market prospects of non-steel workers in treated regions during the period the REBP was in effect. We perform three robustness tests to examine the presence of region-specific labor market shocks. First, we estimate equation (1) for job losers in the age groups 45-49 and 58-59. Because these individuals were not eligible for the REBP (age group 45-49) or did not need the REBP to retire early (age group 58-59), the estimated coefficients should be zero. In the second approach we restrict attention in the estimation to unemployed men who live no farther than a 30 minutes car drive from the border between treated and control regions. The idea is that job losers living close to the border are likely to operate in the same local labor market. Hence, labor market shocks should affect treated and non-treated job losers in the same way. In the third approach we estimate equation (1) for a sample of job losers who previously worked in the tradable-goods sector. The idea behind this approach is that labor demand prospects in this sector are less influenced by local economic conditions. Hence, potential spillovers effects from the steel sector should be less important. These robustness tests will yield unbiased estimates if the extension of UI benefits in treated regions does not feed back to the labor demand for non-treated individuals.

A final concern is differences in the characteristics of job losers in treated and non-treated regions. On the one hand, Table 2 shows that unemployed men in treated regions tend to be less educated and are more likely to work in blue-collar occupations. If the impact of the policy is heterogeneous with respect to observable characteristics, it is important to control for relevant observable characteristics in a very flexible way. The linear specification proposed in equation (1) may not be sufficient to capture the influence of covariates. To allow for more flexibility, we follow Blundell et al. (2004) and use propensity score matching adapted for the case of difference-in-difference.

On the other hand, Table 2 also illustrates that there was an increase in unemployment inflow in REBP-regions while the program was in effect. Winter-Ebmer (2003) suggests that this increase occurs because firms used the REBP to get rid of high-tenured and expensive older workers. This finding is consistent with the fact that during the REBP job losers in the treated regions earn higher wages and have more tenure than job losers in the control regions. To ascertain that selective inflow does not affect our results, we estimate equation (1) excluding job losers with high tenure from the sample.

5 Results

5.1 Main Results

The first set of results is summarized in Table 3, with columns 1 through 3 providing the results from equation (1) for the age group 50-54 and the next three columns displaying the analogous results for the age group 45-49. The dependent variable is an indicator, which is equal to 1 if an individual exits unemployment through the state in question and 0 otherwise.

The first row shows that the REBP increases the probability of entering early retirement among

50-54 year old job losers in treated regions by 17 percentage points, or 50% of the baseline transition rate into early retirement in the pre-REBP period. This decline is mostly driven by an increase in transitions to disability pensions of 12.6 percentage points (column 2) and - to a lesser extent - by an increase in transitions to old-age pensions by 3.9 percentage points (column 3). The third row shows that the effects on transitions from unemployment into different exit states are reversed after the program is abolished. The effect on transitions to early retirement is somewhat larger in absolute value, but the difference is statistically not significant.

The next three columns present analogous estimates for the age group 45-49 who were not eligible for the REBP. The point estimates are always small and insignificant. This finding suggests that the REBP had no substantial spillover effects to the labor demand for the age group 45-49 via general equilibrium effects and that labor market prospects of job losers in treated regions and non-treated regions followed similar trends. Table 3 also illustrates that over the period under consideration there is an upward trend in the incidence of early retirement for the age group 50-54 both in treated and non-treated regions. More specifically, among 50-54 year old job losers there is 14.2 percentage point increase in the probability to enter early retirement. The rise in early retirement is due to an increase in transitions to disability pensions. No such increase can be observed for the age group 45-49. This pattern may indicate a general decline in labor market conditions for older workers.

Table 3

Table 4 presents analogous estimates for the age group 55-57 (columns 1 to 3) and the age group 58-59 (columns 4 to 6). The first row indicates that the introduction of the REBP led to an increase in transitions from unemployment to early retirement of 10.8 percentage points among the treated individuals aged 55-57. Consistent with the predictions from the theoretical model, there is also clear evidence for a program substitution effect. In the years the program was in effect older job seekers are significantly less likely to enter the DI program and more likely to use the REBP as a bridge to an old-age pension. More specifically, during the REBP there is a decline in transitions to disability pensions of 12.7 percentage points and an increase in transitions to old-age pensions of 23.1 percentage points. Similar to unemployed men in the age group 50-54, there is a clear reversal in the effects on early retirement behavior after the program was abolished, as shown in the third row. Columns 4 to 6 present analogous estimates for the age group 58-59. The point estimates are mostly insignificant, which is consistent with the proposition that for this age group the REBP had no impact on the set of available pathways to early retirement.

Table 4

In the estimates presented in Tables 3 to 4, the variables to correct for differences in observable characteristics between treated and non-treated regions enter in a linear way. This approach is quite restrictive as it imposes common support on the distribution of covariates across regions before, during, and after the REBP. To allow for more flexibility, we follow Blundell et al. (2004) and match

on two propensity scores to estimate the effects of the introduction of the REBP. These propensity scores balance the distribution of observable characteristics in the treated and non-treated regions before and during the REBP. A similar matching method can be applied to estimate the effects of the abolishment of the REBP. We estimate the propensity score with a probit model and use radius matching with a radius of 0.02. Estimates of the matching difference-in-difference approach are reported in Table 5. The first three columns show that for the age group 50-54 the estimates are very similar as the OLS estimates reported in Table 3. For the age group 55-57 we find similar effects for the abolishment of the REBP as in Table 4 and a somewhat larger program substitution effect during the REBP. Overall, these results suggest that the linear model corrects well for regional differences in observable characteristics.

Table 5

To further explore the impact of the introduction and abolishment of the REBP, Figure 7 plots the estimated coefficients of the interaction terms from equation (2) for each age l separately. Each dot on the solid lines is an indicator for living in a treated region and being a given age during the REBP (black line) and after the REBP (grey line). A 95-percent confidence interval is shown by dotted lines.

As shown in the first panel, coefficients for entering early retirement are positive for all ages during the REBP is in effect. The point estimate at age 50 amounts to approximately 10 percentage points and increases to around 20 percentage points for the ages 51 to 55. The effect is not so strong for 50 year olds because in addition to the REBP these individuals need to draw one year of unemployment assistance, which is lower than regular unemployment benefits, to bridge the gap until the age for relaxed access to a disability pension. The point estimates decline at ages 56 and 57 because these job losers are relatively close to age 59 when they become eligible for special income support. Hence, many of these job losers permanently retire even without the REBP. As the grey line illustrates, the impact of extended unemployment benefits on the incidence of early retirement are reversed after the program is abolished.

The black line in the middle panel shows that for job losers below age 54 in treated regions there is a significant increase in transitions from unemployment to disability pension of almost 20 percentage points. The point estimate for age 54 is insignificant because 54 year old old job losers in non-treated regions can also bridge the time until age 55 with the regular duration of UI benefits of one year. With the abolishment of the REBP excess DI take-up in the age group 50-53 is reversed, as shown by the grey line.

For unemployed workers in the age group 55-57, estimated coefficients for entering disability are negative, providing evidence for the program substitution effect. More specifically, with the introduction of the REBP, the exit channel into an old-age pension became financially more attractive relative to claiming a disability pension. The estimated decline during the REBP is large and amounts from 12 to 20 percentage points. Consistent with this view, for unemployed men above age 55 transitions to old-age pensions increase by almost 30 percentage points during the REBP

is in effect, as illustrated in the third panel. There is also a significant increase in transitions to old-age pensions for 54 year old job losers, even though these individuals need to rely on one year of unemployment assistance to bridge the time until age 60 when they become eligible for an old-age pension. Finally, the grey line in the third subfigure highlights that after the abolishment of the REBP the effects on transitions to old-age pensions are reversed for all ages.

Figure 7

Our model assumes that for the age group 50-54 there is no program substitution effect because eligibility criteria for disability pensions are very strict before age 55. Our data allow us to examine this conjecture since we know the exact age at which job losers start to claim disability benefits. More specifically, we estimate two versions of (1). In the first version the dependent variable is an indicator taking the value 1 if a 50-54 year old job loser claims a disability pension before age 55. In the second version the dependent variable is an indicator taking the value 1 if a 50-54 year old job loser claims a disability pension after age 55. If there is a program substitution effect, we would expect to see less DI entry at ages 50-54 because during the REBP job losers are more likely to stay unemployed until age 55 when access to a disability pension is relaxed. The first column of Table 6 shows that the program substitution effect for the age group 50-54 is small. The probability to claim a disability pension before age 55 declines by 2.5 percentage points during the REBP and increases by 1.3 percentage points after the REBP. On the other hand, the probability to enter DI after age 55 increases by 15.1 percentage points during the REBP and decreases by 13.6 percentage points after the REBP.

Table 6

5.2 Policy Endogeneity

The key assumption of our identification strategy is that trends in transitions from unemployment into different exit states would be the same in treated and non-treated regions in the absence of the REBP. This assumption rules out differential trends that existed already prior to the REBP as well as idiosyncratic shocks to treated and non-treated regions.

The availability of several years of data before and after the REBP allows us to investigate to what extent trends differ across regions. More specifically, Figure 8 plots the estimated coefficients of the interaction terms (equation (3)) for the age groups 50-54 and 55-57 over the full sample period 1985 to 1995. Each dot on the solid line is the coefficient of the interaction between an indicator variable for half-year and living in a treated region (a 95-percent confidence interval is shown by dotted lines). In all six panels the estimated coefficients fluctuate around 0 before the REBP (June 1988) and after its complete abolishment (July 1993), providing evidence that the empirical strategy is not simply picking up long-run trends in differences between treated and non-treated regions. As shown in the top left and bottom left panels, coefficients for early retirement turn significantly positive during the REBP. For the age group 50-54 the effect increases over time,

except for a sharp drop after the REBP was abolished in TR1s (January 1992). For the age group 55-57 the estimated increase declines over time. The raise in early retirement in the age group 50-54 is driven by a large increase in transitions to disability pensions and, to a lesser extent, transitions to old-age pensions (top right panel). The bottom middle and the bottom right panel indicate that for the age group 55-57 there is a decline in transitions to disability pensions and a large increase in transitions to old-age pensions during the REBP.

Figure 8

Table 7 presents OLS estimates of equation (1) for job losers who live no farther than a 30 minutes car drive from the border between treated and control regions. Labor market conditions should be quite similar within this tightly defined geographical area. Thus, spillovers from the problems in the steel sector in non-treated regions close to the border should be as important as in treated regions close to the border.

The first row shows that among unemployed in the age group 50-54 there is a 16.7 percentage points increase in early retirement during the REBP. This estimate is almost identical to the estimate for the full sample reported in Table 3 (17 percentage points). As the second (third) column illustrates, the increase in transitions to disability pensions (old-age pensions) is smaller (larger) than the estimate for the full sample of 50-54 year old job losers, but the difference is statistically not significant. Similarly, the second row shows that the effects of the abolishment of the REBP for 50-54 year old losers living close to the border are quantitatively similar to the estimates for the full sample.

Turning to the results for the age group 55-57 (columns 4-6), we find that transitions into early retirement increase by 8.4 percentage points during the REBP and decrease by 8.2 percentage points after the REBP. These estimates are around 2 percentage points below the estimates for the full sample, as reported in Table 4. Similarly, as column 6 illustrates, the estimates for transitions to old-age pensions are in absolute value roughly 2-3 percentage points below the estimates for the full sample. However, these differences are statistically not significant. These results suggest that spillover effects are not important for the age group 50-54 and quantitatively small for the age group 55-57.

Table 7

As an additional robustness check we replicate our findings for job losers whose last job was in the tradable goods sector with the exception of industries that are directly linked with the steel sector via the factor market (iron and steel product manufacturing) or via the product market (ore mining). The idea behind this approach is that labor demand prospects in the tradable-goods sector are less dependent on local economic conditions. Hence, the estimates should be less afflicted by sectoral spillover effects. OLS estimates of equation (1) for job losers who previously worked in the tradable goods sector are shown in Table 8. The estimates are quantitatively very similar to the estimates for the full sample reported in Tables 3 and 4. Only the estimated impact of the REBP

on transitions to early retirement for the age group 55-57 is significantly higher (at the 10%-level) than the corresponding estimate for the full sample.

Table 8

5.3 Unemployment Inflow

The descriptive statistics indicated a higher inflow of unemployed in treated regions during the REBP. To examine the impact of the REBP on unemployment inflow in more detail, Figure 9 plots the half-year transition rates from employment into unemployment, disability pensions, and old-age pensions (including special income support) by age in treated and non-treated regions before and during the REBP. The first panel illustrates that there is only a small regional difference in transitions to unemployment before the REBP starts (solid lines). During the period the program was in effect, the transition rate into unemployment is higher treated regions for almost all ages (dashed lines), suggesting that the REBP increased the unemployment inflow.

The middle panel shows that the REBP had no effect on the transition rate from employment into disability for workers in the age group 50-54. Before and during the REBP, the transition rate into disability is very similar in treated and non-treated regions. The situation is different for the age group 55-59. For these workers the transition rate into disability is higher in treated regions already before the REBP was introduced. During the REBP-period the transition rate declines in treated regions which is evidence for a program substitution effect. Although part of this decline is likely to reflect a time trend given that transitions into disability also decline in non-treated regions. Finally, the last panel shows the corresponding picture for transitions from employment into old-age pensions. Transition rates are very similar in treated and non-treated regions both before and during the REBP for all ages except for age 55. At that age the transition rate to old-age pensions of workers in REBP-regions is higher before and during the REBP. The reason is that in treated regions men are more likely to be eligible for special income support at age 55 because a larger fraction of men works in the mining sector.

Figure 9

A potential concern for our analysis is that the composition of the excess inflow in REBP regions was affected by the eligibility status for the program. The increase in unemployment inflow could either occur because workers voluntary quit to retire early with the REBP or because firms are more likely to lay off workers with higher potential benefit duration. Winter-Ebmer (2003) finds that the increase in unemployment entry is not driven by voluntary quits but by layoffs by firms who want to get rid of high-tenured and expensive older workers. To ascertain that selective inflow does not affect our results, we therefore replicate our findings for job losers whose previous job tenure is below the 75th percentile of the tenure distribution (Table 9).

The first row indicates that the introduction of the REBP had a similar impact on the incidence of early retirement for job losers with low-tenure as for the full sample. In particular, during the

REBP transitions to early retirement increase by 16.6 percentage points among 50-54 year old job losers with low tenure (column 1) and by 13.4 percentage points among 55-57 year old job losers with low tenure (column 4). We also find that the introduction of the REBP had quantitatively similar effects on transitions to disability pensions (columns 2 and 5) and on transitions to old-age pensions (columns 3 and 6) as for the full sample. Similarly, the second row illustrates that, as for the full sample, abolishing the REBP lead to a reversal of the effects. Almost all estimates in Table 9 are not significantly different from the estimates for full sample reported in Tables 3 and 4. The only exceptions are the estimates of introducing the REBP on transitions to early retirement and disability pension for the age group 55-57, which are significantly higher at the 10% and 5%-level, respectively. Thus, all our results are robust to the exclusion of high-tenured job losers.

Table 9

6 Social Welfare Analysis

In this section we use our above results to shed light on the welfare implications of extended UI-benefits provided by the REBP. Specifically, we ask whether the benefits provided by the REBP – the eased access to early retirement in the case of job loss – justified the costs of the REBP to the taxpayer. We build on the sufficient statistics approach developed by Chetty (2006a) building on the work of Baily (1978). We develop our argument in three steps. In a first step, we set up a simple model of early retirement featuring program complementarity and program substitution effects. In a second step, we use this model and derive an extended Baily-Chetty formula accounting for multiple retirement pathways. This formula allows us to (locally) evaluate the welfare effects of providing unemployment benefits as an early retirement program.⁹ In a third part we undertake a calibration exercise that feeds our empirical estimates together with the changes of institutional environment generated by the REBP into the model.

6.1 Modeling the Early Retirement Decision

Consider the early retirement decision of an older displaced worker. The worker’s remaining lifetime consists of (at most) three periods $t = 0, 1, 2$. Job loss occurs either at (the beginning of) $t = 0$ or at $t = 1$. In $t = 0$ and $t = 1$ the worker is still productive and can earn a wage w on the labor market. In $t = 2$ the worker is no longer productive but entitled to a public pension that depends on the individual’s previous work experience. When losing the job at $t = 0$ or $t = 1$ the worker can either retire early or continue to work. At the beginning of $t = 2$ the worker retires and draws a regular public pension. Periods 0 and 1 have length 1 and period 2 has length T .¹⁰

⁹See Chetty (2009) for a comprehensive review on the use of the sufficient statistics approach contextual to income taxation, social insurance, and behavioral models.

¹⁰We think of period $t = 0$ as ages 50-54, period $t = 1$ as ages 55-59, and period $t = 2$ as ages 60+. This intends to capture the early retirement incentives of the Austrian system: extended UI-benefits of the REBP become available at age 50; relaxed DI-benefits at age 55, and regular public pensions at age 60.

Displacement at $t = 1$. Consider a worker who gets displaced at the beginning of $t = 1$. If the worker goes back to work in $t = 1$ he generates income w . However, in order to find a job, a search cost θ_1 has to be incurred. (We think of θ_1 as cost and effort of job search as well as the cost to the worker of adjusting to a new work environment.) θ_1 is a random variable drawn from a continuous distribution function $F(\theta)$. Alternatively, the worker may retire early at $t = 1$. Early retirement through the DI-system yields a benefit d . Claiming DI-benefits is associated with costs κ reflecting the hassle of a medical check and other bureaucratic obstacles, or stigma-costs associated with DI-status. Early retirement through the UI-system yields a benefit b (any costs associated with claiming UI-benefits are normalized to zero).¹¹

In $t = 2$ the worker draws a public pension p^W if entering from employment, p^D if entering from the DI-system, and p^U if entering from the UI-system. Assuming that workers do not save and ignoring discounting, the lifetime utilities from going back to work, $W_1 - \theta_1$, retiring early by claiming DI-benefits, D_1 , and retiring early by claiming UI-benefits, U_1 , are given by

$$W_1 - \theta_1 = u(w) - \theta_1 + Tu(p^W), \quad D_1 = u(d) - \kappa + Tu(p^D), \quad U_1 = u(b) + Tu(p^U).$$

To make progress, we evaluate the optimal choice assuming that the welfare benefits d , p^D , p^U and p^W are related to each other in ways that capture the Austrian welfare benefit system. According to the Austrian rules outlined in Section 2, workers entering regular retirement directly from DI get a public pension equal to the previous DI-benefits in period 1, $p^D = d$. In contrast, unemployed and employed workers' public pension equals the (potential) DI-benefits in $t = 1$, augmented by some factor $\alpha > 1$, or $p^W = p^U = \alpha d$.¹² Given these rules, heterogeneity in DI-benefits and public pension benefits is captured by the parameter d .

Lemma 1. *a) The worker will claim DI- rather than UI-benefits if $d \geq \hat{d}$, where \hat{d} satisfies $u(b) = u(\hat{d}) - T(u(\alpha\hat{d}) - u(\hat{d})) - \kappa$. b) The worker will retire early rather than go back to work, if $\theta_1 \geq \hat{\theta}_1$, where $\hat{\theta}_1 = u(w) - u(b)$ if $d < \hat{d}$ and $\hat{\theta}_1(d) = u(w) - u(d) + T(u(\alpha d) - u(d))$ if $d \geq \hat{d}$, where $\partial\hat{\theta}_1(d)/\partial d \leq 0$ if $1 - (\alpha - 1)T \geq 0$.*

Figure 10 illustrates individuals' optimal choices in $t = 1$ given their location in (θ_1, d) space. The threshold \hat{d} says that individuals choose an early retirement path through the UI-system when DI-benefits fall short of the critical value \hat{d} . This reflects part a) of the Lemma. The threshold $\hat{\theta}_1$ is flat for $d < \hat{d}$, and decreases in d for $d \geq \hat{d}$. At low values of d , early retirement occurs through the UI-system rather than the DI-benefits, hence the DI-benefit level is irrelevant for the early retirement decision. However, at high values of d , early retirement occurs via the DI-system

¹¹We think of the UI-benefit b as the UI-transfer when staying unemployed throughout one period. b is a weighted average UI-benefits b^u and UI-assistance b^a where $b^a \ll b^u$, with $b = \tau b^u + (1 - \tau)b^a$. We think of τ as the maximum duration of regular UI-benefits b^u . Eligibility to the REBP is associated with an increase of in τ from 0.2 (1 year of the 5-year period) to 0.8 (4 years of a 5-year period).

¹²As outlined in Section 2, the pension p_{t+1} is given by the assessment basis $\hat{\omega}_{t+1}$ times the pension coefficient a_{t+1} . Assuming that the assessment basis remains stable $\hat{\omega}_{t+1} = \hat{\omega}_t$, we obtain $p_{t+1} = p_t \alpha$ with $\alpha = a_{t+1}/a_t$. We will calibrate α such that empirical moments are matched.

and individuals with higher DI-benefits are more likely to retire early. This reflects part b) of the Lemma.¹³

Figure 10

How do early retirement incentives and early retirement pathways change when UI-benefits become more generous? It is straightforward to see from the above Lemma that the \hat{d} -threshold shifts to the right. This reflects the program substitution effect: early retirees that would use the DI-system under the less generous UI-rules now take up UI-benefits. Moreover, the $\hat{\theta}_1$ -threshold shifts down. This reflects work disincentives of higher UI-benefits: individuals who would have gone back to work under the less generous UI-system now take up UI-benefits. This leads to the following proposition.

Proposition 1. *Consider workers who get displaced in period $t = 1$. More generous UI-benefits increase early retirement due to a work disincentive effect. More generous UI-benefits increase the UI- rather than the DI-pathway due to a program substitution effect.*

Displacement at $t = 0$. Now consider a worker who gets displaced at the beginning of period $t = 0$. For such an individual, there are two options. *First*, the worker may choose early retirement in $t = 0$. We assume that this requires a sequential take-up of different welfare programs: UI-benefits b in $t = 0$ and DI-benefits d in $t = 1$.¹⁴ In $t = 2$ the workers gets a public pension $p^D = d$.

The *second* option for the worker is returning to work in $t = 0$. Going back to work yields utility $u(w)$ but is associated with a search cost θ_0 that has to be incurred at the beginning of $t = 0$. Like before, we assume that θ_0 is a random draw from the distribution function $F(\theta)$. Provided θ_0 is low enough, the worker will go back to work. In $t = 1$ the workers keeps his job with probability $1 - q$ and is fired with probability q . (We abstract from selective firing, hence q is the same for all workers). If the worker keeps his job, he earns a wage w also in $t = 1$ without having to bear search costs. If fired, the worker faces exactly the same decision problem as described above (see “Displacement at $t = 1$ ”). We assume that the search costs after displacement at the beginning of $t = 1$, θ_1 , are independently drawn from the same distribution $F(\theta)$ as the search costs after displacement at the beginning of $t = 0$, θ_0 .¹⁵ In $t = 2$ the worker draws a public pension that depends on employment or benefit-status in $t = 1$, with $p^D = d$ and $p^W = p^U = \alpha d > d$.

¹³A sufficient condition for a negative slope is $1 - (\alpha - 1)T \geq 0$ or, equivalently, $(p^W - p^D)T < d$. Future gains from postponing retirement $(p^W - p^D)T$ are lower than current gains from DI take-up d . Delaying retirement is unfair at the margin. This is the relevant case under Austrian DI-benefit and public pension rules (Hofer and Koman, 2006).

¹⁴We rule out an early retirement path where the individual draws either DI-benefits or UI-benefits in both periods. We rule out DI-benefits in both periods because, under Austrian rules, the DI-program as an early-retirement scheme (“relaxed access to disability”) is only available at $t = 1$ but not at $t = 0$. We rule out drawing UI-benefits in both periods because regular UI-benefits have limited duration. While UI-assistance is unlimited, benefits are lower and means-tested, and hence dominated by drawing DI-benefits in the second period. Finally, we assume a worker’s human capital fully depreciates if he is not working at all in $t = 0$. Hence we can rule out careers where individuals draw UI in $t = 0$ and go back to work in $t = 1$.

¹⁵This implies that average search costs for worker fired in $t = 1$ are higher than the average search costs when fired in $t = 0$. Workers fired in $t = 1$ must have been re-employed after being fired in $t = 0$ meaning their draw θ_0 must

In sum, the lifetime utilities at $t = 0$ from going back to work, $W_0 - \theta_0$, and from retiring early, R_0 , can be written as

$$W_0 - \theta_0 = u(w) - \theta_0 + q \cdot E_\theta V_1 + (1 - q)W_1, \quad R_0 = u(b) + (1 + T)u(d) - \kappa,$$

where $E_\theta V_1 \equiv \int \max(W_1 - \theta, D_1, U_1) dF(\theta)$ is the expected utility when losing the job in $t = 1$. Let us consider the worker's optimal choice in $t = 0$, focusing on heterogeneity in the variables θ_0 and d . We denote by $\hat{\theta}_0(d)$ the critical level of θ that keeps the worker indifferent between retirement early and going back to work.

Lemma 2. *The worker will retire early if $\theta_0 \geq \hat{\theta}_0(d)$, and will go back to work otherwise. When $1 - (\alpha - 1)T \geq 0$, we have $\partial \hat{\theta}_0(d) / \partial d \leq 0$.*

Proof. See Appendix. □

Figure 11 illustrates individuals' optimal choices in $t = 0$ given the location in (θ_0, d) space. The threshold $\hat{\theta}_0$ is downward sloping in d . The flat segment that shows up in the early retirement choice at $t = 1$ (see Figure 10 above), does not exist for the early retirement choice at $t = 0$. The reason is that, under our assumptions, the only feasible early retirement path is drawing UI-benefits at $t = 0$ and DI-benefits at $t = 1$. Since early retirees have to rely on DI-benefits, early retirement is discouraged at very low values of d .

Figure: 11

We are now able to explore how more generous UI-benefits affects early retirement incentives in $t = 0$. A higher b has two countervailing effects on the threshold $\hat{\theta}_0(d; b)$. On the one hand, a higher b increase the incentive to use UI and DI sequentially: program complementarity increases the value of early retirement R_0 . On the other hand, higher benefits also increase the value of going back to work. This entitlement effect (see Mortensen 1977) implies that becoming unemployed in $t = 1$ harms less and increases the value of going back to work at $t = 0$. We summarize our discussion in the following proposition.

Proposition 2. *More generous UI-benefits b lead to a program complementarity effect and an entitlement effect. The former increases and the latter decreases the probability to retire early at $t = 0$. The program complementarity effect dominates.*

Proof. See Appendix. □

have been sufficiently low to induce them going back to work. Average search costs conditional on re-employment are $E(\theta \mid \theta \leq \theta_0)$. In contrast, θ_1 is a new independent draw from the same distribution $F(\theta)$ that is not conditional on re-employment. Hence average search costs of workers fired in $t = 1$ are $E(\theta) > E(\theta \mid \theta \leq \theta_0)$.

6.2 An Extended Baily-Chetty Formula for Early Retirement

We now look at the social optimality of the REBP as an early retirement program. We proceed by describing government's optimization problem and the economic environment. While we try to understand the behavior of older workers' early retirement decisions, younger individuals are indirectly affected as the additional tax burden is shared among the entire population. Hence welfare considerations need to account for impact of the REBP on younger individuals' welfare. We extend the above model for one additional period, $t = -1$, during which the worker is not yet eligible to the more generous UI early retirement pathway. Assume period $t = -1$ has length φ and that younger individuals are fully employed.¹⁶ Employed workers contribute pay roll taxes τ , so the gross wage w equals $w = \omega + \tau$. The size of a cohort is normalized to one and the population is stationary. Heterogeneity in pension benefits among individuals is captured by the distribution $G(d)$ over the domain $[\underline{d}, \bar{d}]$.¹⁷ The corresponding utilitarian social welfare function equals

$$\mathcal{W} = \int_{\underline{d}}^{\bar{d}} \left(\varphi u(w - \tau) + q \int_0^\infty V_0(d, \theta) dF(\theta) + (1 - q)W_0(d) \right) dG(d). \quad (4)$$

We introduce new notation before describing the respective budget constraint. *First*, let π_t^i denote the probability that a worker displaced at the beginning of t enters state $i = W, U, D$ during t . By construction, we have $\pi_0^W = 1 - \pi_0^U$ and $\pi_1^W = 1 - \pi_1^U - \pi_1^D$.¹⁸ *Second*, denote by Π_t^i the mass of workers losing the job in t and entering $i = U, D$. Assuming that the probability of job loss q is the same at $t = 0$ and $t = 1$,¹⁹ we have $\Pi_0^U = q\pi_0^U$, $\Pi_0^D = 0$, $\Pi_1^U = q(1 - q\pi_0^U)\pi_1^U$, and $\Pi_1^D = q(1 - q\pi_0^U)\pi_1^D$. The budget constraint requires UI expenditures plus government's expenditure for DI-benefits and public pensions (N) to match overall tax revenues, or

$$b \cdot (\Pi_0^U + \Pi_1^U) + N = \tau \cdot (\varphi + \Pi_0^W + \Pi_1^W) \quad (5)$$

DI-benefits and public pensions (N) are described in Appendix A.1. Finally, the government maximizes social welfare (4) with respect to b such that (5) is satisfied.

Next, we derive a sufficient statistic in the spirit of Baily (1978) and Chetty (2006a).²⁰ Maxi-

¹⁶Ignoring any unemployment risk for the young is, of course, a crude simplification. However, the present analysis focuses on the impact of more generous UI-benefits *specific to older workers* and their impact on early retirement. Allowing for unemployment by the young would not generate any additional insights.

¹⁷Technically, we also require sufficient variation in d , i.e. $\underline{d} < b$ and $\hat{d} < \bar{d}$, and positive density $g(d) > 0$ over the entire domain.

¹⁸Notice that we have $\pi_0^U \geq 0$ and $\pi_0^D = 0$ and $\pi_1^D \geq 0$ and $\pi_1^U \geq 0$ ($\pi_0^D = 0$ because we rule out the retirement pathway DI both in $t = 0$ and $t = 1$, see footnote 14).

¹⁹We assume that q does not change with t , ignoring that the firing probability may depend on age. Introducing age-dependent firing is straightforward but would increase notational burden without adding any substantial insight.

²⁰There is, however, a conceptual difference to the standard Baily-Chetty framework: the Baily-Chetty formula is based on a model where individuals adjust search efforts in order to increase the probability to find a job. A similar formula is obtained in a simple early retirement model where displaced individuals draw a fixed job search disutility $F(\theta)$, see Section 6.1, and then decide whether to return to work or draw early retirement benefits. In other words, the decision making changes from the intensive margin (how much to search?) to the extensive margin (investing in job search at all?). We extend this formula by introducing complementarity and substitution effects.

mizing \mathcal{W} with respect to b yields the first order condition

$$\frac{d\mathcal{W}}{db} = (\Pi_0^U + \Pi_1^U) \cdot u'(b) - (\varphi + \Pi_0^W + \Pi_1^W) \cdot u'(w - \tau) \frac{d\tau}{db} \stackrel{!}{=} 0. \quad (6)$$

Optimal UI-benefits equate the marginal social benefits of better insurance to the marginal social costs of higher taxes. On the one hand, higher UI-benefits provide better insurance in the case of job loss. The marginal social benefit from better insurance is given by the mass of UI-beneficiaries in $t = 0, 1$, $\Pi_0^U + \Pi_1^U$, times their marginal utility gain, $u'(b)$. On the other hand, higher UI-benefits require higher taxes on employed workers. The marginal social cost from higher taxes are given by the mass of employed workers during work life, $\varphi + \Pi_0^W + \Pi_1^W$, times their marginal utility loss, $u'(w - \tau) (d\tau/db)$. Notice that welfare effects generated by pathway switching, i.e. workers' labor supply and retirement adjustments due to the policy change, are second-order (Envelope Theorem).

Before proceeding to the implied tax increase, or $d\tau/db$, we have to make an assumption: The required tax increase does not generate an increase in the mass of individuals claiming DI-benefits instead of continuing to work.²¹ Notice, however, that this assumption is not particularly strong because the group that may consider switching to DI is a small proportion of all taxpayers.²² Next, in order to characterize $d\tau/db$, it is instructive to investigate how program switchers alter government's fiscal resources. In $t = 1$, each individual who retires early via UI-pathway instead of working (work disincentive effect) draws UI-benefits and saves pay roll taxes. Government's overall financial loss becomes $\Delta_1^w = b + \tau$.²³ In contrast, program substitution behavior in $t = 1$ affects governments budget through a change in future pension streams. For each DI- to UI-pathway switcher, the government pays UI-benefits and normal old age pension but saves DI pensions, or $\Delta_1^s = b + \bar{p}_1^U - \bar{d}_1^D - \bar{p}_1^D$. Finally, the financial effect of pathway switchers in $t = 0$, denoted by Δ_0^c (definition see A.2), not only includes the work-early retirement margin, as captured by $b + \tau$, but also subsequent pension streams in $t = 1$. On the one hand, the government pays disability benefits in $t = 1$ (program complementarity effect); on the other hand the expected pension/benefits transfers of a worker are saved. Besides the financial wedges (Δ), the government takes also into account the change in the labor supply and the retirement behavior. We capture these behavioral effects by the respective elasticities $\varepsilon_t^i = (d\pi_t^i/\pi_t^U)/(db/b)$: the complementarity elasticity ε_0^c , for example, quantifies the percentage increase of early retirement due to complementarity effects in $t = 0$ triggered by a one percentage increase of long-term UI benefits. Importantly, as already derived in Section 6.1, one may think of ε_1^s and ε_1^w as a decomposition of the overall UI-pathway elasticity, or $\varepsilon_1 = \varepsilon_1^s + \varepsilon_1^w$, into program substitution (ε_1^s) and work disincentive effects (ε_1^w). The following Lemma relates ε and Δ to the overall fiscal impact.

²¹This assumption can be made precise using Figure 3, panel b) which draws the impact of an increase in UI-benefits. The implicit assumption in Figure 3, panel b) is that the net wage remains constant. When the net wage falls because of higher taxes, the downward sloping branch in the figure shifts down as well. The above assumption implies that the downward shift is small and affected individuals do not change their behavior.

²²It consists of individuals at age $t = 1$ with $d > \hat{d}$ and $\theta_1 \geq \hat{\theta}_1$ switching to DI rather than continue to work as a result of the higher taxes.

²³There is no effect on pension expenditures as both pathways lead to the same old-age pension starting at the beginning of $t = 2$.

Lemma 3. *An increase in UI-benefits leads to an increase in expenditures and forgone tax revenues, \mathcal{E} ,*

$$\mathcal{E} \approx \Pi_0^U \left(1 + \varepsilon_0^c \frac{\Delta_0^c}{b} \right) + \Pi_1^U \left(1 + \varepsilon_1^w \frac{\Delta_1^w}{b} + \varepsilon_1^s \frac{\Delta_1^s}{b} \right). \quad (7)$$

Proof. See Appendix. □

Equation (7) in the above Lemma shows two effects: (i) the mechanical effect, $\Pi_0^U + \Pi_1^U$, that arises because higher UI-benefits have to be paid to the unemployed both in $t = 0$ and $t = 1$; and (ii) the behavioral effects that arise due to program complementarity and program substitution. These latter effects correspond to the mass of program switchers, $\Pi_t^U \cdot (\varepsilon_t^i/b)$, weighted by their respective financial impact Δ_t^i .

We are now ready to state our main result. This result expresses optimal UI-benefits for older workers in terms of workers' degree of risk aversion and the elasticities of program complementarity and program substitution. A balanced budget requires marginal expenditures and foregone taxes to be equal to marginal tax revenues, or $\mathcal{E} = (\varphi + \Pi_0^W + \Pi_1^W) \cdot (d\tau/db)$. Combining this with equations (6) and (7) yields

Proposition 3. *Optimal UI-benefits for older workers satisfy*

$$\frac{u'(b) - u'(w - \tau)}{u'(w - \tau)} \approx \varepsilon_0^c \frac{\Delta_0^c}{b} \cdot \frac{\Pi_0^U}{\Pi_0^U + \Pi_1^U} + \left(\varepsilon_1^w \frac{\Delta_1^w}{b} + \varepsilon_1^s \frac{\Delta_1^s}{b} \right) \cdot \frac{\Pi_1^U}{\Pi_0^U + \Pi_1^U}. \quad (8)$$

The l.h.s. of formula (8) captures the value of consumption smoothing while the r.h.s. quantifies the costs associated with distorted labor supply and early retirement choices. This formula extends the Baily-Chetty and allows substitution and complementarity - two aspects that are not present in the standard Baily-Chetty framework.²⁴ One might wonder why the length of the work life φ and the distribution of search costs θ , $F(\theta)$, do not appear in the above formula. However, both enter the above formula indirectly. A higher φ would imply lower pay roll taxes τ relaxing the overall tax burden allowing for higher benefit generosity for older individuals. $F(\theta)$ does not affect the above formula because the individuals' utility is additively separable in search costs θ and consumption c . Hence θ has no impact on marginal consumption values.

6.3 Calibration

This section calibrates formula (8). We start by implementing the left hand side: let the utility over consumption be CRRA, or $u(c) = c^{1-\gamma}/(1-\gamma)$, with the relative risk aversion parameter γ . Then the l.h.s. of equation (8) becomes $RR(b)^{-\gamma} - 1$ where $RR(b)$ denotes the replacement rate of UI-benefits in terms of after tax income $(w - \tau)$. Note that $RR(b)$ captures the replacement rate of

²⁴A simple way to see how equation (8) becomes the "standard early retirement" Baily-Chetty formula: ignore first complementarity effects for simplicity, i.e. $\Pi_0^U/(\Pi_0^U + \Pi_1^U) = 0$. Then ruling out the DI-pathway (no substitution effects) implies $\varepsilon_1^s = 0$. The r.h.s of formula (8) becomes $\varepsilon_1^w \cdot \Delta_1^w/b$ with $\Delta_1^w = \tau + b$. Exploiting the relationship $\pi_1^U = 1 - \pi_1^W$ because there is no DI pathway available, one obtains the budget constraint $b(1 - \pi_1^W) = \pi_1^W \tau$. Finally, use the budget constraint to get $(u'(b) - u'(w - \tau))/u'(w - \tau) = \varepsilon_1^w/\pi_1^W$.

long-term unemployment normalized to a five-year average. Hence, one obtains the time-weighted $RR(b) = 0.42$ before the REBP (1/5 regular UI-benefits and 4/5 UI-assistance) and $RR(b) = 0.52$ during the REBP (4/5 regular UI-benefits and 1/5 UI-assistance).²⁵ Next, consider the r.h.s. of formula (8). Use Table 3 to estimate the program complementarity elasticity²⁶

$$\hat{\varepsilon}_0^c = \frac{\Delta\pi_0^U/\pi_0^U}{\Delta b/b} = \frac{13\%/27\%}{10\%/42\%} = 2.02.$$

The $t = 1$ counterparts²⁷ build on Table 4 and follow directly from decomposing the total old-age pension treatment effect ($\Delta\pi_1^U = 23\%$) into substitution ($-\Delta\pi_1^D = 13\%$) and work disincentive effect ($-\Delta\pi_1^W = 10\%$). This procedure yields

$$\hat{\varepsilon}_1^w = \frac{-\Delta\pi_1^W/\pi_1^U}{\Delta b/b} = \frac{10\%/25\%}{10\%/42\%} = 1.68 \text{ and } \hat{\varepsilon}_1^s = \frac{-\Delta\pi_1^D/\pi_1^U}{\Delta b/b} = \frac{13\%/25\%}{10\%/42\%} = 2.18.$$

Next, we calculate factual and counterfactual pensions to get the financial impact of program-switchers (Δ). Given our sample, the program-switchers are estimated to have an after-tax DI replacement rate of around 80%. This holds true for both pathways into disability in $t = 0, 1$. The average pension benefits increase by around 1.9 percentage points per annum, or $\alpha = 1.1$ using a five years interval. Finally, payroll taxes τ are set equal to 12.25 percentage point of gross wage.²⁸ Table 10 lists the estimated program-switching costs in relative terms (Δ) as well as in Euros (year 2000).

Table 10

Table 10 reveals two important findings. First, complementarity effects ($t = 0$) are almost twice as expensive as work disincentive effects in $t = 1$. Our calibration shows that each switcher imposes overall costs, comprising forgone taxes and additional benefits, of 100'000 Euros (baseline year 2000). This seems to be a rather large number, but one has to keep in mind that complementarity means retiring 10 years prior to normal retirement age. Second, program substitution effects enter negatively, e.g. the government saves money for each retirement pathway change. This feature is explained by the application disutility κ to become eligible for disability benefits. In other words, individuals, who change from DI to UI, are willing to accept lower benefits because they avoid the DI application disutility. The financial effect is, however, rather small (- 10'000 Euros).

²⁵Net replacement rate of regular UI-benefits equals 55% while UI-assistance replaces around 38.5%, or 70% of regular UI-benefits.

²⁶In general, the complementarity elasticity (ε_0^c) and the work disincentive elasticity (ε_0^w) also comprise behavioral changes due to the implicate tax increase to keep the budget balanced. However, we think that the gap between the REBP estimates and the ones required in formula (8) differ not substantially: the implied tax increase is expected to be small because program costs were shared among the entire working population, i.e. younger workers in particular. Nevertheless, fully incorporating the tax increase would increase the elasticities further as working becomes less attractive. To the end, this procedure implies higher program costs and pushes the implicate risk aversion (10) further up.

²⁷Note that in $t = 1$, the 55-57 estimates are taken which implies that we ignore SIS program effects.

²⁸By using the historical pay roll tax rate τ we implicitly assume budget neutrality before the reform was enacted.

The weighting factors $\Pi_0^U/(\Pi_0^U + \Pi_1^U)$ and $\Pi_1^U/(\Pi_0^U + \Pi_1^U)$ are almost symmetric with 0.49 and 0.51, respectively.²⁹ Collecting all r.h.s. terms of equation (8) yields

$$0.49 \cdot 2.02 \cdot \frac{1.10}{0.42} + 0.51 \cdot \left(1.68 \cdot \frac{0.56}{0.42} - 2.18 \cdot \frac{0.10}{0.42} \right) = 2.59 + (1.14 - 0.26) = 3.47. \quad (9)$$

Looking at the relative shares provides the following insights. First, complementarity effects are very expensive because both the individuals react very strongly to financial work incentives and early retirement in $t = 0$ implies long-lasting benefits pay. Second, complementarity effects in $t = 1$ are less expensive than its $t = 0$ counterpart. This is mainly due to the substantially lower financial impact as early retirement is triggered five years later. Third, program substitution effects mitigate program costs without having a first order effect on social welfare and distorting labor decision. Finally, given the calibration stated above, we are able to calculate a hypothetical risk aversion level γ^h that satisfies the local optimality condition. If the “true” relative risk aversion γ is above (below) the threshold value γ^h then UI benefits duration is too low (high). Hence, suppose that the true risk aversion (γ) is below

$$\gamma^h = -\frac{\ln(1 + \text{r.h.s. of equation 8})}{\ln RR(b)} = -\frac{\ln(1 + 3.47)}{\ln 0.42} = 1.73. \quad (10)$$

then extending the UI benefits duration, as enacted by the REBP, is socially not optimal. Unfortunately, we do not know the relative risk aversion (γ) of the population considered and it is well known that risk preferences vary among different contexts and types of risk. This particular setting involves substantial labor supply choices (or risks) because of a complete withdrawal from labor market many years before normal retirement age. Therefore, it seems indeed appropriate to focus on the literature that elicit γ from larger income risks. The work by Manoli et al. (2011) comes close to our preferred setting: they estimate γ by comparing retirement adjustment of elderly households induced by various pension reforms in Austria and estimate γ to be around 0.71.³⁰ In contrast, our estimate of $\gamma = 1.73$ required for socially optimal UI-benefits is fairly above: Hence we conclude that the REBP was too generous. This finding seems to be plausible given that UI benefits serve as an important bridge (complementarity effects) for the unemployed to a very generous pension system. Of course, this statement is contingent on the very generous pension system in place, and restricting eligibility or increasing age thresholds may be other valid policies to lower program costs.

²⁹We allow the probability of repeated unemployment, $q^u = 39\%$, to differ from the baseline layoff probability $q = 16\%$ which yields $\Pi_0^U = 4.3\%$ and $\Pi_1^U = 4.5\%$. Notice this modification affects the sufficient statistic (8) only through pension expenditures, which have been adjusted accordingly (see Appendix A.2).

³⁰Chetty (2006b), studying life-cycle labor income risks as well, estimates the relative risk aversion parameter to be around 1 (he also provides the methodological foundation of the Manoli et al. study). This estimate is based on various micro and macro economic labor supply studies in the U.S..

7 Conclusion

In this paper, we study the effects on early retirement of combined incentives in unemployment insurance (UI-) and disability insurance (DI-) programs in Austria. We feel that Austria is an interesting case as Austrian policy makers have used early retirement schemes extensively over the past decades to mitigate labor market problems of older workers. While the incidence of early retirement is high, the Austrian early retirement system works qualitatively similar as in many other countries. Hence understanding the Austrian situation helps to understand how early retirement decisions are shaped by the joint incentives generated by UI- and DI-benefit rules. In this sense the Austrian case is of more general interest.

We focus on the impact of one particular policy parameter that is of crucial importance for transitions from UI to early retirement: the maximum duration of UI-benefits for older workers. This parameter is among the most important ones generating early retirement incentives in many countries. To identify the impact of the maximum duration of UI-benefits for the incidence of early retirement, we exploit the Austrian Regional Extended Benefits Program (REBP) that was in place between June 1988 and July 1993. This policy granted regular UI-benefits for up to 4 years to workers above age 50 living in eligible regions, while workers in non-REBP regions were eligible to 1 year of regular UI-benefits. Our identification strategy involves a difference-in-differences comparisons of individuals in REBP-regions to individuals in non-REBP regions, before, during, and after the program.

We find that the REBP had a dramatic effect on the incidence of early retirement. The probability that an unemployment entrants aged 50-54 (55-57) retires early is 17 (10.8) percentage points higher among individuals eligible to the REBP. Among unemployment entrants aged 50-54 *program complementarity* – the sequential take-up of UI- and DI-benefits – is important: Of the 17 percentage point increase in early retirement, 12.6 percentage points are associated with DI take-up following the UI-spell. In contrast, for unemployment entrants aged 55 to 57, *program substitution* – higher UI- but lower DI take-up – is important. Of the 10.8 percentage points excess retirement of this age group, comprises of an increase in 23.1 percentage points of individuals who stay on UI-benefits until they get a public pension and a reduction of 12.7 percentage points in DI take-up following the UI-spell.

We then use our empirical estimates to shed light on the welfare consequences of Austrian early retirement rules of the late 1980s and early 1990s. We set up a simple early retirement model and implement the sufficient-statistics approach proposed by Chetty (2006a) building on the work of Baily (1978). We set up a simple model that makes precise the impact of more generous UI-benefits on the incidence of early retirement among older displaced workers and how more generous UI-benefits affect the pathways through which workers retire early. The model establishes a simple rule for optimality of more generous UI-benefits for older displaced workers. This rule accounts for both program complementarity and program substitution. Using our empirical estimates, we can explore the welfare implications of the increased early retirement incentives induced by the REBP. We find that the Austrian retirement rules of the late 1980s and early 1990s were too generous.

Local optimality would require a degree of risk aversion of 1.73 which seem excessively high. We therefore conclude that the REBP was a suboptimal policy.

From a policy perspective, our study suggests that policy reforms aiming at increasing the effective retirement age should take particular care to carefully consider the entire set of welfare programs that impact on the early retirement decision. A policy mix that allow for simultaneous and coordinated reforms in UI- and DI-systems to tackle the unemployment-disability margin, together with complementary measures that induce firms to hire older workers and that make older individuals better employable, are the most promising route for policy reforms.

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A Pensions

A.1 Definition

Overall pension expenditures (N) are subdivided into three additive components $\{N_t\}_{t=0,1,2}$. Let $h_t(\theta, d)$ denote the joint distribution over (θ, d) of displaced workers in $t = 0, 1$. Then pension expenditures due to early retirement in $t = 0$ equal

$$N_0 = q \int_{\underline{d}}^{\bar{d}} \int_{\hat{\theta}_0(d)}^{\infty} d(1+T)h_0(\theta, d)d\theta dd.$$

Pension expenditures due to early retirement in $t = 1$, i.e. DI and UI pathway, are given by

$$N_1 = \Phi \left(\int_{\hat{d}}^{\bar{d}} \int_{\hat{\theta}_1(d)}^{\infty} d(1+T)h_1(\theta, d)d\theta dd + \int_{\underline{d}}^{\hat{d}} \int_{\hat{\theta}_1(d)}^{\infty} \alpha d T h_1(\theta, d)d\theta dd \right)$$

with $\Phi = q(1 - q(1 - \pi_0^W))$ denoting the overall mass of displaced in $t = 1$. Finally, normal retirement at the beginning of $t = 2$ costs

$$N_2 = \Phi \int_{\underline{d}}^{\bar{d}} \int_0^{\hat{\theta}_1(d)} \alpha d T h_1(\theta, d)d\theta dd + q\pi^W(1 - q) \int_{\underline{d}}^{\bar{d}} \alpha d T \hat{g}(d)dd + (1 - q)^2 \int_{\underline{d}}^{\bar{d}} \alpha d T g(d)dd$$

whereas $\hat{g}(d)$ ($g(d)$) denotes the distribution over d for worker with one displacement in $t = 0$ only (no displacement at all). The first term represents expenditures due to individuals displaced in $t = 1$ who return to work and retire at the normal retirement age. The second term captures displaced individuals in $t = 0$ who return to work without being displaced in $t = 1$. The third term captures workers without displacement throughout the entire career.

A.2 Calibration of \mathcal{T}_1

The financial impact of program complementarity equals $\Delta_0^c = b + \tau + \bar{d}_0^R + \bar{p}_0^R - \mathcal{T}_1$ with (see Appendix Lemma B.3)

$$\mathcal{T}_1 = q^u(P_1 + \pi_1^U b - \pi_1^W \tau) + (1 - q^u) \left(\int_{\underline{d}}^{\bar{d}} \alpha d T \hat{g}(d)dd - \tau \right).$$

We allow the probability of repeated unemployment, q^u , to differ from the baseline layoff probability q .³¹ Set $q^u = 39\%$ to match the probability of 50-54 year old individuals during pre-REBP time to become repeated unemployed at age 55-57. We then simplify

$$\begin{aligned} \mathcal{T}_1 &= q^u(\pi_1^D(\bar{d}_0^D + \bar{p}_0^D) + \pi_1^U b - \pi_1^W \tau) + (1 - q^u \pi_1^D)(\bar{p}_0^U - \tau) \\ &= 0.39(0.37(0.80 + 2.85) + 0.25 \cdot 0.42 - (1 - 0.37 - 0.25)0.14) + (1 - 0.39 \cdot 0.37)(3.13 - 0.14) = 3.11 \end{aligned}$$

³¹This modification only affects Π_t^U in the sufficient statistic (8); see footnote 29.

B Proofs

B.1 Lemma 2

Proof. Set the value of working ($W_0 - \theta_0$) equal to the value of early retirement (R_0) to obtain the threshold value $\hat{\theta}_0$. Differentiation of $\hat{\theta}_0$ with respect to d yields

$$\partial\hat{\theta}_0/\partial d = q \cdot \partial E_\theta V_1/\partial d + (1 - q)\alpha T u'(\alpha d) - (1 + T)u'(d).$$

We need to distinguish two cases (see Lemma 1) in deriving $E_\theta V_1$. *Case 1* ($d < \hat{d}$): Sub-set of displaced individuals strictly preferring the UI- over the DI-pathway. The probability to return to work equals to $F(\hat{\theta}_1)$ while early retirement occurs with $1 - F(\hat{\theta}_1)$. The ex-ante marginal expected utility corresponds to the sum of the ex-post marginal utility of the work- and the UI-pathway weighted by their respective take-up probabilities, i.e.

$$\partial E_\theta V_1/\partial d = F(\hat{\theta}_1) \cdot \partial W_1/\partial d + (1 - F(\hat{\theta}_1)) \cdot \partial U_1/\partial d$$

with $\partial W_1/\partial d = \partial U_1/\partial d = \alpha T u'(\alpha d)$. Collect all terms of $\partial\hat{\theta}_0/\partial d$ and exploit $u'(\alpha d) < u'(d)$ to bound $\partial\hat{\theta}_0/\partial d < -(1 - q)u'(d)(1 - (\alpha - 1)T)$. Finally, assuming $1 - (\alpha - 1)T \geq 0$ completes the first case. *Case 2* ($d > \hat{d}$): Sub-set of displaced individuals strictly preferring the DI- over the UI-pathway. The same reasoning, as already applied in Case 1, yields³²

$$\partial E_\theta V_1/\partial d = F(\hat{\theta}_1) \cdot \partial W_1/\partial d + (1 - F(\hat{\theta}_1)) \cdot \partial D_1/\partial d$$

with $\partial W_1/\partial d = \alpha T u'(\alpha d)$ and $\partial D_1/\partial d = (1 + T)u'(d)$. Again, collect all terms of $\partial\hat{\theta}_0/\partial d$ and apply a similar bounding procedure

$$\begin{aligned} \partial\hat{\theta}_0/\partial d &= (1 + T)u'(d)(1 - q(1 - F_1(\hat{\theta}_1))) - \alpha T u'(\alpha d)(1 - q(1 - F_1(\hat{\theta}_1))) \\ &< -(1 - q(1 - F_1(\hat{\theta}_1)))u'(d)(1 - (\alpha - 1)T) \end{aligned}$$

which is, by exploiting the assumption $1 - (\alpha - 1)T \geq 0$, strictly below zero. \square

B.2 Proposition 2

Proof. Differentiation of $\hat{\theta}_0$ with respect to b yields $\partial\hat{\theta}_0/\partial b = q \cdot \partial E_\theta V_1/\partial b - u'(b)$. In analogy to Lemma 2, two cases are distinguished: In *Case 1* ($d < \hat{d}$) we obtain $\partial E_\theta V_1/\partial b = (1 - F(\hat{\theta}_1)) \cdot \partial U_1/\partial b$ which represents the marginal utility gains of retirement weighted by the probability to retire early. Welfare effects due to switching behavior are second order because individuals optimize in $t = 1$ (Envelope Theorem). Hence, $\hat{\theta}_0(d)$ decreases in b because $0 < q < 1$ and $0 \leq F(\hat{\theta}_1) \leq 1$. *Case 2* ($d > \hat{d}$) yields $\partial E_\theta V_1/\partial b = 0$ as the UI-pathway is never chosen and therefore $\partial\hat{\theta}_0/\partial b = -u'(b)$. \square

³²There is, however, an important difference: the threshold $\hat{\theta}_1$ becomes a function of d over the domain $d > \hat{d}$. Nevertheless, utility effects due to changes in the threshold $\hat{\theta}_1$ are second-order because individuals optimize over pathway choices (Envelope Theorem).

B.3 Lemma 3

Proof. Differentiation of the budget constraint (5) with respect to b yields

$$(\varphi + \Pi_0^W + \Pi_1^W) \frac{d\tau}{db} + \tau \frac{d(\Pi_0^W + \Pi_1^W)}{db} = \Pi_0^U + \Pi_1^U + b \frac{d(\Pi_0^U + \Pi_1^U)}{db} + \frac{dN}{db}.$$

The marginal pension expenditures (dN/db) are derived by looking at each component of N (see Appendix A.1) separately. After some rearrangements, the first component (N_0) equals

$$dN_0/db = \Pi_0^U \cdot (\varepsilon_0^c/b) \cdot (1 + T) \bar{d}_0^R$$

whereas $\Pi_0^U \cdot (\varepsilon_0^c/b)$ captures the mass of individuals switching to early retirement in $t = 0$, i.e. program complementarity effect, while $(1 + T) \bar{d}_0^R$ denotes the corresponding average pension benefits. We tackle dN_1/db and dN_2/db in two steps: (i) Define $\hat{N} = \Phi \cdot P_1$ with P_1 denoting all pension expenditures triggered by displaced workers in $t = 1$, i.e. N_1 plus the first component of N_2 . Under the assumption that (a) the work-DI-margin is not affected by the policy change - see Section 6.2 - and (b) dynamic sorting effects from $t = 0$ to $t = 1$ are neglected, we obtain the approximation

$$d\hat{N}/db \approx -q \cdot \Pi_0^U \cdot (\varepsilon_0^c/b) \cdot P_1 + \Pi_1^U \cdot (\varepsilon_1^s/b) \cdot (1 + T - \alpha T) \bar{d}_1^D.$$

The first term captures pension expenditures in $t = 1$ due to inflow effects triggered by complementarity effects in $t = 0$. The second term represents the additional DI expenditures minus old age pension due to program substitution effects. (ii) Out of the two remaining terms in N_2 only the first one is of interest (the last term drops out): $-(1 - q) \cdot \Pi_0^U \cdot (\varepsilon_0^c/b) \cdot \int_{\underline{d}}^{\bar{d}} \alpha dT \hat{g}(d) dd$. Next, decompose the mass of early retirees using the UI-pathway, i.e.

$$d(\Pi_0^U + \Pi_1^U)/db = \Pi_0^U (\varepsilon_0^c/b) (1 - q\pi_1^U) + \Pi_1^U (\varepsilon_1^w/b - \varepsilon_1^s/b) \quad (11)$$

exploiting the relationship $\varepsilon_1 = \varepsilon_1^w + \varepsilon_1^s$. A similar procedure applies for the workers as well:

$$d(\Pi_0^W + \Pi_1^W)/db = -\Pi_0^U (\varepsilon_0^c/b) (1 + q\pi_1^W + 1 - q) - \Pi_1^U (\varepsilon_1^w/b). \quad (12)$$

Combine all terms of dN/db , (11), and (12) to obtain equation (7) with $\Delta_1^w = b + \tau$, $\Delta_1^s = \bar{d}_1^D + \bar{p}_1^D - b - \bar{p}_1^U$, and $\Delta_0^c = b + \tau + \bar{d}_0^R + \bar{p}_0^R - \mathcal{T}_1$ with

$$\mathcal{T}_1 = q(P_1 + \pi_1^U b - \pi_1^W \tau) + (1 - q) \left(\int_{\underline{d}}^{\bar{d}} \alpha dT \hat{g}(d) dd - \tau \right).$$

□

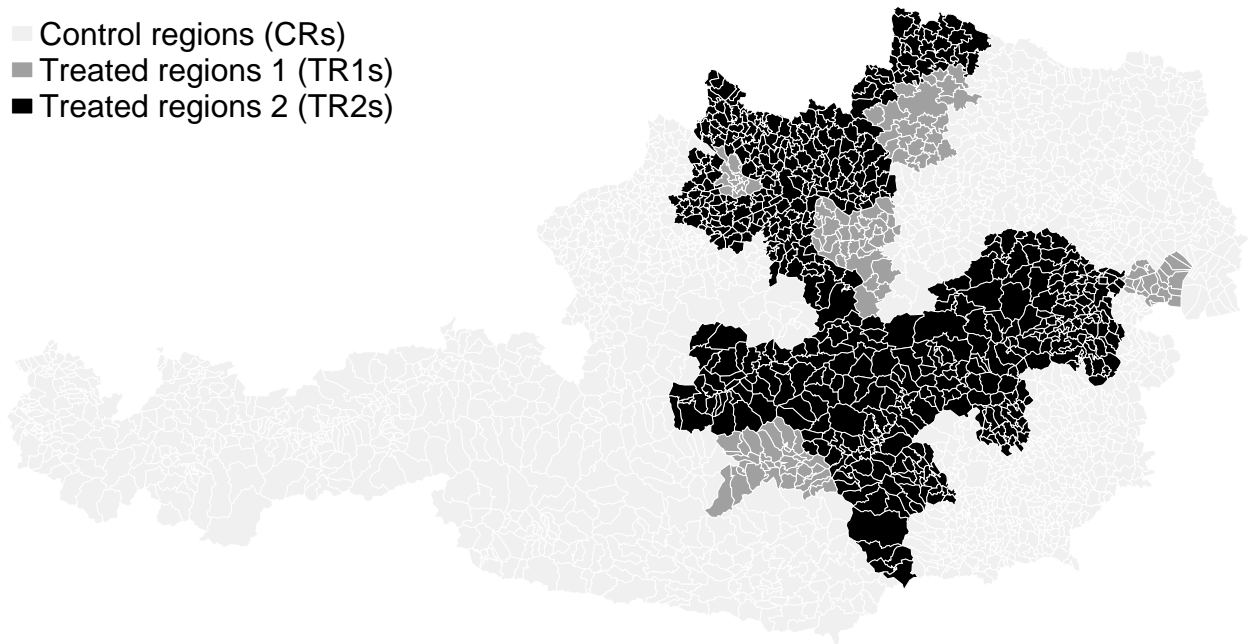


Figure 1: The Regional Extended Benefits Program (REBP)

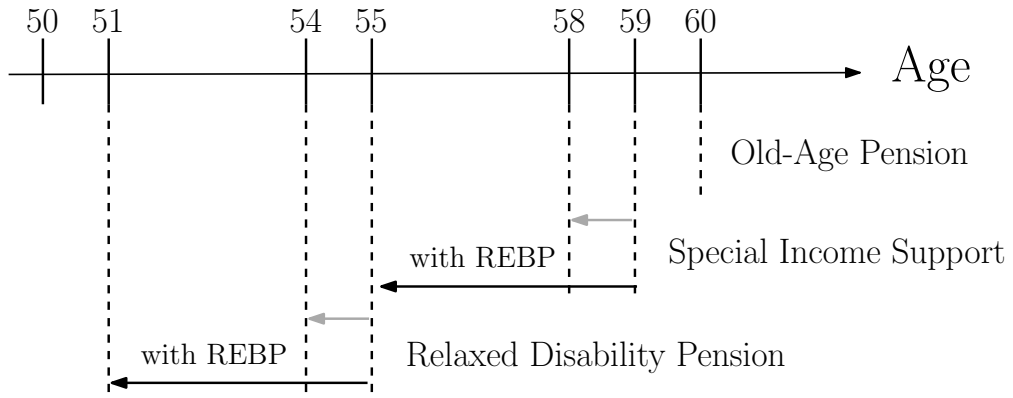


Figure 2: Early retirement pathways with/without REBP-eligibility

Table 1: Heterogeneity in UI and DI replacement rates

	DI repl. rate age 50-54				DI repl. rate age 55-57			
	1st quartile	2nd quartile	3rd quartile	4th quartile	1st quartile	2nd quartile	3rd quartile	4th quartile
<u>UI repl. rate</u>								
<u>1st quartile</u>								
No. of Obs.	6,841	6,216	5,720	2,572	1,383	1,541	1,648	925
Median DI repl. rate	48.0	62.5	72.1	90.5	47.5	64.0	74.2	84.8
Median UI repl. rate	55.3	54.3	53.5	54.8	55.0	53.7	52.2	54.5
<u>2nd quartile</u>								
No. of Obs.	5,326	6,001	5,921	4,103	1,360	1,780	1,376	980
Median DI repl. rate	49.6	62.4	72.7	88.6	49.5	63.8	73.7	85.5
Median UI repl. rate	58.6	59.2	59.9	60.0	57.9	58.3	58.6	59.4
<u>3rd quartile</u>								
No. of Obs.	4,594	5,205	5,680	5,871	1,131	1,216	1,579	1,572
Median DI repl. rate	49.1	62.6	72.8	91.6	49.1	64.7	74.2	89.2
Median UI repl. rate	61.4	61.4	61.4	61.5	61.2	61.1	61.1	61.1
<u>4th quartile</u>								
No. of Obs.	4,590	3,928	4,029	8,804	1,623	960	894	2,019
Median DI repl. rate	48.3	62.5	72.8	104.6	47.7	63.8	74.0	97.0
Median UI repl. rate	62.7	62.5	62.5	62.9	62.0	62.0	61.9	62.0

Notes: All replacement rates are after taxes. Sample includes unemployment spells starting in January 1985 to December 1995 (except spell starting between January 1988 and June 1988) by men aged 50-57. See Section 3.1 for details on the construction of the sample.

Table 2: Sample statistics in TRs and CRs before, during, and after REBP

	Before REBP		During REBP		After REBP	
	CRs	TRs	CRs	TRs	CRs	TRs
<u>Exit destinations (%)</u>						
Early retirement	33.7	41.5	44.1	75.4	47.9	56.8
Disability pension	22.4	29.7	30.2	45.7	33.0	42.1
Old-age pension	9.8	9.8	11.5	26.6	11.7	11.4
Censored	1.5	2.0	2.4	3.2	3.2	3.3
<u>Background characteristics</u>						
Age at UI entry	53.5	53.4	53.3	53.6	53.5	53.5
Sick days	113	117	112	93	97	101
Married	0.752	0.777	0.753	0.807	0.759	0.770
<u>Education</u>						
Low	0.575	0.621	0.495	0.485	0.429	0.455
Medium	0.356	0.336	0.404	0.436	0.443	0.444
High	0.070	0.043	0.101	0.079	0.128	0.101
Daily wage	56.6	54.5	63.7	69.4	68.9	68.2
Blue collar	0.802	0.837	0.726	0.745	0.664	0.719
Experience (years)	11.3	11.3	11.1	11.8	11.2	11.2
Tenure (years)	3.1	3.1	3.6	5.1	4.1	4.3
Number of observations	10,677	2,578	24,287	9,049	16,669	4,054

Notes: “Before” denotes unemployment spells starting in January 1985 to December 1987. “During” denotes unemployment spells starting in June 1988 to July 1993 (December 1991 in TR1s). “After” denotes unemployment spells starting in August 1993 (January 1992 in TR1s) to December 1995. “Sick days” is the sum of days spent in sick leave prior to unemployment entry, “experience” denotes work experience in the last 13 years, and “tenure” refers to tenure in last job. Daily wage is adjusted for inflation.

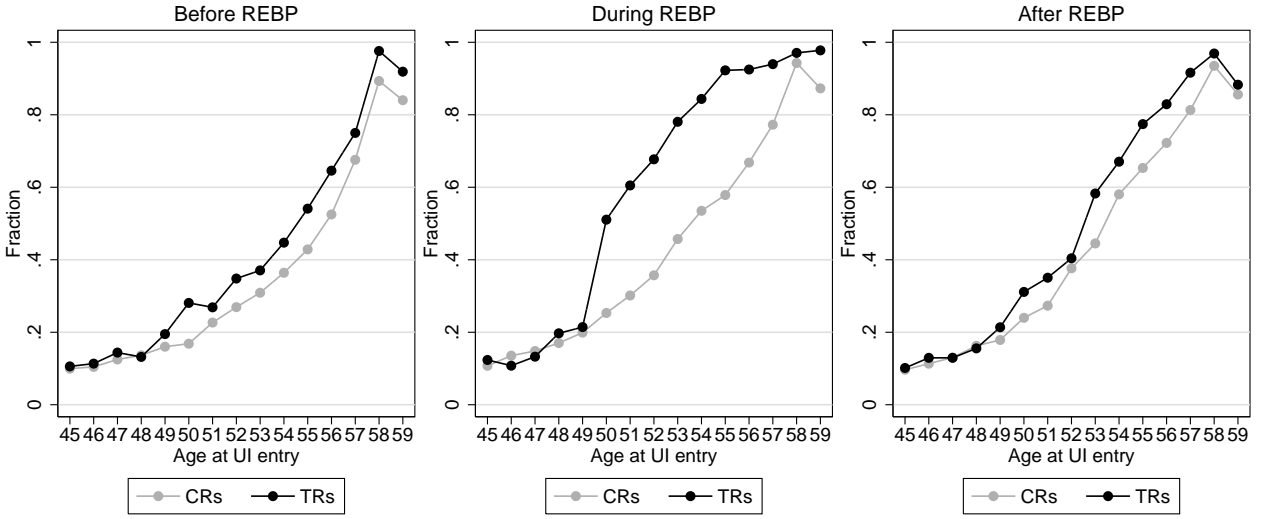


Figure 3: Transitions to early retirement by age in CRs and TRs before, during, and after REBP
 Source: Own calculations, based on Austrian Social Security Data.

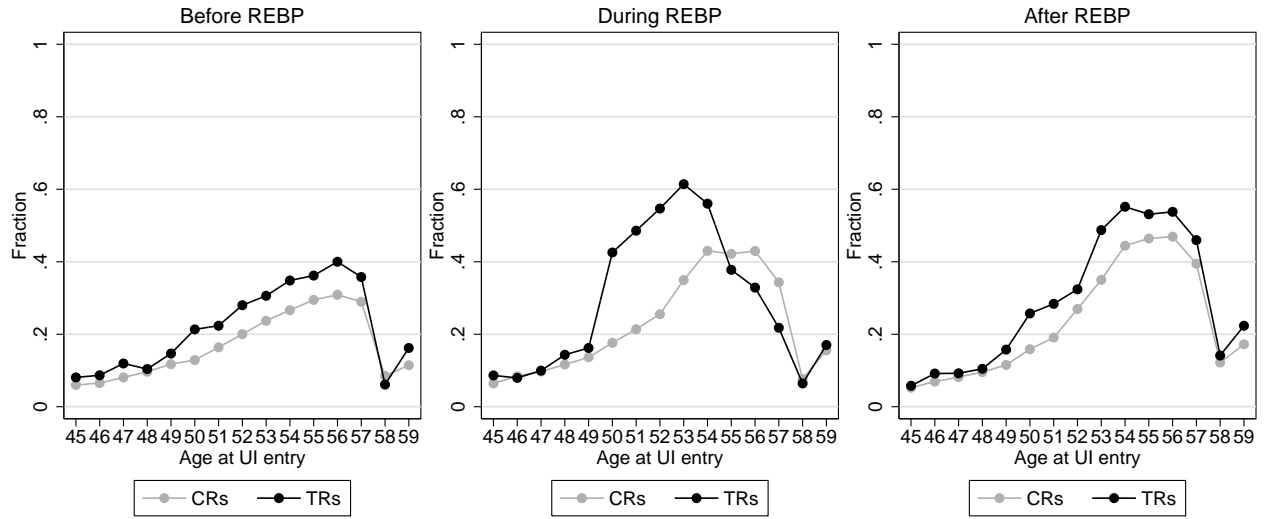


Figure 4: Transitions to disability pensions by age in CRs and TRs before, during, and after REBP
 Source: Own calculations, based on Austrian Social Security Data.

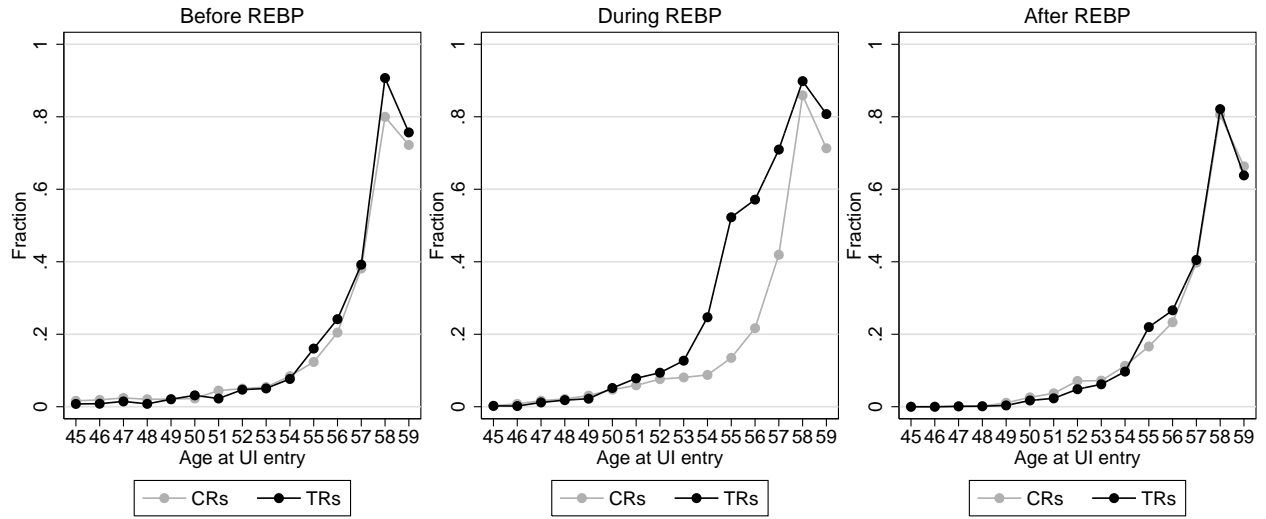


Figure 5: Transitions to old-age pensions by age in CRs and TRs before, during, and after REBP
 Source: Own calculations, based on Austrian Social Security Data.

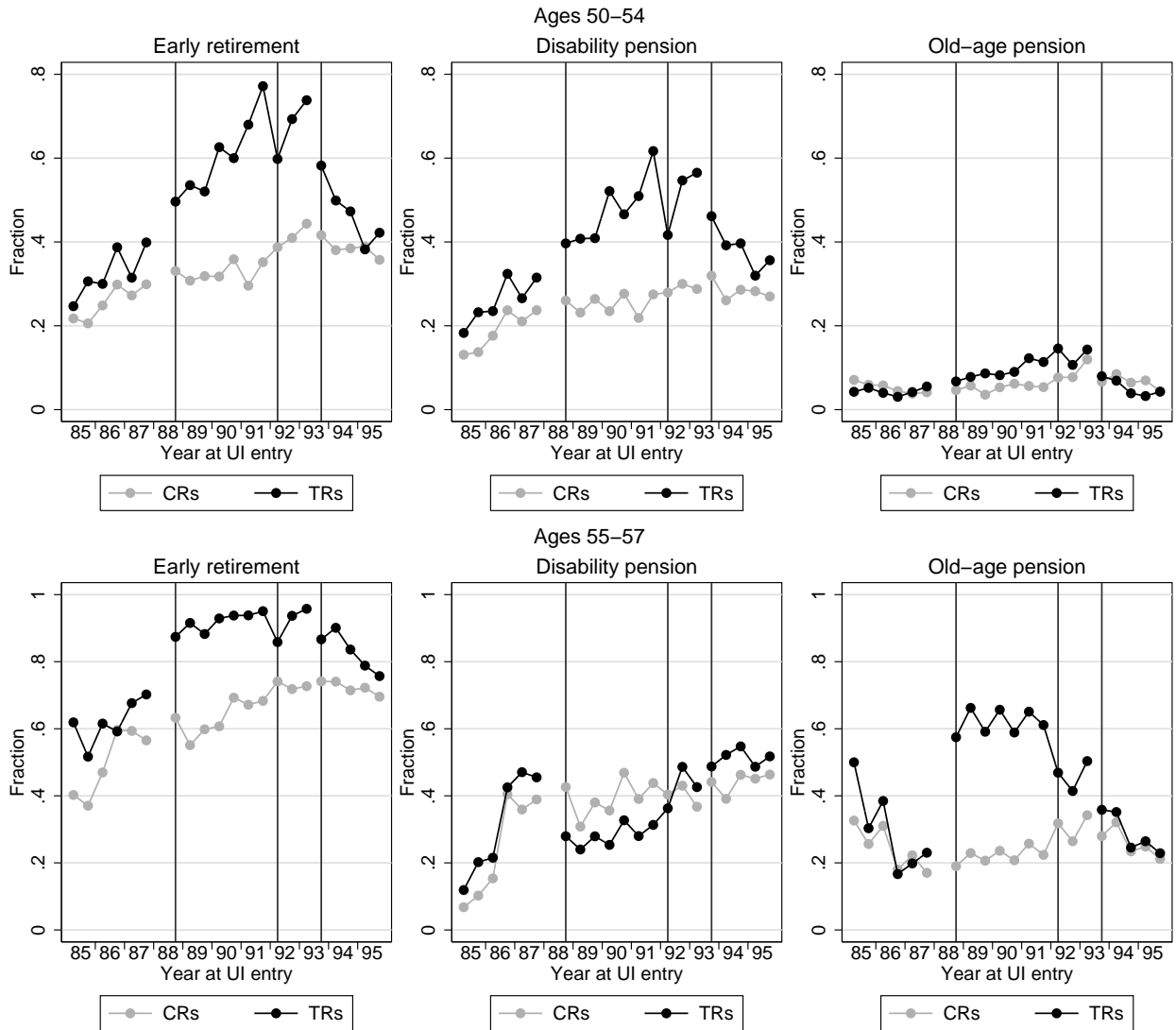


Figure 6: Trends in transitions to early retirement, disability pensions, and old-age pensions in CRs and TRs by year and age group

Source: Own calculations, based on Austrian Social Security Data.

Table 3: Average effect on unemployment exit of age groups 50-54 and 45-49

	Age 50-54			Age 45-49		
	Early retirement	Disability pension	Old-age pension	Early retirement	Disability pension	Old-age pension
REBP introduced ($D \times TR$)	0.170*** (0.022)	0.126*** (0.028)	0.039* (0.022)	-0.007 (0.012)	-0.008 (0.011)	0.004 (0.004)
REBP abolished ($A \times TR$)	-0.187*** (0.017)	-0.123*** (0.022)	-0.048*** (0.013)	0.006 (0.010)	0.002 (0.008)	0.003 (0.003)
During (D)	0.142*** (0.019)	0.127*** (0.014)	-0.008 (0.014)	0.024** (0.012)	0.005 (0.008)	-0.022*** (0.005)
After (A)	-0.008 (0.012)	0.005 (0.013)	-0.017* (0.010)	-0.008 (0.008)	-0.004 (0.007)	-0.001 (0.002)
TRs 1 ($TR1$)	0.014 (0.037)	0.025 (0.036)	-0.014 (0.014)	-0.009 (0.014)	0.010 (0.014)	-0.010** (0.004)
TRs 2 ($TR2$)	0.081*** (0.019)	0.080*** (0.022)	-0.006 (0.013)	0.003 (0.012)	0.016 (0.012)	-0.008* (0.005)
R ²	0.194	0.144	0.084	0.133	0.103	0.011
Mean in TRs pre-REBP	0.336	0.269	0.044	0.079	0.061	0.017
No. of Obs.	48,666	48,666	48,666	63,689	63,689	63,689

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market regions. Controls: marital status, education, last annual wage, unemployment, blue collar status, employment history, tenure in last job, previous industry, age, year and quarter of inflow. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 4: Average effect on unemployment exit of age groups 55-57 and 58-59

	Age 55-57			Age 58-59		
	Early retirement	Disability pension	Old-age pension	Early retirement	Disability pension	Old-age pension
REBP introduced ($D \times TR$)	0.108*** (0.029)	-0.127*** (0.046)	0.231*** (0.042)	-0.017 (0.012)	0.001 (0.015)	-0.019 (0.021)
REBP abolished ($A \times TR$)	-0.101*** (0.019)	0.134*** (0.022)	-0.240*** (0.023)	-0.018 (0.013)	0.038* (0.023)	-0.055** (0.028)
During (D)	0.242*** (0.054)	0.377*** (0.035)	-0.146*** (0.048)	0.452*** (0.079)	0.199*** (0.029)	0.237*** (0.074)
After (A)	0.025 (0.018)	0.000 (0.023)	0.020 (0.025)	-0.004 (0.014)	-0.010 (0.015)	0.008 (0.019)
TRs 1 ($TR1$)	0.071** (0.031)	0.065 (0.056)	0.009 (0.052)	0.061*** (0.020)	-0.050* (0.026)	0.112*** (0.034)
TRs 2 ($TR2$)	0.094*** (0.030)	0.048 (0.042)	0.046 (0.039)	0.045*** (0.014)	-0.001 (0.020)	0.046 (0.028)
R^2	0.204	0.079	0.250	0.141	0.087	0.169
Mean in TRs pre-REBP	0.632	0.374	0.249	0.971	0.070	0.893
No. of Obs.	18,648	18,648	18,648	11,501	11,501	11,501

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market regions. Controls: marital status, education, last annual wage, unemployment, blue collar status, employment history, tenure in last job, previous industry, age, year and quarter of inflow. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 5: Difference-in-difference matching

	Age 50-54			Age 55-57		
	Early retirement	Disability pension	Old-age pension	Early retirement	Disability pension	Old-age pension
REBP introduced	0.165*** (0.021)	0.128*** (0.020)	0.031** (0.013)	0.113*** (0.023)	-0.186*** (0.038)	0.284*** (0.038)
REBP abolished	-0.166*** (0.012)	-0.102*** (0.013)	-0.044*** (0.007)	-0.112*** (0.017)	0.115*** (0.023)	-0.233*** (0.021)

Notes: Estimation based on the approach by Blundell et al. (2004). Radius matching with a radius of 0.02. Propensity score estimated with a probit model. Controls: marital status, education, last annual wage, unemployment, blue collar status, employment history, tenure in last job, previous industry, age, and quarter of inflow. Significance levels: *** = 1%, ** = 5%, * = 10%.

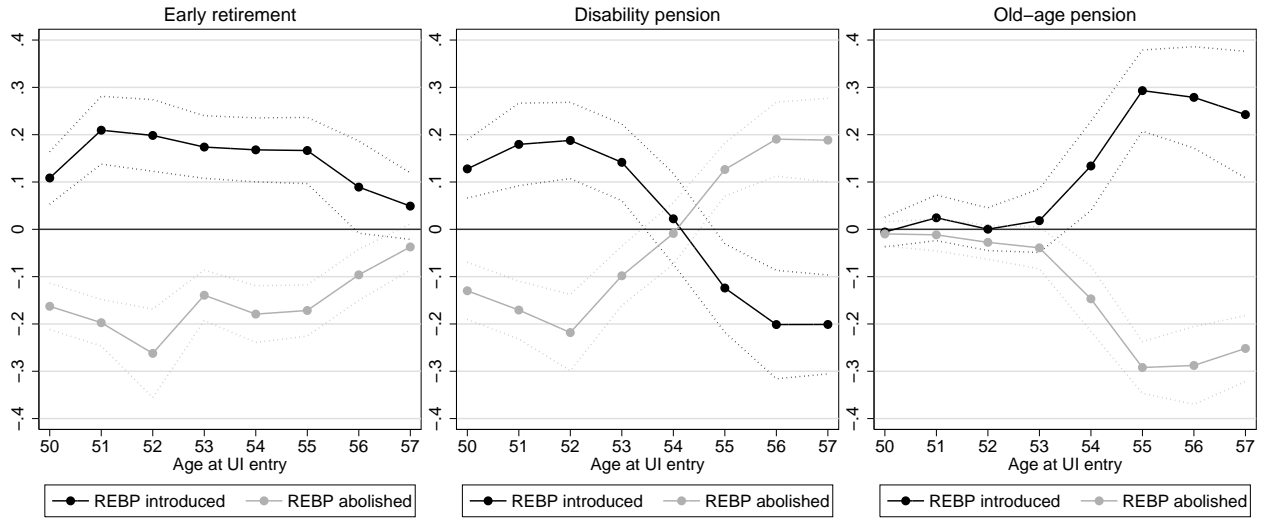


Figure 7: Coefficients of the interactions $(d_{ijt} \times D_t \times TR_i)$ and $(d_{ijt} \times A_t \times TR_i)$ in equation (2) for transitions to early retirement, disability pensions, and old-age pensions (dotted lines represent 95-percent confidence interval).

Source: Own calculations, based on Austrian Social Security Data.

Table 6: Exit to disability pensions for age group 50-54

	Exit age 50-54	Exit Age 55+
REBP introduced	-0.025**	0.151***
($D \times TR$)	(0.011)	(0.026)
REBP abolished	0.013	-0.136***
($A \times TR$)	(0.008)	(0.023)
During	0.038***	0.090***
(D)	(0.010)	(0.013)
After	-0.018**	0.023**
(A)	(0.009)	(0.011)
TRs 1	0.013	0.012
($TR1$)	(0.017)	(0.024)
TRs 2	0.026**	0.054***
($TR2$)	(0.013)	(0.017)
R^2	0.035	0.155
Mean in TRs pre-REBP	0.100	0.169
No. of Obs.	48,666	48,666

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market regions. Controls: marital status, education, last annual wage, unemployment, blue collar status, employment history, tenure in last job, previous industry, and quarter of inflow. Significance levels: *** = 1%, ** = 5%, * = 10%.

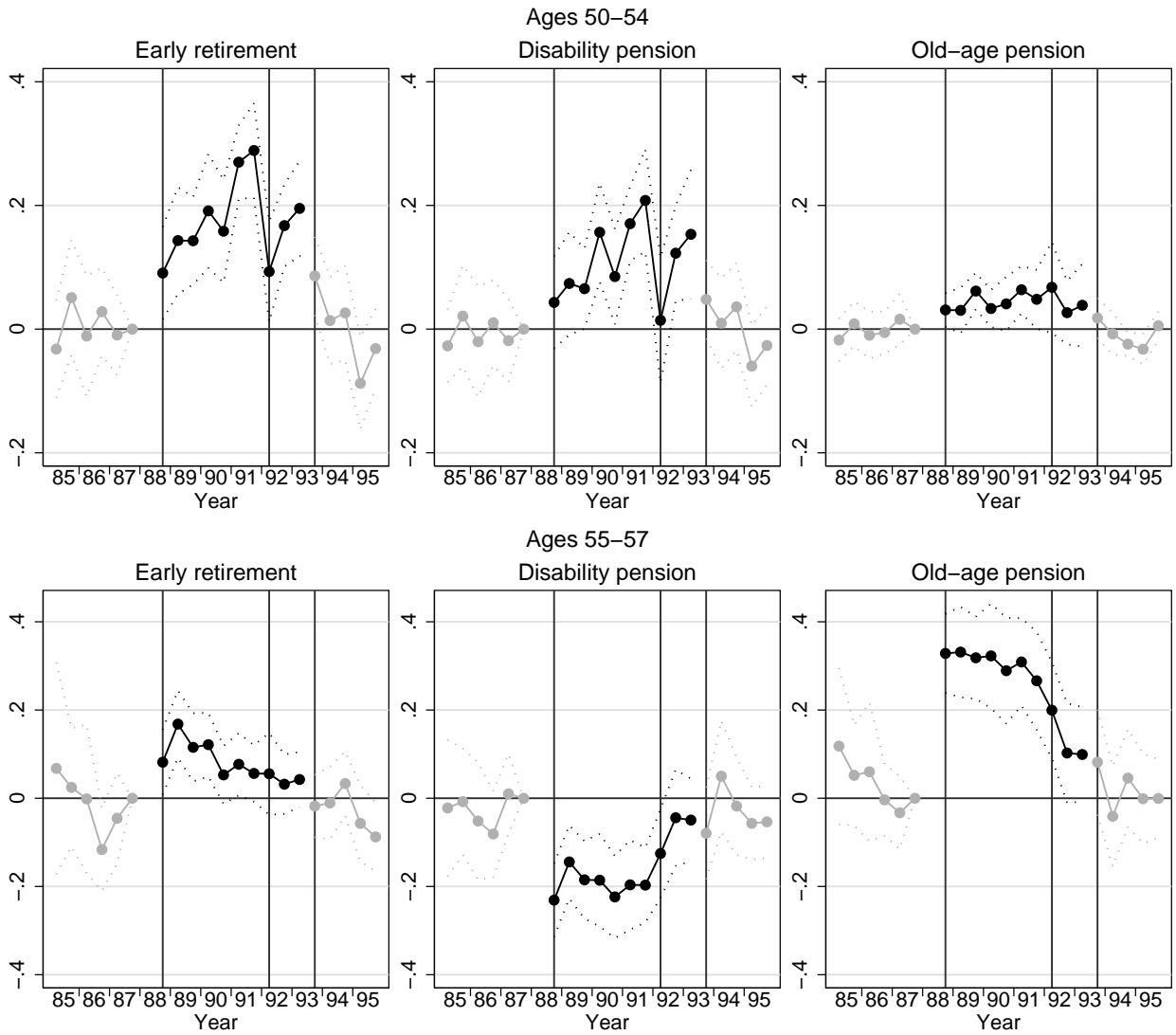


Figure 8: Coefficients of the interactions $(d_{ijt} \times D_t \times TR_i)$ and $(d_{ijt} \times A_t \times TR_i)$ in equation (3) for transitions to early retirement, disability pensions, and old-age pensions by age group (dotted lines represent 95-percent confidence interval).

Source: Own calculations, based on Austrian Social Security Data.

Table 7: Effects for unemployed who live within 30 minutes driving time to the border

	Age 50-54			Age 55-57		
	Early retirement	Disability pension	Old-age pension	Early retirement	Disability pension	Old-age pension
REBP introduced ($D \times TR$)	0.167*** (0.032)	0.099** (0.046)	0.066*** (0.024)	0.084** (0.032)	-0.131** (0.058)	0.203*** (0.048)
REBP abolished ($A \times TR$)	-0.176*** (0.026)	-0.116*** (0.032)	-0.058*** (0.014)	-0.082*** (0.022)	0.140*** (0.030)	-0.220*** (0.026)
During (D)	0.121*** (0.035)	0.114*** (0.037)	-0.015 (0.019)	0.333*** (0.047)	0.465*** (0.083)	-0.129 (0.079)
After (A)	0.019 (0.025)	0.029 (0.025)	-0.010 (0.013)	0.029 (0.035)	0.000 (0.054)	0.019 (0.054)
TRs 1 ($TR1$)	-0.012 (0.041)	-0.007 (0.037)	-0.008 (0.014)	0.051 (0.035)	0.012 (0.050)	0.039 (0.048)
TRs 2 ($TR2$)	0.056** (0.028)	0.054 (0.032)	-0.006 (0.015)	0.092*** (0.032)	0.032 (0.061)	0.065 (0.051)
R ²	0.215	0.142	0.088	0.230	0.095	0.269
Mean in TRs pre-REBP	0.317	0.253	0.039	0.599	0.347	0.242
No. of Obs.	12,057	12,057	12,057	4,953	4,953	4,953

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market regions. Controls: marital status, education, last annual wage, unemployment, blue collar status, employment history, tenure in last job, previous industry, age, year and quarter of inflow. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 8: Effects for unemployed whose last job was in the tradable goods sector

	Age 50-54			Age 55-57		
	Early retirement	Disability pension	Old-age pension	Early retirement	Disability pension	Old-age pension
REBP introduced ($D \times TR$)	0.170*** (0.028)	0.135*** (0.032)	0.031 (0.025)	0.070** (0.034)	-0.148*** (0.049)	0.220*** (0.047)
REBP abolished ($A \times TR$)	-0.193*** (0.028)	-0.132*** (0.014)	-0.038*** (0.016)	-0.113*** (0.020)	0.134*** (0.032)	-0.248*** (0.035)
During (D)	0.144*** (0.030)	0.110*** (0.022)	0.004 (0.023)	0.212*** (0.055)	0.364*** (0.046)	-0.165** (0.064)
After (A)	-0.022 (0.019)	0.019 (0.020)	-0.037** (0.015)	0.028 (0.022)	0.011 (0.033)	0.015 (0.034)
TRs 1 ($TR1$)	-0.001 (0.040)	0.008 (0.042)	-0.013 (0.018)	0.089** (0.036)	0.068 (0.077)	0.024 (0.069)
TRs 2 ($TR2$)	0.087*** (0.026)	0.088*** (0.027)	-0.009 (0.018)	0.113*** (0.035)	0.074* (0.044)	0.038 (0.044)
R ²	0.211	0.162	0.100	0.225	0.089	0.223
Mean in TRs pre-REBP	0.373	0.291	0.058	0.715	0.396	0.309
No. of Obs.	24,681	24,681	24,681	9,604	9,604	9,604

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market regions. Controls: marital status, education, last annual wage, unemployment, blue collar status, employment history, tenure in last job, previous industry, age, year and quarter of inflow. Significance levels: *** = 1%, ** = 5%, * = 10%.

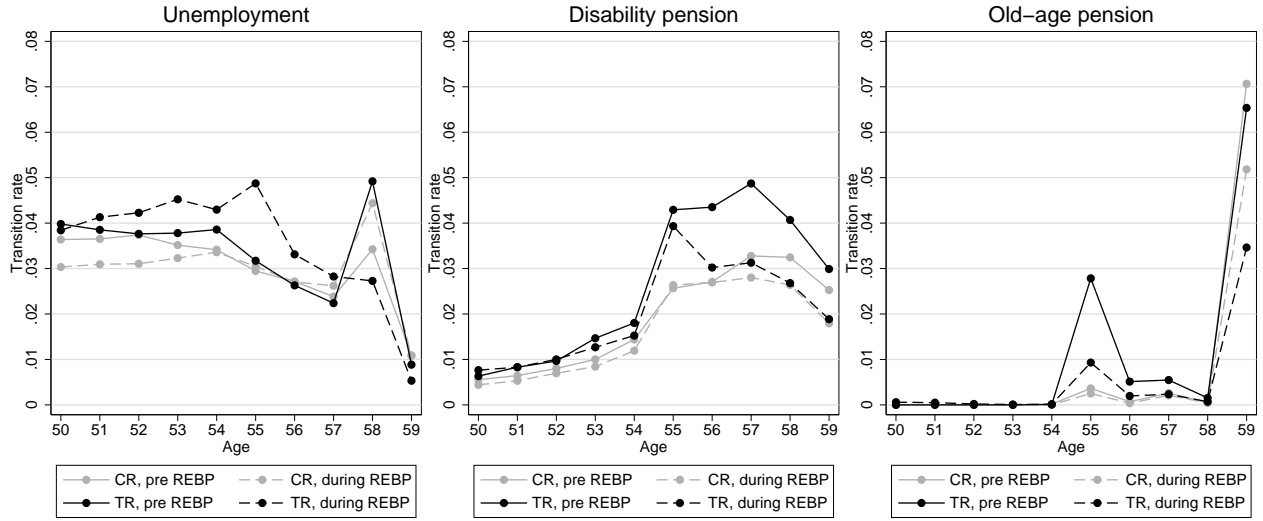


Figure 9: Transition rates from employment into unemployment, disability pensions, and old-age pensions by age in CRs and TRs before and during the REBP

Source: Own calculations, based on Austrian Social Security Data.

Table 9: Effects for unemployed with low-tenure

	Age 50-54			Age 55-57		
	Early retirement	Disability pension	Old-age pension	Early retirement	Disability pension	Old-age pension
REBP introduced ($D \times TR$)	0.166*** (0.024)	0.129*** (0.030)	0.033* (0.018)	0.134*** (0.033)	-0.097** (0.042)	0.229*** (0.039)
REBP abolished ($A \times TR$)	-0.180*** (0.020)	-0.123*** (0.025)	-0.042*** (0.012)	-0.111*** (0.023)	0.135*** (0.025)	-0.256*** (0.023)
During (D)	0.134*** (0.018)	0.132*** (0.016)	-0.018* (0.010)	0.283*** (0.055)	0.407*** (0.040)	-0.129*** (0.042)
After (A)	0.001 (0.012)	-0.007 (0.013)	0.002 (0.007)	0.035 (0.024)	-0.006 (0.030)	0.027 (0.025)
TRs 1 ($TR1$)	0.009 (0.035)	0.015 (0.034)	-0.010 (0.011)	0.071** (0.034)	0.049 (0.052)	0.022 (0.043)
TRs 2 ($TR2$)	0.080*** (0.019)	0.072*** (0.020)	-0.001 (0.009)	0.098*** (0.033)	0.029 (0.043)	0.068* (0.038)
R ²	0.165	0.131	0.048	0.180	0.079	0.226
Mean in TRs pre-REBP	0.288	0.231	0.031	0.550	0.335	0.207
No. of Obs.	36,485	36,485	36,485	13,983	13,983	13,983

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market regions. Controls: marital status, education, last annual wage, unemployment, blue collar status, employment history, tenure in last job, previous industry, age, year and quarter of inflow. Significance levels: *** = 1%, ** = 5%, * = 10%.

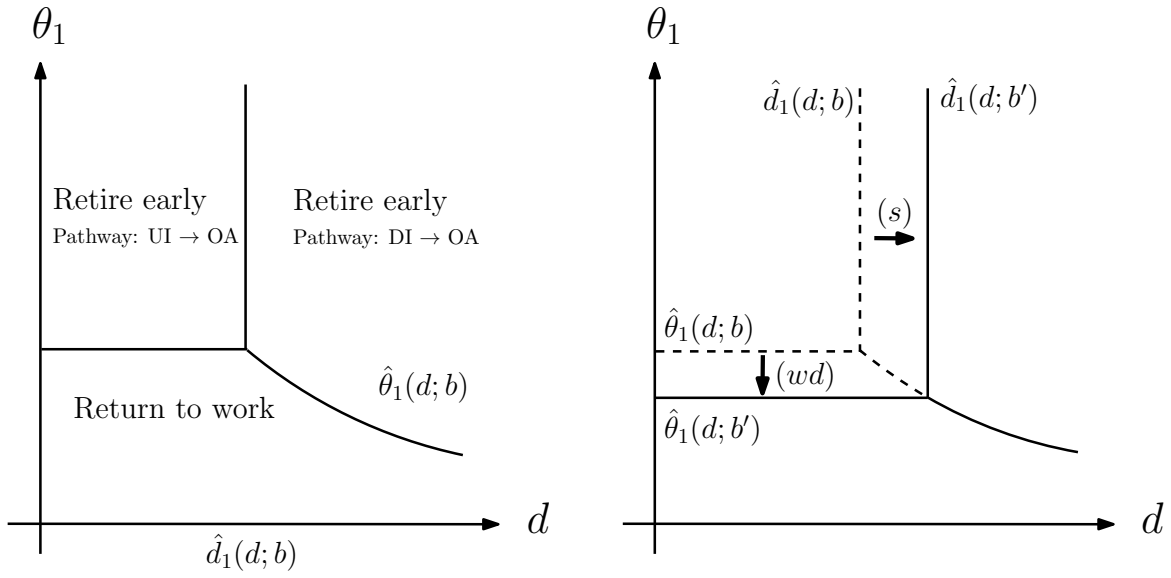


Figure 10: Left panel: Early retirement thresholds in $t = 1$. Right panel: Work disincentive effects (wd) as well as program substitution effects (s) when unemployment benefits increase from b to b' .

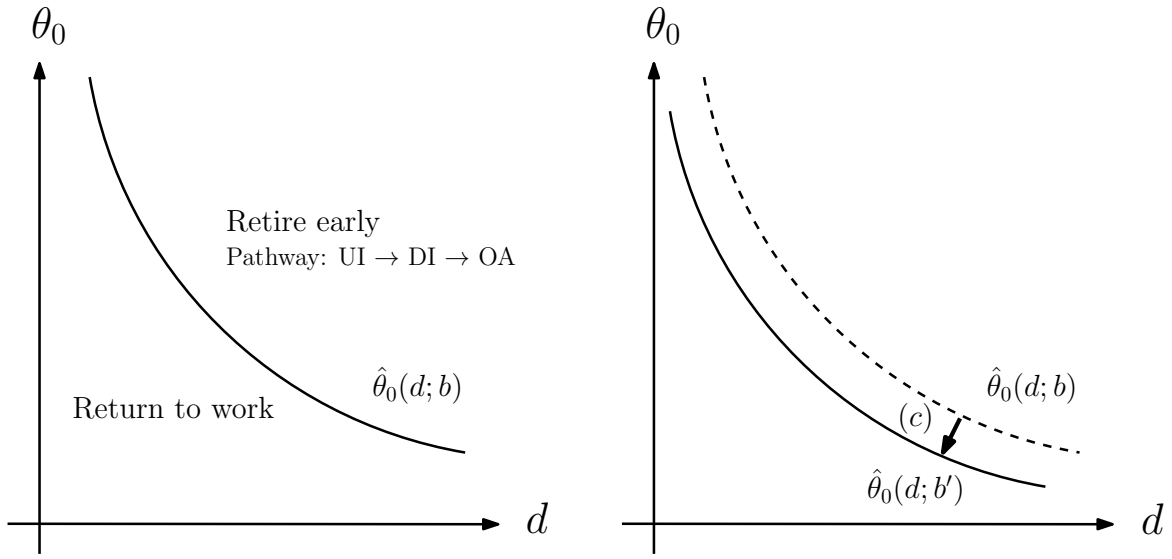


Figure 11: Left panel: Early retirement threshold $\hat{\theta}_0(d; b)$ in $t = 0$. Right panel: Program complementarity effects (c) when unemployment benefits increase from b to b' .

Table 10: Financial impact per pathway switcher

	In after-tax replacement rates	In Thousands of Euros (year 2000)
$\hat{\Delta}_0^c = RR(b) + \hat{\tau} + RR(\bar{d}_1^D + \bar{p}_1^D) - \mathcal{T}_1$	$0.42 + 0.14 + 0.80 + 2.85 - 3.11 = 1.14$	109
$\hat{\Delta}_1^w = RR(b) + \hat{\tau}$	$0.42 + 0.14 = 0.56$	56
$\hat{\Delta}_1^s = RR(b + \bar{p}_1^U) - RR(\bar{d}_1^D + \bar{p}_1^D)$	$0.42 + 3.13 - 0.80 - 2.85 = -0.10$	-10

Notes: Pensions are reported in after tax replacement rates, or $RR(x) = x/(w - \tau)$, and pay roll taxes are adjusted by $\hat{\tau} = \tau/(1 - \tau) = 0.14$. \mathcal{T}_1 denotes the expected net transfers in $t = 1$ given the individual returns to work in $t = 0$. See Appendix A.2 for a comprehensive calibration of this term. The conditional lifetime expectation of a 60 year old male individual was about 17.8 years, or $T = 3.56$, in 1990 (STATISTIK AUSTRIA, 2012). Expenditures/revenues in Euro are obtained by multiplying $\hat{\Delta}$ by the average daily wage before REBP in the TR, or 54.5 Euro/day (see Table 2) times the amount of days within five years (1825). Use $\hat{\Delta}_t^i/RR(b) \equiv \Delta_t^i/b$ to obtain the Δ s in equation (8)