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Substitution

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

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Abstract

This paper explores how extended unemployment insurance (UI) benefits targeted to older workers affect early retirement and social welfare. We argue that the analysis of UI's trade-off between consumption smoothing and moral hazard needs to consider the entire early retirement system, which often consists of extended UI and relaxed access to disability insurance (DI). We argue that extended UI generates program complementarity (higher future take-up of DI and/or regular retirement benefits) or program substitution (lower contemporaneous take-up of DI benefits). Exploiting Austria's regional extended benefit program, which extended regular UI benefits to up to 4 years, we find: (i) program complementarity is quantitatively important for workers aged 50+; and (ii) program substitution is quantitatively relevant for workers aged 55+. We derive an optimal UI formula in the spirit of Baily (1978) and Chetty (2006) that features program complementarity and program substitution. Using the sufficient statistics approach, we conclude that UI for older workers was too generous and the regional extended benefit program was a suboptimal policy.

Keywords

Early retirement, unemployment, disability, policy reform, optimal benefits

JEL Classification

J14, J26, J65

1 Introduction

Extending the potential duration of unemployment insurance (UI) benefits is one of the most important policy instruments to ease economic hardships of job losers. For instance, the United States extended UI benefits from 26 weeks up to 99 weeks during the Great Recession. The UI systems of many other countries do not let UI generosity vary over the business cycle but rather across groups with different labor market conditions. In particular, many countries grant more generous UI benefits to older job losers. The present paper studies the impact of extended UI benefits on employment and retirement behavior and explores the social welfare implications of a UI system that grants more generous benefits to older workers.

The social desirability of UI benefit extensions is highly controversial. Theoretical arguments show that optimal UI faces a trade-off between moral hazard effects, captured by labor supply/job search responses, and consumption smoothing benefits, captured by relaxed liquidity constraints (Baily (1978), Chetty (2008)).¹ In the context of older workers, this general logic needs to be broadened by considering the costs and benefits of *all* welfare benefits that protect older workers in case of a job loss. In many countries, early retirement schemes allow older unemployed workers to withdraw from the work force by using extended UI benefits in combination with other public transfers (DI benefits and/or retirement benefits). This is what we call *program complementarity*. Alternatively, more generous UI benefits may induce workers to reduce take-up of other welfare programs, in particular DI benefits. This is what we mean by *program substitution*. While program complementarity imposes an additional burden on government budgets, the impact of program substitution is unclear.²

The aim of the present paper is twofold. *First*, we study the causal impact of extended UI benefits on (i) the incidence of early retirement and (ii) the particular pathways through which workers exit the labor market. We focus on Austria. Under the Austrian system of the late 1980s and early 1990s, workers aged 50+ were eligible for 1 year of regular UI benefits. Moreover, worker aged 55+ had relaxed access to DI benefits. To empirically identify the causal impact of extended UI benefits for older workers we exploit a policy intervention that changed early retirement incentives dramatically: the regional extended benefits program (REBP). This program was in place between June 1988 and July 1993 and granted regular UI benefits for up to 4 years to workers aged 50+ living in certain regions of the country. Variation in the maximum duration of UI benefits across regions and age groups allows us to identify the causal impact of extended UI benefits on the incidence of early retirement and the particular pathways by which workers leave the labor market.

¹While a large literature has documented the adverse consequences of more generous benefits for unemployment exit rates (see, e.g., Meyer (1990), Katz and Meyer (1990), and Card and Levine (2000)), only few empirical papers have examined the consumption smoothing benefits of UI benefits (Gruber (1997), Browning and Crossley (2001)).

²When DI take-up is associated with stigma costs or a disutility due to medical checks/bureaucratic hassles, a worker may decide to stay unemployed even when UI benefits are smaller than DI benefits. This saves money to the government. In contrast, DI benefits often provide a constant stream of income while alternative early retirement pathways imply varying income levels over time. Liquidity constrained workers may thus prefer DI benefits even if lifetime income is lower. When, starting from such a situation, UI becomes more generous, some worker will switch to UI benefits. This increases government expenditures.

Since the REBP was only in effect for a limited period of time we can estimate both the effects of introducing and abolishing extended UI benefits using a difference-in-differences approach.

We find that extended UI benefits have a strong effect on the incidence of early retirement. The probability that a job loser aged 50-54 permanently withdraws from the labor market increases by 16.2 percentage points when the worker is eligible to the REBP. Among job losers aged 55-57, the incidence of early retirement increases by 14.8 percentage for those eligible to the REBP.³ Extended UI benefits also affect the pathways into early retirement. For workers aged 50-54, *program complementarity* – increased take-up of UI followed by higher DI benefit claims and/or retirement benefits – is quantitatively important. The 16.2 percentage point increase in early retirement is associated with a 12.2 percentage point increase in a subsequent DI take-up. For workers aged 55-57 both *program complementarity* and *program substitution* – higher take-up of UI but lower take-up of DI – are at work. The 14.8 percentage point increase in early retirement is associated with a 24 percentage point increase in subsequently claiming of retirement benefits and a 9.7 percentage reduction in claiming of DI benefits.

The *second* aim of this paper is to explore the welfare consequences of extended UI benefits for older workers. We follow the sufficient statistics approach proposed by Chetty (2006a) and set up a simple model that makes precise the impact of more generous UI benefits on labor supply and retirement.⁴ Using this model, we establish a simple rule for optimal UI that accounts for both program complementarity and program substitution. We find that, given the Austrian early retirement rules of the late 1980s and early 1990s, the extension of UI benefits was welfare-improving only if the degree of risk aversion exceeds 2.22. The value of risk aversion remains disputed and a growing body of literature suggests that risk preferences are context-specific (Chetty and Szeidl (2007), Barseghyan et al. (2011), Einav et al. (2012)). Studies that use labor supply elasticities to estimate risk aversion come closest to our setting. These studies typically find values of risk aversion below 1 (Chetty, 2006b). We therefore conclude that extended UI through the REBP was most likely a suboptimal policy.

We think our study is of general interest for two reasons. *First*, policy makers in many countries have implemented early retirement schemes and these schemes are both very costly and very controversial. In many countries, reforms reducing the generosity of these schemes are debated or under way. In this context, Austria is an interesting case study because early retirement schemes were heavily used to mitigate labor market problems of older workers over the past decades. As a result, Austria's effective retirement age has fallen to age 59, well below the OECD average. *Second*, while the Austrian early retirement system created particularly large incentives, it works qualitatively similar than in many other countries. Early retirement schemes often feature relaxed DI-eligibility criteria for older workers, including the United States (Chen and van der Klaauw,

³As we explain in more detail in the next section, retirement incentives are different before and after age 55 due to relaxed access to DI benefits. Moreover retirement incentives between REBP- and non-REBP regions disappear after age 57. This is why our analysis looks at age groups 50-54 and 55-57.

⁴Recent applications of the sufficient statistic approach for optimal UI design include Shimer and Werning (2007), Chetty (2008), Kroft (2008), Landais et al. (2010), Kroft and Notowidigdo (2011), Schmieder et al. (2012), and Landais (2012). See the article by Chetty and Finkelstein (2013) for a detailed discussion of this literature.

2008), and extended UI benefit durations are extended above certain age thresholds, as in Germany, (Schmieder et al., 2012).⁵ This suggests that our results illustrates mechanisms of policies that are at work (and under debate) in many other countries.

Our paper is related to a growing literature that studies how multiple social insurance programs affect workers' labor supply decisions and if differs from the larger literature that studies the isolated effect of a single program on labor supply and/or early retirement. Autor and Duggan (2003) examine the interaction between unemployment and disability insurance in the United States. They find that less strict medical 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. Using administrative data from the Netherlands, Borghans et al. (2012) provide empirical evidence that more restrictive DI benefits increase enrollment into other forms of social insurance. 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. She finds that the associated 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.⁶

A recent literature studies the impact of UI and/or DI on labor supply and retirement of older workers.⁷ Karlström et al. (2008) find that stricter eligibility criteria for DI benefits in Sweden increased take-up of unemployment and sickness benefits, but did not increase employment rates. In contrast, Kyrrä (2010) provide evidence that increasing age-thresholds for extended UI benefits and tightening medical criteria for DI eligibility in Finland raised the effective retirement age by almost 4 months. The results of Staubli (2011) suggest that increasing the minimum age of relaxed DI access in Austria lead to a significant decline in DI enrollment but only a slight increase in employment. Kyrrä and Ollikainen (2008) document a strong decrease in early retirement after a reform in Finland that increased the eligibility age for extended UI benefits from 53 to 55. Lammers et al. (2013) show that increased search requirements for older unemployed in the Netherlands increased not only employment rates but also DI take-up. Our paper extends this literature by investigating how extended UI benefits for older workers affect retirement behavior through program complementarity and program substitution; and by using the estimated behavioral elasticities to explore the welfare implications of extended UI benefits for older unemployed workers.

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

⁵Countries other than Austria and the United States that relax access to DI for older workers include Australia, Denmark, Finland (until 2003), and Sweden (until 1997). Countries other than Austria and Germany that extend UI above certain age thresholds include France, Finland, Greece, Italy, and Portugal.

⁶Spillover effects among social insurance programs have been examined in other contexts by Garrett and Glied (2000), Schmidt and Sevak (2004), Bound et al. (2004), Duggan et al. (2007), Roelofs and van Vuuren (2011), and Staubli and Zweimüller (2012).

⁷Related to these studies is the work on the extension of UI benefits for older workers by Winter-Ebmer (2003), Kyrrä and Wilke (2007), Lalive and Zweimüller (2004a, 2004b) and Lalive (2008). These papers analyze the UI program in isolation and ignore potential interactions with other social insurance programs.

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 6 we develop a theoretical early retirement framework which allows us to address the welfare consequences of extending the unemployment benefits duration. Section 7 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 affect the timing of workers’ exit from the labor force: old-age pensions, disability pensions, and unemployment benefits. Under the rules in place during the late 1980s and the early 1990s, an old-age pension can 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 are 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. 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. An old-age pension replaces on average 80% of the last net wage after subtracting income taxes and mandatory health insurance contributions.

The Austrian DI program grants relaxed access to DI benefits from age 55. This resembles the disability screening process in the United States, where standards are relaxed discontinuously at age 55 (Chen and van der Klaauw, 2008). More specifically, Austrian applicants below age 55 are eligible for DI benefits if a medical impairment reduces the capacity to work by at least 50 percent *in any occupation*. Applicants *above* age 55 are classified as disabled if their work capacity is reduced by more than 50% *in the same occupation*. Due to this relaxation in eligibility criteria, disability enrollment raises significantly at age 55.⁸ DI benefits are calculated in the same way as old-age pensions, except for a “special increment” that is granted to claimants below age 55. Postponing a DI benefit or an old-age pension claim by one year increases the replacement rate by roughly 2 percentage points.

The UI system is an important pathway into early retirement because older unemployed are eligible for extended UI benefits. Regular UI benefits are a function of annual earnings one or two years before unemployment entry (depending on the starting month of the UI spell). The net

⁸In 1996, the age limit for relaxed access to disability pensions 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 disability pension rules.

replacement rate declines with previous earnings from a maximum of around 60% for low-income earners to approximately 50% for high-income earners. On top of regular UI benefits, family allowances are paid. Regular UI 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 UI contributions for 9 years or more in the last 15 years can claim UI benefits for 52 week.⁹ Job losers who exhaust the regular UI benefits can apply for unemployment assistance. These means-tested transfers last for an indefinite period and are about 70% of regular UI benefits.

In addition, unemployed men aged 59 or older can claim “special income support”, provided that they have contributed to the UI program for at least 15 out of the previous 25 years. Special income support is equivalent to an UI spell in legal terms, but with 25% 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 starting at age 55. Special income support can be combined with regular UI benefits and unemployment assistance. Thus, eligible unemployed can claim UI benefits up to age 59 followed by special income support.

Notice that UI benefits depend only on earnings in the previous job, while DI benefits and old-age pensions are based on the entire work history. Thus, an individual’s replacement rate of a DI benefit or an old-age pension can be very different from the replacement rate of UI benefits. For example, an unemployed worker with pre-unemployment earnings higher than his or her life-time earnings will have relatively high UI benefits compared to DI benefits or old-age pensions. As a consequence, job losers with otherwise similar characteristics may have quite different incentives to retire early.

2.2 The Regional Extended Benefit Program and Retirement Pathways

To preclude Soviet appropriation after World War II, Austria nationalized its iron, steel, and oil industries, and related heavy industries. 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. Before 1986, financial losses were covered by governmental subsidies, but in 1986 a speculation scandal in the steel industry triggered the abolishment of this protectionist policy. A new management was appointed that implemented a strict restructuring plan. This process caused layoffs and downsizing of production plants, particularly in the steel industry.

To protect older workers against adverse labor market conditions in the steel industry, the Austrian government enacted the Regional Extended Benefit Program (REBP) in June 1988. The

⁹Before 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.

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 a new unemployment spell after June 1988 or spell in progress in June 1988.

The REBP was initially implemented in 28 regions. The minister for social affairs, a member of the ruling social democratic party (SPÖ), was in charge of selecting the regions that were included in the program. While the records of the meetings in which the set of regions eligible to the program was decided upon are not open to the public, Lalive and Zweimüller (2004b) show that eligible regions were characterized by a relatively high share of employment in the steel sector (around 17% in REBP regions versus roughly 5% in non-REBP regions).¹⁰ However, they find no differences in the unemployment rate or the fraction of long-term unemployed between treated and non-treated regions. In January 1992 a reform became effective that abolished the benefit extension in six of the originally 28 regions. The 1992 reform also tightened eligibility criteria, as individuals had to be not only residents, but also previously employed in a REBP region. 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”. Figure 1 plots the distribution of REBP across the 2,361 communities in Austria. The figure illustrates that TRs (communities with blue or dark-blue shading) are all located on a contiguous area in the Eastern and Central parts of Austria.

Figure 1

The introduction of the REBP dramatically changed early retirement incentives for older unemployed men, as illustrated in Figure 2. Without the REBP older unemployed men 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 men could effectively withdraw through the UI system at age 55. Thus, we expect that during the REBP period there will be an increase in the fraction of 55-57 year old unemployed who permanently exit the labor force by using the extended UI benefits as a bridge to an old-age pension. This is an example of a program complementarity effect: the more generous UI benefits increase the *future take-up* of other welfare-state programs. Notice that job losers above age 55 also have a higher incentive to claim a DI pension due to relaxed eligibility criteria. It is very likely that some 55-57 year old unemployed men who would have claimed a disability pension without the REBP may instead have decided to retire early via the UI system during the REBP. This is an example of a program substitution effect: the more generous UI benefits reduce *contemporaneous take-up* of another program.

¹⁰The ultimate decision on set of regions that became eligible to the program was heavily criticized by opposition parties and media as being biased towards the clientele of the ruling parties.

Figure 2 also suggests that the REBP led to important changes in the early retirement incentives for unemployed men below age 55. More specifically, without the REBP unemployed men below age 55 could withdraw from the labor market at age 54 by claiming unemployment benefits for 12 months followed by a disability pension at age 55. With the introduction of the REBP this option was already available to unemployed men aged 51 and older. Thus, we expect that the REBP leads to a program complementarity effect among unemployed men younger than 55; some unemployed men who would have returned to employment without the REBP may have instead used extended UI benefits during the REBP as a bridge to a DI pension.

Figure 2

3 Data and Descriptive Evidence

3.1 Data

We combine register data from two different sources. The Austrian Social Security Database (ASSD) provides detailed longitudinal information on labor market and earnings histories of the universe of private-sector workers in Austria (Zweimüller et al., 2009). The second source is the Austrian unemployment register, which contains information on the place of residence (community) and relevant socio-economic characteristics of registered unemployed workers.

We consider all job separations of male workers aged 50-57 at the beginning of their UI spell between 1985 and 1995. These spells are then followed up until the 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 relevant in the case of females. We exclude job losers who enter unemployment from a job in the steel sector because they may face worse labor market prospects in TRs due to the steel crisis.¹¹

In our observation period 216,246 unemployment spells were started by men in the age group 50-57. From these, we drop 13,595 unemployed men whose last job was in the steel sector. We also exclude 42,247 unemployed men with less than 15 employment years in the past 25 years. Only job seekers who satisfy this criterion are eligible for the REBP. This 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. Because the Austrian labor market is characterized by large seasonal employment fluctuations (Del Bono and Weber, 2008), we exclude 80,892 men whose last two jobs were with the same employer. These job seekers are likely to be on a temporary layoff and do not face a trade-off between return to work and early retirement. We also drop 1,438 unemployed men who previously worked in the mining sector as this sector has more generous rules for special income support. The final sample thus comprises 78,074 unemployment spells.

¹¹The steel crisis may have affected job prospects of unemployed men in TRs whose last job was not in the steel sector through spillover effects. In the next section we will discuss how we address this concern in the empirical analysis.

Panel A of Table 1 presents summary statistics on exit states after the unemployment spell by region of residence before (1/1985–5/1988), during (6/1988–7/1993), and after the REBP (7/1993–12/1995). The exit “early retirement” comprises exits to disability pensions, old-age pensions, and censored spells. Before the REBP the probability to retire early (return to work) is 5.3 percentage points higher (lower) in TRs relative to CRs because job losers in TRs are more likely to exit unemployment by claiming a DI pension. During the REBP the difference in the probability to retire early increases to 29.3 percentage points. This increase is primarily driven by an increase in the share of job losers in TRs who claim a disability or an old-age pension at unemployment exit. After the abolishment of the REBP, the difference in the incidence of early retirement between TRs and CRs decreases again to the pre-REBP level, suggesting that the program had no long-lasting effects on the labor supply of unemployed men. Notice also that over the observation period there is an increase in the incidence of early retirement and disability enrollment in all regions, which likely reflects a general deterioration in labor market conditions for older workers and/or an increased propensity to retire early.

Panel B of Table 1 shows that before and after the REBP job losers in TRs are somewhat less educated and are more likely to have worked in blue-collar occupations and the manufacturing industry than job losers in CRs, but overall the background characteristics are remarkably similar. During the REBP there are more apparent differences in background characteristics. More specifically, job losers in TRs are more likely to have worked in the machine industry, have earned higher wages, and have more tenure compared to job losers in CRs. This pattern is consistent with a study by Winter-Ebmer (2003) who argues that firms used the REBP to get rid of high-tenured and expensive older workers. Table 1 also illustrates that during the REBP there is a significant increase in unemployment inflow in TRs relative to CRs. The ratio of unemployment spells in TRs versus CRs is roughly 1 to 4 before and after the REBP; this ratio increase to around 1 to 2.5 during the REBP. In Section 5 we will examine the impact of the REBP on unemployment inflow in more detail.

Table 1

3.2 Descriptive Evidence

To graphically assess the impact of extended UI benefits on early retirement behavior, Figure 3 plots the fraction of transitions from unemployment into early retirement (Panel A), disability pensions (Panel B), and old-age pensions (Panel C) by age at UI entry and region of residence before, during, and after the REBP. Early retirement comprises exits to disability and old-age pensions as well as job losers who stay unemployed until the end of 2006. Panel A of Figure 3 shows that both before and after the REBP transition rates into early retirement are very similar in TRs and CRs at all ages. The transition rate peaks at age 58, which is the earliest age that allows for a permanent exit from the labor market through the UI system in the absence of the REBP (see Figure 2). During the REBP is in effect, the transition rate into early retirement between

ages 50-57 is around 30 percentage points higher in TRs, indicating that a significant portion of unemployed men uses the extended UI benefits to permanently exit the labor force. For the age group 58-59 there are only small regional differences in early retirement rates during the REBP because unemployed men in this age group can rely on regular UI benefits and special income support to retire early.

Panel B of Figure 3 shows that the transition rate into disability pensions is slightly higher in TRs before and after the REBP, perhaps reflecting some underlying regional differences in the characteristics of unemployed men. For example, Table 1 shows that job losers in TRs are more likely to work in blue-collar occupations and tend to be less educated. Both factors are associated with a higher disability risk. During the REBP period, there is a striking increase in transitions into disability pensions between ages 50-54 in TRs, suggesting that extended UI benefits serve as a bridge to a disability pension for some unemployed men in this age group (program complementarity). For the age group 55-57 there is evidence of a program substitution effect, given there is a sizable decline in transitions into disability pensions in TRs relative to CRs. Put differently, the REBP induces some unemployed men who in the absence of extended UI benefits would have claimed a disability pension to stay unemployed until they become eligible for an old-age pension. This substitution away from disability pensions is also reflected in Panel C of Figure 3, which shows that the transition rate into old-age pensions is significantly higher between ages 55-57 in TRs during the REBP is in effect (program complementarity).

Figure 3

As we will discuss in more detail in the next section, our empirical approach to evaluate the impact of the REBP relies primarily on the assumption that UI exits would have followed similar trends in TRs and CRs in the absence of the REBP. To shed light on this assumption, it is useful to compare trends in transitions into different exit states in TRs and CRs over time. Such a comparison is particularly important in our context, given that the REBP was implemented in regions with a strong steel sector that were particularly affected by the steel crisis. Importantly, adverse labor market conditions in the steel industry may have had local spillover effects into other industries, which would violate the assumption underlying our empirical approach.

Figure 4 illustrates how transitions into early retirement, disability pensions, and old-age pension for the age groups 50-54 and 55-57 develop over time by region. UI spells in TRs that started after November 1988 (first vertical line) could potentially benefit from the REBP, given that UI spells in progress when the REBP was implemented (second vertical line) were also eligible. The third and the fourth vertical line denote the dates when the REBP was abolished in TR1s and TR2s, respectively. For both age groups transition rates into different exit states are very similar in TRs and CRs before the second half of 1987, suggesting that the steel crisis had only little impact on other industries in TRs. In the second half of 1988, the period when the REBP started, transitions rates start to diverge. For the age group 50-54 there is a program complementarity effect; transition rates into early retirement, disability pensions, and (to a smaller extent) old-age

pensions increase in TRs relative to CRs. For the age group 55-57 there is a program substitution and a program complementarity effect; transitions into disability pensions decline and transitions into old-age pensions increase disproportionately so that overall transitions into 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. Notice also that transitions into early retirement in the age group 55-57 start to increase in TRs already one year before the REBP, suggesting that some job losers who were already unemployed when the REBP was implemented took advantage of the REBP to retire early.

Figure 4

4 Identification Strategy

To estimate the causal effect of extended UI benefits on early retirement, we exploit the quasi-experimental variation in the duration of UI benefits across Austrian regions generated by the REBP. Our identification strategy relies on a difference-in-differences (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 extended UI benefits are symmetric.

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

$$y_{it} = \alpha + \beta(D_t \times TR_i) + \gamma(A_t \times TR_i) + \lambda_t + \eta_i + X'_{it}\delta + \varepsilon_{it}, \quad (1)$$

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 variable 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 during the REBP (June 1988 until December 1991 for TR1s; and June 1988 until July 1993 for TR2s); and A is an indicator taking the value 1 if the unemployment spell started after the REBP was abolished (January 1992 or later in TR1s; and August 1993 or later in TR2s). We include labor market region fixed effects (η_i) to control for region-specific differences, year-quarter fixed effects (λ_t) to control for macroeconomic conditions, and a set of background characteristics (X_{it}) to control for observable differences that might confound the analysis.¹² Remember that UI spells in progress at the time of the REBP implementation were also eligible for the extended UI benefits. This rule implies that UI spells that started less than 30 weeks (November 1987) before

¹²Background characteristics are age-in-year dummies, marital status, blue-collar status, education, work experience, years of service, sick leave history, last wage, previous industry, quarter of UI benefit claim, and dummies for weeks of UI eligibility (30, 39, 52 weeks).

the REBP were potentially eligible. To capture the impact of the REBP on UI spells in progress, we include an indicator for UI spells in TRs that started between November 1987 and May 1988.

The coefficients of interest in equation (1) are β and γ which measure the effect of the REBP on older job losers in TRs relative to CRs in the years when the program was in effect relative to before its implementation (β) and in the years after the program was abolished relative to during the program (γ). Clearly, if the introduction and abolishment of the REBP have symmetric effects on the outcome variable of interest we have $\beta = -\gamma$.

Equation (1) is estimated separately for the age groups 50-54 and 55-57 because the impact of the REBP on early retirement behavior is likely 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 when conditions for disability classification are relaxed. Job losers in the age group 55-57 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.

The central identifying assumption is that trends in the outcome variable in CRs are informative on the counterfactual in the absence of the REBP. This assumption implies that there are no omitted time-varying and region-specific effects correlated with the program. There are some concerns about the validity of this assumption, given that the motivation behind the implementation of this policy was to provide a better protection to older unemployed in regions with a strong steel sector and it is possible that the steel crisis may have had spillover effects to other industries in TRs. Such idiosyncratic shocks to TRs would violate the identifying assumption and lead to an upward bias in the estimates. We run several robustness checks to test for this possibility.

First, the availability of data from several years pre- and post-REBP allow us to examine the importance of spillovers from the steel sector affecting the entire region. In particular, labor market trends in TRs and CRs should move in parallel in the absence of spillover effects from the steel sector. The graphical analysis from the previous section suggests that transition rates into different exit states are similar in TRs and CRs 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:

$$y_{it} = \alpha + \sum_{j=1985h1}^{1995h2} \pi_j (d_{jt} \times TR_i) + \lambda_t + \eta_i + X'_{it} \delta + \varepsilon_{it}, \quad (2)$$

where d_{jt} is a dummy that equals 1 if the unemployment spell (t) starts in half-year j and 0 otherwise. Here, we set TR equal to 0 in TR1s after the reform of the REBP in December 1991. Each coefficient π_j can be interpreted as an estimate of the impact of the policy change on the treatment group relative to the control group in a given half-year relative to the baseline half-year (1987h1). The interaction terms provide tests for anticipatory behavior and differential trends. The coefficients π_j should be zero prior to the second half of 1988 and after the first half of 1993, if the REBP was an exogenous and unanticipated policy.

As a second robustness test to examine the presence of region-specific labor market shocks, we restrict attention in the estimation to unemployed men who live no farther than a 30 minutes car drive from the border between TRs and CRs. The idea behind this approach 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. However, this approach is potentially problematic if the REBP affects employment opportunities of job losers living in CRs close to the border due to reduced competition for jobs. Such spillover effects to non-treated workers would violate the assumption that trends in CRs are informative on the counterfactual. To examine whether the REBP had an effect on non-treated job losers, 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; any statistical significance would indicate direct spillover effects from treated to non-treated individuals.

As a third robustness test we estimate equation (1) for a sample of job losers who previously worked in the tradable-goods sector with the exception of industries that are directly linked with the steel sector (iron and steel product manufacturing). The idea behind this approach is that labor demand prospects in the tradable-goods sector are less influenced by local economic conditions. Hence, potential spillovers effects from the steel sector to non-steel sectors should be less important. Moreover, this approach is less susceptible to externalities of the REBP on non-treated individuals, because treated and non-treated individuals are less likely to operate in the same local labor market.

Another threat to the validity of our identification strategy is the possibility that the more generous unemployment rules changed the composition of unemployment inflow in TRs, which may lead to a selection bias. Table 1 provides some evidence that selection may occur given that during the REBP period unemployment inflow increases in TRs relative to CRs and job losers in TRs are more likely to have worked in the machine industry in their last job, have earned higher wages, and have more tenure than job losers in CRs. We follow a two-stage approach to ascertain that selective inflow does not affect our results. In the first stage, we estimate the impact of the REBP on UI inflow rates for different subsamples of the population using the same specification as in equation (1). This allows us to identify a subsample of unemployed men whose layoff was likely exogenous. In the second stage, we examine the impact of the REBP for this subsample of job losers.

5 Results

5.1 Main Results

The first set of results is summarized in Table 2, 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.

Consistent with the graphical evidence from Figure 3, the first row indicates that the REBP increased the probability of entering early retirement among 50-54 year old unemployed men by 16.2 percentage points, or 61% of the baseline transition rate into early retirement in the pre-REBP period. This decline is mostly driven by an increase in transitions into disability pensions of 12.2 percentage points (column 2) and – to a lesser extent – by an increase in transitions into old-age pensions of 3.4 percentage points (column 3). These estimates suggest that unemployed men in this age group used the benefit extension to bridge the time until they become eligible for a disability or an old-age pension (program complementarity). The third row shows that the effects on transitions from unemployment into different exit states are completely reversed after the program is abolished. The effect on transitions into disability pensions is somewhat smaller in absolute value, but the difference is statistically not significant. Columns 4 to 6 present analogous estimates for the age group 45-49 who was never eligible for the REBP. The point estimates are small and insignificant, suggesting that the REBP did not affect early retirement behavior of non-eligible job losers.

The variable “anticipation effects” captures the impact of the REBP on UI spells that started up to 30 weeks before the REBP but were potentially eligible for extended UI benefits given that spells in progress were also eligible for the REBP. The coefficient estimates are insignificant and very small in magnitude, reflecting that this policy was not anticipated by job losers.

Table 2

The increased inflow into disability pensions by 50-54 year old job losers in TRs should occur mostly after age 55, because eligibility criteria for a disability pension are very strict before age 55. We estimate two versions of equation (1) to investigate at which age unemployed men claim a disability pension. 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. Table 3 shows that the REBP has only little impact on the claiming of a disability pension before age 55 (first column), but there is a sizeable increase in the probability to claim a disability pension after age 55 (second column). More specifically, the probability to enter the DI program after age 55 increases by 13.7 percentage points during the REBP and decreases by 10.7 percentage points after the REBP. These results are consistent with a program complementarity effect; many 50-54 year old unemployed men who would have returned to work in the absence of extended benefits instead use the REBP to bridge the gap until age 55 when eligibility criteria for a disability pension are relaxed.

Table 3

Table 4 presents estimates of equation (1) for the age group 55-57 (columns 1 to 3) and the age group 58-59 (columns 4 to 6). The first row shows that the introduction of the REBP led to an increase in transitions from unemployment into early retirement of 14.8 percentage points among the treated individuals aged 55-57. There is also clear evidence for program substitution

and complementarity effects: in the years the program was in effect there is a 9.7 percentage point decline in the probability to claim a disability pension (program substitution) and a 24 percentage point increase in the probability to claim an old-age pension (program complementarity). As for job losers in the age group 50-54, the effects are completely reversed after the abolishment of the program, as shown in the third row. The estimates for the variable “anticipation effects” are imprecisely estimated, but are large in absolute size for transitions into disability pensions and old-age pensions, suggesting that the REBP also had an effect on job losers above age 55 who were already unemployed when the REBP started. Columns 4 to 6 present analogous estimates for the age group 58-59. The point estimates for the introduction of the REBP are 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. The point estimates for the abolishment of the REBP are significant, but relatively small in magnitude compared to estimates for the age group 55-57.

Table 4

In Tables 2 to 4 the variables to control for differences in observable characteristics between TRs and CRs enter in a linear way. However, 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. Moreover, Table 1 shows that there are some differences in observable characteristics between job losers in TRs and CRs. The linear specification may therefore not be sufficient to capture the influence of covariates. 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-differences approach are reported in Table 5.¹³ The first three columns show that for the age group 50-54 the estimates are very similar as the OLS estimates reported in Table 2. 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, we estimate equation (1) for each age separately. Figure 5 shows the results; the dots on the solid black are the coefficient estimates of the interactions ($D_t \times TR_i$) and the dots on the gray line are the coefficient estimates for the interactions ($A_t \times TR_i$). A 95-percent confidence interval is shown by dotted lines. As shown in the first panel, during the program is in effect the probability to retire early increases at

¹³To guarantee that the before-REBP period is not affected by the REBP, we exclude UI spells starting between 11/1987 and 5/1988 but our results are robust to including these spells.

all ages, providing evidence for sizeable program complementarity effects. The impact of extended unemployment benefits on the incidence of early retirement is fully reversed after the program is abolished, as illustrated by the gray line. The black line in the middle panel shows that during the REBP there is a significant increase in transitions into disability pensions of almost 20 percentage points among eligible job losers below age 54. The point estimate for age 54 is insignificant because 54 year old job losers in CRs can also bridge the time until age 55 with the regular duration of UI benefits of one year. As the gray line shows, excess DI entry in the age group 50-53 is reversed after the abolishment of the REBP.

For unemployed workers in the age group 55-57, estimated coefficients for entering disability are negative, providing evidence for a 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 to around 10 percentage points. Consistent with this view, during the REBP period there is a 25 percentage point increase in the probability to claim an old-age pension for job losers above age 55, as shown in the third panel. There is also a significant increase in transitions into old-age pensions for 54 year old job losers, even though these individuals need to also rely on unemployment assistance to bridge the time until age 60 when they become eligible for an old-age pension. Finally, the gray line in the third subfigure highlights that the effects on transitions into old-age pensions are reversed for all ages after the abolishment of the REBP.

Figure 5

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 TRs and CRs 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 TRs and CRs.

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 6 plots the estimated coefficients of the interaction terms from equation (2) for the age groups 50-54 and 55-57 over the 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 TRs (a 95-percent confidence interval is shown by dotted lines). In all six panels the estimated coefficients fluctuate around 0 before the second-half of 1987 and after the complete abolishment of the REBP (second-half of 1993), providing evidence that the empirical strategy is not simply picking up long-run trends in differences between TRs and CRs. For the age group 55-57 there is an increase (decline) in transitions into old-age pensions (disability pensions) in the second-half of 1987 and the first-half of 1988, suggesting that there is a program substitution effect for job losers who were already unemployed when the REBP became effective.

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 effect declines over time. The increase in early retirement in the age group 50-54 is driven by a large increase in transitions into disability pensions (top middle panel) and, to a lesser extent, transitions into 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 into disability pensions and a large increase in transitions into old-age pensions during the REBP.

Figure 6

Table 6 presents OLS estimates of equation (1) for job losers who live no farther than a 30 minutes car drive from the border between TRs and CRs. Labor market conditions should be quite similar within this tightly defined geographical area. Thus, spillovers from the problems in the steel sector in CRs close to the border should be as important as in TRs. The first row shows that the estimates of the REBP introduction are broadly similar to the estimates for the full sample reported in Tables 2 and 4. Only the estimates for transitions into disability and old-age pensions among 50-54 year old job losers are significantly different from the corresponding estimates for the full sample. Similarly, the third row shows that the effects of the REBP abolishment for job losers living close to the border are quantitatively very similar to the estimates for the full sample. Overall these results suggest that spillover effects are quantitatively small for both age groups.

Table 6

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 (iron and steel product manufacturing). 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 and by spillover effects from treated to non-treated individuals via changes in local labor demand due to the REBP. OLS estimates of this robustness test are shown in Table 7. The estimates are quantitatively very similar to the estimates for the full sample reported in Tables 2 and 4. The only exceptions are the estimates of the REBP introduction on transitions into early retirement and disability pensions for the age group 55-57 which are significantly lower and the estimate of the REBP introduction on transitions into disability pensions for the age group 50-54 which are significantly higher.

Table 7

5.3 Unemployment Inflow

In this section, we examine the impact of the REBP on unemployment inflow in more detail. Figure 7 plots the difference in the quarterly unemployment inflow in percent of employment be-

tween TRs and CRs.¹⁴ For both age groups there are no particular regional differences in inflow rates before the last quarter of 1987. For the age group 50-54 regional UI inflow rates are also similar during the REBP period except for the last quarter before the REBP was abolished in TR1s (January 1992). In this quarter the difference in UI inflow rates increases by almost 2 percentage points. Similarly, the difference in inflow rates also increases in the three quarters before the REBP was abolished in TR2s. For the age group 55-57 the difference in UI inflow rates begins to increase already in the last quarter of 1987 and remains positive during the REBP is in effect. As for the age group 50-54, there is a large peak in the difference of inflow rates in the last quarter of 1991. After the REBP abolishment inflow rates are slightly lower in TRs compared to CRs for both age groups. This pattern suggests that there is a re-timing effect: firms who have to lay off workers and workers who want to quit are more likely to do so when unemployment benefits are still generous.

Figure 7

To quantify the impact of the REBP on UI inflow rates, Table 8 presents OLS estimates of equation (1) for different subgroups. In each case the outcome variable is a dummy that is 1 if a worker starts a UI benefit claim in a given quarter and 0 otherwise. Consistent with the graphical analysis, columns 1 and 4 show that there is a significant increase in UI benefit claims in TRs during the REBP is in effect followed by a large decline after its abolishment. If the sample is restricted to the period before October 1991, the inflow effect completely disappears for the age group 50-54 (column 2) but remains significant for the age group 55-57 (column 5). However, as columns 3 and 6 illustrate, the inflow effect becomes insignificant for both age groups, if we additionally exclude workers in TRs who are above the 75th percentile in the tenure or wage distribution or who previously worked in the machine industry. This finding is consistent with Table 1 which shows that excess UI inflow in TRs during the REBP is concentrated in the machine industry and among high-wage earners with high tenure. Based on these results, it is reasonable to assume that layoffs for this group of workers are exogenous and not determined by the REBP. Thus, it is instructive to examine the impact of the REBP on this subgroup of job losers.

Table 8

Panel A of Table 9 reports estimates of equation (1) for job losers who started a UI benefit claim before October 1991, while Panel B shows analogous estimates if we additionally exclude job losers in TRs whose last job was in the machinery industry or whose tenure or wage in the last job is above the 75th percentile in the tenure or wage distribution. Columns 1-3 of Panel A indicate that the introduction of the REBP had quantitatively similar effects for 50-54 year old job losers who started an unemployment spell before October 1991 as for the full sample. The estimates for transition into early retirement and disability pension are around 5 percentage points smaller

¹⁴These figures are based on a sample of workers with a continuous employment history (at least 15 year in the past 25 years) who are not working in the steel or mining industry and who are employed at the beginning of a quarter.

if we additionally exclude high-tenure and high-wage individuals (columns 1-3 of Panel B), but they are still sizeable in magnitude and statistically significant. As columns 1-3 of Panel A show, the point estimates of the REBP introduction for job losers between ages 55-57 who enter the UI program before October 1991 are very similar to the estimates for the full sample presented in Table 4. Moreover, further restricting the sample to low-wage and low-tenure job losers who have not worked in the machine industry in their last job has very little effect on the estimates (columns 4-6 of Panel B). Overall these findings suggest that our estimates are not strongly affected by selective unemployment inflow.

Table 9

6 Social Welfare Analysis

In this section we use the above results to shed light on the welfare implications of extended UI benefits provided by the REBP. 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 to derive a sufficient statistics formula in the spirit of Baily (1978) and Chetty (2006a) that incorporates multiple retirement pathways and, thus, explicitly accounts for fiscal externalities from more generous UI benefit on other government programs. In doing so, we take the design and generosity of the DI and old-age pension programs as given.¹⁵ In a third step, we (locally) evaluate the welfare effects of providing unemployment benefits as an early retirement program by feeding our empirical estimates and the changes in the institutional environment generated by the REBP into the model.¹⁶

6.1 The Retirement Decision

Consider the early retirement decision of an older worker. Assuming there is no possibility for self-insurance, the worker has no savings and has to rely on current earnings or public benefits to finance current consumption. The worker's remaining lifetime consists of two working periods, $t = 0$ and $t = 1$, and a retirement period, $t = 2$.¹⁷ Periods 0 and 1 have length 1 and period 2 has length T . When losing the job at the beginning $t = 0, 1$, the individual either goes back to work

¹⁵Modeling explicitly the welfare effects of all programs is beyond the scope of this paper. See Pavoni and Violante (2007) or Spinnewijn (2013) for an analysis of the optimal sequence and duration of different labor market policies in the context of welfare to work and job training programs.

¹⁶A recent paper by Lawson (2013) examines optimal UI when there are additional, mutually exclusive, social welfare programs. He shows that optimal UI generosity is higher since take-up of UI will prevent some individuals from claiming other social benefits. This mechanism is also present in our framework because, within a given period, UI and DI are mutually exclusive. However, we argue that more generous UI may create incentives for increased take-up of DI and old-age benefits in future periods. This latter effect is particularly relevant in the context of early retirement because UI can be used to bridge the gap until individuals become eligible for relaxed DI or old-age benefits. This is a crucial feature of many real-world early retirement schemes.

¹⁷Period $t = 0$ can be associated with ages 50-54, period $t = 1$ with ages 55-59, and period $t = 2$ with ages 60+. This captures the early retirement incentives of the Austrian system: extended UI benefits of the REBP become available at age 50; relaxed access to disability pensions at age 55, and regular old-age pensions at age 60.

immediately or retires early. In the spirit of our empirical analysis we assume that, during both periods, the worker can be in only one of three states: UI, DI, or working. Within-period durations are either 0 or 1 whereas varying within-period durations are ignored. At the beginning of $t = 2$, all (remaining) workers retire and draw a regular old-age pension.

Displacement at $t = 1$. Consider a worker who gets displaced at the beginning of $t = 1$. If the worker goes back to work he earns income w . In order to find a job, a search cost θ_1 has to be incurred. We think of θ_1 as the disutility of job search efforts as well as effort costs of adjusting to a new work environment. θ_1 is randomly 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 a disability pension is associated with disutility κ reflecting the hassle of a medical check, bureaucratic obstacles, or DI related stigma costs. Early retirement through the UI system yields a benefit b (any costs associated with claiming UI benefits are normalized to zero).¹⁸

In $t = 2$ the worker draws an old-age pension p^W if entering from employment, p^D if entering from the DI system, and p^U if entering from the UI system. Ignoring time discounting, the lifetime utilities from going back to work, $W_1 - \theta_1$, retiring early by claiming a disability pension, 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 assume that benefits d , p^D , p^U and p^W are related to each other in ways that capture the rules of the Austrian social security system. According to these rules (see Section 2 above), workers entering regular retirement directly from DI get an old-age pension equal to the previous disability pension in period 1, $p^D = d$. In contrast, unemployed and employed workers' old-age pension equals the (potential) disability pension in $t = 1$, augmented by some factor $\alpha > 1$, or $p^W = p^U = \alpha d$.¹⁹ Given these rules, heterogeneity in disability pensions and old-age pensions is captured by the parameter d .

Lemma 1. *The worker will claim a disability pension rather than UI benefits, if the pension d is above the threshold $\hat{d}$. 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 $\hat{\theta}_1(d) = W_1(d) - D_1(d)$ otherwise. Moreover, $\partial \hat{\theta}_1 / \partial d \leq 0$ if $1 - (\alpha - 1)T \geq 0$.*

Figure 8 illustrates individuals' optimal choices in $t = 1$ given their location in (θ_1, d) space. The critical value $\hat{d}$ simply represents the minimal pension d above which D_1 becomes larger than

¹⁸We think of the UI benefit b as the UI transfer when staying unemployed throughout one period; b is a weighted average of UI benefits b^u and UI assistance b^a with $b = \tau b^u + (1 - \tau)b^a$, where τ is the maximum duration of regular UI benefits b^u . Eligibility to the REBP is associated with an increase in τ from 0.2 (1 year of the 5-year period) to 0.8 (4 years of a 5-year period).

¹⁹As outlined in Section 2, the pension p_{t+1} is given by the assessment basis $\hat{w}_{t+1}$ times the pension coefficient a_{t+1} . If the assessment basis remains constant $\hat{w}_{t+1} = \hat{w}_t$, we obtain $p_{t+1} = p_t \alpha$ with $\alpha = a_{t+1}/a_t$. Notice that we have assumed $p^W = p^U$ which is justified as long as the assessment basis remains constant (employment and unemployment periods affect the pension coefficient in the same way). We will calibrate α such that empirical moments are matched.

U_1 . Notice that 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 system, hence the level of the disability pension is irrelevant for the early retirement decision. However, at high values of d , early retirement occurs via the DI system and individuals with a higher disability pension are more likely to retire early.²⁰

Figure 8

How do incentives 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 use the DI system under less generous UI rules but take up UI benefits under more generous UI rules. Moreover, the $\hat{\theta}_1$ -threshold shifts down. This reflects the program complementarity effect of higher UI benefits: individuals go back to work under the less generous UI system, but use UI benefits as a bridge to an old-age pension under more generous UI benefits. This leads to the following proposition.

Proposition 1 (Period $t = 1$). *More generous UI benefits increase early retirement due to the program complementarity effect. More generous UI benefits increase the UI rather than the DI pathway due to the 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 retire early. We assume that this requires a sequential take-up of different welfare programs: UI benefits b in $t = 0$ and a disability pension d in $t = 1$.²¹ In $t = 2$ the worker gets an old-age 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 . 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 worker 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 in “Displacement at $t = 1$ ”. We assume that the search costs after displacement at the beginning of $t = 1$ are independently drawn from the same distribution $F(\theta)$ as the search costs after displacement at the beginning of $t = 0$.²² In $t = 2$

²⁰A sufficient condition for a negative slope is $1 - (\alpha - 1)T \geq 0$ or, equivalently, $(p^W - p^D)T \leq d$. Future gains from postponing retirement $(p^W - p^D)T$ are lower than current gains from DI take-up d . This is the relevant case under Austrian disability and old-age pension rules (Hofer and Koman, 2006).

²¹This set-up rules out three pathways. First, we neglect drawing a disability pension in both $t = 0, 1$ because the DI program as an early-retirement scheme is only available at $t = 1$ but not at $t = 0$. Second, we rule out drawing UI benefits in both periods because UI benefits have limited duration. While UI assistance is unlimited, benefits are lower and means-tested, and hence dominated by drawing a disability pension in the second period. Third, we assume a worker’s human capital fully depreciates if not working in $t = 0$. Hence careers where individuals fully exhaust UI in $t = 0$ and then go back to work in $t = 1$ are ruled out.

²²This implies that average search costs for worker fired in $t = 1$ are higher than the average search costs when fired

the worker draws an old-age pension that depends on employment or benefit status in $t = 1$ with $p^D = d$ and $p^W = p^U = \alpha d$.

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:

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

whereas $E_\theta V_1 \equiv \int \max(W_1 - \theta, D_1, U_1) dF(\theta)$ denotes the expected utility when losing the job in $t = 1$. Next, let us consider the worker's optimal choice in $t = 0$. We denote by $\hat{\theta}_0$ the critical level of search costs θ that keeps the worker indifferent between retiring 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 $\partial \hat{\theta}_0 / \partial d \leq 0$.*

Proof. See Appendix. □

Figure 9 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 8 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 a disability pension at $t = 1$. Since early retirees have to rely on a disability pension, early retirement is discouraged at very low values of d .

Figure: 9

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 $\hat{\theta}_0$. 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 (Mortensen, 1977) increases the value of going back to work at $t = 0$ because becoming unemployed in $t = 1$ is less harmful. We summarize our discussion in the following proposition.

Proposition 2 (Period $t = 0$). *More generous UI benefits 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. □

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 have been sufficiently low to induce them going back to work. Average search costs conditional on re-employment are $E_\theta(\theta \mid \theta \leq \theta_0)$. 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 $E_\theta(\theta) > E_\theta(\theta \mid \theta \leq \theta_0)$.

6.2 An Extended Baily-Chetty Formula

We now look at the social optimality of the REBP as an early retirement program. We proceed by describing the social planner's problem. The social planner has to take into account how older workers' behavioral responses. Moreover, the social planner also has to take into account that younger individuals are affected since the additional tax burden is shared among the entire population. We therefore extend the above model by one additional period, $t = -1$, during which the worker is not yet eligible for the more generous UI benefits. For simplicity, we assume that period $t = -1$ has length φ and that individuals are fully employed during that period. Employed workers contribute payroll taxes τ , so the gross wage w equals $w = \omega + \tau$. We normalize the size of a cohort to unity. Heterogeneity in pension benefits among individuals is captured by the distribution $G(d)$ over the domain $[\underline{d}, \bar{d}]$. The utilitarian social welfare equals

$$\mathcal{W} = \int_{\underline{d}}^{\bar{d}} \left(\varphi u(w - \tau) + q \int_0^\infty V_0(d, \theta) dF(\theta) + (1 - q)W_0(d) \right) dG(d) \quad (3)$$

and represents the average expected lifetime utility among all individuals. The expected value over the periods $t = 0$ to $t = 2$ is recursively defined: at the beginning of $t = 0$ individuals either (i) become unemployed with probability q , draw job search disutility θ , and choose pathways according to $V_0 = \max(W_0 - \theta, R_0)$ or (ii) stay employed with probability $(1 - q)$ and obtain utility W_0 .²³ As outlined in Section 6.1, the pathway utilities W_0 and R_0 then comprise the subsequent periods as well.

The social planner maximizes the above welfare function subject to government's budget constraint, which takes into account that expenditures on UI, DI and old-age pensions have to be financed by taxes paid by the entire working population. Denote by Π_t^i the *mass* of workers in state $i = U, D, W$ at date t . This can be written as

$$(\Pi_0^U + \Pi_1^U)b + N = (\varphi + \Pi_0^W + \Pi_1^W)\tau, \quad (4)$$

where N denotes government expenditures on disability and old-age pensions (see Appendix A.1).²⁴

We now derive a sufficient statistic in the spirit of Baily (1978) and Chetty (2006a) which allows us to assess the welfare implications of extended UI. The government maximizes social welfare (3) with respect to b subject to the government budget constraint (4). This yields the first-order

²³We assume that the layoff probability q is exogenous and does not depend on the generosity of UI benefits. In the Online Appendix we show that if the layoff probability is increasing in the generosity of UI benefits then the optimal level of UI benefits is lower.

²⁴The stocks Π_t^i , $i = U, D, W$ refer to the fraction of a cohort that chooses a particular retirement pathway. These stocks derive from the behavioral responses of workers as follows: Denote by π_t^i the probability that a worker displaced at the end of $t - 1$ enters state $i = W, U, D$ during t , we have $\pi_0^W = 1 - \pi_0^U$ and $\pi_1^W = 1 - \pi_1^U - \pi_1^D$ (since, by assumption, workers can enter state D only in period $t = 1$ but not in period $t = 0$). In steady-state, $\Pi_0^U = q\pi_0^U$ workers choose early retirement in period $t = 0$; $\Pi_0^W = 1 - \Pi_0^U$ continue to work during $t = 0$; $\Pi_1^U = q(1 - q\pi_0^U)\pi_1^U$ choose early retirement in $t = 1$ by drawing UI benefits and $\Pi_1^D = q(1 - q\pi_0^U)\pi_1^D$ chooses early retirement by claiming DI-pensions; $\Pi_1^W = 1 - \Pi_0^U - \Pi_1^U - \Pi_1^D$ retire regularly at $t = 2$. In our quantitative exercise below, we make assumptions on q and use our empirical estimates to calculate the π_t^i 's. This lets us infer steady-state value of the stocks Π_t^i , $i = U, D, W$.

condition

$$\frac{d\mathcal{W}}{db} = (\Pi_0^U + \Pi_1^U)u'(b) - (\varphi + \Pi_0^W + \Pi_1^W)u'(w - \tau)\frac{d\tau}{db} \stackrel{!}{=} 0. \quad (5)$$

Equation (5) yields the familiar result that optimal UI balances the marginal social benefits of better insurance to the marginal social costs of higher taxes. The marginal social benefit from better insurance is given by the mass of UI beneficiaries in $t = 0$ and $t = 1$, $\Pi_0^U + \Pi_1^U$, times their marginal utility gain, $u'(b)$. 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, $u'(w - \tau) (d\tau/db)$. By the Envelope Theorem, the welfare effects of workers' labor supply and retirement responses do not show up directly in the first order condition (but only indirectly through $d\tau/db$).

It is useful to take a closer look at $d\tau/db$, the increase in taxes necessary to finance the more generous UI system.²⁵ Denote by Δ_0^c the net government expenditures caused by early retirees in $t = 0$. One additional early retirement in $t = 0$ increases net government expenditures in $t = 0$ by $b + \tau$, and it further generates a loss for the government in $t = 1$, as the government has to pay disability pensions and forgoes taxes (and saves UI benefits) on those who would have otherwise worked (become unemployed). In $t = 2$, expenditures for old-age pensions are lower because early retirement in $t = 0$ requires take-up of DI in $t = 1$ which lead to lower pensions compared to the alternative scenario of being employed or unemployed before pension take-up. In Appendix A.2, we explicitly calculate Δ_0^c .

Furthermore denote by Δ_1^c and Δ_1^s the marginal net government expenditures arising from one additional worker that retires early in $t = 1$, through program complementarity and program substitution effects, respectively. Workers who retire early through UI rather than continue to work (program complementarity) cause additional net government expenditures $\Delta_1^c = b + \tau$. (There is no impact on government expenditures in $t = 2$ because pensions do not depend on whether new pension claimants were previously employed or unemployed.) Workers who retire early through UI rather than through DI (program substitution) cause net government expenditure to the extent that UI-benefits is more generous than DI benefits and because retiring through UI instead of DI increases the old-age pension (under Austrian pension rules). The resulting net government expenditures are is leads to additional program substitution induces net government expenditures $\Delta_1^s = b + Tp^U - (1 + T)d$.²⁶

To calculate the marginal costs of extended UI we also need workers' employment and retirement responses. Denote by π_t^i the probability that a worker displaced at the end of $t - 1$ enters state $i = W, U, D$ during t . The $\varepsilon_0^c = (d\pi_0^U/\pi_0^U)/(db/b)$ is the elasticity of the probability of being on UI

²⁵To keep things simple, we assume that the required tax increase does not generate an increase in the mass of individuals claiming DI rather than returning to work. This assumption can be made precise using Figure 8 (right panel) which implicitly keeps the net wage remains constant. When the net wage falls because of higher taxes, the downward sloping branch shifts down as well. The above assumption implies that the downward shift is small and affected individuals do not change their behavior. 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 (unemployed at $t = 1$ with $d > \hat{d}$ and $\theta_1 \geq \hat{\theta}_1$ switching to DI rather than work as a result of the higher taxes).

²⁶Expenditures are affected by the average DI pension among those who react to the UI extension. See the proof to Lemma B.3 in the Appendix.

in $t = 0$ with respect to the UI benefit level; $\varepsilon_1^c = -(d\pi_1^W/\pi_1^U)/(db/b)$ is the corresponding elasticity of being on UI in $t = 1$; and $\varepsilon_1^s = -(d\pi_1^D/\pi_1^U)/(db/b)$ is the corresponding elasticity of being on DI in $t = 1$. The elasticities ε_0^c and ε_1^c capture program complementarity effects while ε_1^s captures the program substitution effect.

The following Lemma relates the ε 's and the Δ 's to the overall fiscal impact.

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

$$\mathcal{E} = \Pi_0^U \left(1 + \varepsilon_0^c \frac{\Delta_0^c}{b} \right) + \Pi_1^U \left(1 + \varepsilon_1^c \frac{\Delta_1^c}{b} + \varepsilon_1^s \frac{\Delta_1^s}{b} \right). \quad (6)$$

Proof. See Appendix. □

Equation (6) in the above Lemma shows two effects: (i) a mechanical effect, equal to $\Pi_0^U + \Pi_1^U$, that arises even in the absence of any behavioral responses. More generous UI benefits raise government expenditure, because higher transfer payments accrue for a given stock of unemployed workers. and (ii) the behavioral effects that arise due to program complementarity and program substitution. These latter effects correspond to the mass of individuals who take advantage of program complementarity, $\Pi_0^U(\varepsilon_0^c/b)$, and $\Pi_1^U(\varepsilon_1^c/b)$, weighted by their respective financial impacts, Δ_0^c and Δ_1^c .

Using the above Lemma, we are now ready to state our main result. A balanced budget requires that marginal expenditures and foregone taxes are equal to marginal tax revenues, i.e. $\mathcal{E} = (\varphi + \Pi_0^W + \Pi_1^W)(d\tau/db)$. Combining this with equation (6) and the social planner's first-order condition (5) leads to

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

$$\frac{u'(b) - u'(w - \tau)}{u'(w - \tau)} = \varepsilon_0^c \frac{\Delta_0^c}{b} \frac{\Pi_0^U}{\Pi_0^U + \Pi_1^U} + \left(\varepsilon_1^c \frac{\Delta_1^c}{b} + \varepsilon_1^s \frac{\Delta_1^s}{b} \right) \frac{\Pi_1^U}{\Pi_0^U + \Pi_1^U}. \quad (7)$$

The l.h.s. of formula (7) captures the marginal benefit of smoother consumption while the r.h.s. quantifies the costs associated with distorted labor supply and early retirement choices. This formula extends the Baily-Chetty by allowing for both program complementarity and program substitution.

6.3 Calibration

This section calibrates formula (7). We assume CRRA utility $u(c) = c^{1-\gamma}/(1-\gamma)$, with the relative risk aversion parameter γ . Then the l.h.s. of equation (7) is $RR(b)^{-\gamma} - 1$ where $RR(b)$ denotes the replacement rate of UI benefits in terms of after tax income $(w - \tau)$. Notice that $RR(b)$ captures the replacement rate over a five-year interval, implying $RR(b) = 0.42$ before the REBP

and $RR(b) = 0.52$ during the REBP.²⁷ To estimate the r.h.s. of formula (7), we take our results from Table 2 which estimates an increase in the transition from UI to DI of $\Delta\pi_0^U = 0.122$, starting from the pre-REBP mean of $\pi_0^U = 0.210$ (see second-to-last row in Table 2). Hence the elasticity of program complementarity in $t = 0$ is given by:

$$\varepsilon_0^c = \frac{\Delta\pi_0^U/\pi_0^U}{\Delta b/b} = \frac{0.122/0.210}{0.10/0.42} = 2.44.$$

In $t = 1$ workers' responses consist of both program complementarity and program substitution effects. We take our estimates of Table 4 and decompose the total old-age pension treatment effect ($\Delta\pi_1^U = 0.24$) into a program substitution ($-\Delta\pi_1^D = 0.148$) and a program complementarity effect ($-\Delta\pi_1^W = 0.097$). The mean for transitions from UI to old-age pensions in TRs before the REBP equals $\pi_1^U = 0.207$ (see second-to-last column of Table 4). This yields:

$$\varepsilon_1^c = \frac{-\Delta\pi_1^W/\pi_1^U}{\Delta b/b} = \frac{0.097/0.207}{0.10/0.42} = 1.97 \text{ and } \varepsilon_1^s = \frac{-\Delta\pi_1^D/\pi_1^U}{\Delta b/b} = \frac{0.148/0.207}{0.10/0.42} = 3.00.$$

Next, we calculate factual and counterfactual pensions to get the impact of workers' behavioral responses on the government budget (the Δ 's). We use the following values: (i) an after-tax DI replacement rate of 70 percent in periods $t = 0, 1$; (ii) a pension appreciation factor $\alpha = 1.1$ over a five-year interval; and (iii) total payroll taxes, including employee and employer contributions, of about 25% of the gross wage. Table 10 lists the estimated costs from workers' responses, separately for program complementary and program substitution.

Table 10

Table 10 reveals two findings. First, complementarity effects in $t = 0$ are almost twice as expensive as complementarity effects in $t = 1$. Our calibration shows that each early retiree in $t = 0$ imposes an overall burden on the government budget, both forgone taxes and additional benefits, of 180,000 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. Each additional early retiree in period $t = 1$ imposes an overall burden on the government of 95,000 Euros. Program substitution in $t = 1$ enters negatively, e.g. the government saves money for each retirement pathway change. This may be explained by the transactions costs associated with access to DI (modeled by the disutility κ). Individuals substitute DI for UI even though the latter pays lower benefits because the DI application disutility can be avoided. However, the effect on the government budget is rather small (- 4,000 Euros).

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 0.51 and

²⁷Our calibration intends to represent Austrian UI rules around 1990 with 1/5 regular UI benefits and 4/5 UI assistance before REBP and 4/5 regular UI benefits and 1/5 UI assistance during REBP. We assume a net replacement rate of regular UI benefits of 55% and a net replacement rate of UI assistance of around 38.5%, or 70% of regular UI benefits.

0.49, respectively.²⁸ Next, collect all terms to obtain the three r.h.s. components of equation (7): $4.27 + (1.72 - 0.11) = 5.89$. Looking at the relative shares provides the following insights. First, complementarity effects are very expensive both because individuals react very strongly to financial incentives and because early retirement in $t = 0$ implies long-lasting (10-year) benefit payments and foregone taxes. Second, complementarity effects in $t = 1$ are more than half as expensive due to the shorter (5-year) period over which the government budget is affected. Third, program substitution effects mitigate program costs but are quantitatively small. The above calibration let us calculate a hypothetical risk aversion level γ^h that satisfies the local optimality condition:

$$\gamma^h = -\ln(1 + \text{r.h.s. of equation 7}) / \ln RR(b) = -\ln(1 + 5.89) / \ln 0.42 = 2.22. \quad (8)$$

Despite its importance the value of relative risk aversion remains disputed. In particular, a large literature finds that risk aversion is context-specific and varies with the scale of the risk (Chetty and Szeidl (2007), Barseghyan et al. (2011), Einav et al. (2012)). Studies that use labor supply elasticities to estimate risk aversion come closest to our setting. Using 33 sets of estimates of wage and income elasticities, Chetty (2006b) finds that the mean implied risk aversion is 0.71 with a range of 0.15 to 1.78. Since our estimate of risk aversion is above this range ($\gamma = 2.22$), we conclude that the REBP was most likely too generous.

7 Conclusion

In this paper, we study how extended unemployment insurance (UI) benefits targeted to older workers affect early retirement and social welfare. Extended durations of UI benefits for older workers are an important element of early retirement schemes in many countries. To identify the impact of the maximum duration of UI benefits on 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 constitutes a large policy intervention extending regular UI benefits to 4 years for workers aged 50+ living in certain regions, while workers in non-REBP regions were eligible to 1 year of regular UI benefits. Our identification strategy is based on a difference-in-differences comparison of individuals in REBP-regions to individuals in non-REBP regions, before, during, and after the program.

We find that the REBP had a very strong effect on the incidence of early retirement. The probability that an unemployment entrants aged 50-54 (55-57) retires early is 16.2 (14.8) percentage points higher among individuals eligible to the REBP. Among unemployment entrants aged 50-54 *program complementarity* (higher future take-up of DI) is quantitatively important. Of the 16.2 percentage point increase in early retirement, 12.2 percentage points are to an increase in UI take-up followed by higher DI take-up in the future. Among unemployment entrants aged 55 to 57,

²⁸ We find an average employment to unemployment transition rate of 3% per annum. This estimate includes all 50-57 years old workers satisfying the sample selection criteria (Section 3) and living in one of the REBP regions during the policy change. The corresponding five year period estimate amounts to $q = 5 \times 3\% = 15\%$ which yields $\Pi_0^U = 3.2\%$ and $\Pi_1^U = 3\%$.

both program complementarity and *program substitution* (lower contemporaneous take-up of DI) are quantitatively relevant. The 14.8 percentage point increase in excess retirement consists of a 24 percentage point increase in individuals staying on UI before claiming regular retirement benefits; and a 9.7 percentage point reduction in individuals claiming DI benefits.

Our empirical estimates help to explore whether extending UI benefits for older workers was a socially optimal policy. We set up a simple early retirement model and derive a formula in spirit of Baily (1978) and Chetty (2006a). This formula captures both program complementarity and program substitution effects. We find that while program substitution saves some money to the government, the bulk of changes in government expenditure is driven by program complementarity effects. Using our empirical estimates, we conclude that, extending UI benefits for the elderly is welfare-improving only if the degree of risk aversion exceeds 2.22. This estimate is higher than most previous estimates that use labor supply elasticities to identify risk aversion (Chetty, 2006b). We therefore conclude that the REBP was most likely 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 the (early) retirement decision. A policy mix that allows for simultaneous and coordinated reforms in UI and DI programs to tackle the unemployment-disability margin, together with complementary measures that induce firms to hire and retain older workers are the most promising route for policy reforms.

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A Pensions

A.1 Definition of disability and old-age pension expenditures

N denotes government expenditures (DI and old-age pensions, but *not* UI benefits). N can be subdivided into three components $\{N_t\}_{t=0,1,2}$, where N_t denotes total expenditures in period t or later, that arises from a worker retiring in t . Let E_t be the expectation of d , conditional on retirement in t . There are Π_0^U individuals who retire in $t = 0$. They cause total pension expenditures

$$N_0 = \Pi_0^U E_0((1 + T)d \mid \theta \geq \hat{\theta}_0(d)).$$

There are $\Pi_1^D + \Pi_1^U$ individuals who retire in $t = 1$. They cause DI- and pension expenditures

$$N_1 = \Pi_1^D E_1((1 + T)d \mid \theta \geq \hat{\theta}_1(d), d \geq \hat{d}) + \Pi_1^U E_1(\alpha T d \mid \theta \geq \hat{\theta}_1(d), d < \hat{d}).$$

Finally, there are Π_1^W individuals who retire not before $t = 2$. These workers can be divided into three groups: (i) Π_1^{W1} , workers displaced at the beginning of $t = 1$ who return to work, (ii) Π_1^{W2} , workers displaced in $t = 0$ who return to work in $t = 0$ and continue to work in $t = 1$, and (iii) Π_1^{W3} , workers without displacement in $t = 0$ and $t = 1$. Workers in Π_1^{W1} and Π_1^{W2} tend to have a lower d because they self-selected themselves into work because of both low DI pensions d and low adjustment costs θ . The sum of old-age pensions that accrue to the government by all three subgroups is

$$N_2 = \Pi_1^{W1} E_1(\alpha T d \mid \theta < \hat{\theta}_1(d)) + \Pi_1^{W2} E_0(\alpha T d \mid \theta < \hat{\theta}_0(d)) + \Pi_1^{W3} E_0(\alpha T d).$$

Notice that workers without a previous displacement (third term) are not subject to previous self-selection. Hence, the mean E_0 is unconditional.

A.2 Calibration of $\mathcal{T}_0$

The expected financial burden to the government of a job loser who goes back work (rather than retiring early) in $t = 0$ equals (see proof in Appendix Lemma B.3)

$$\mathcal{T}_0 = q(\hat{\pi}^D(d_0 + T p_0^D) + \hat{\pi}^U(b + T p_0^U) + \hat{\pi}^W(T p_0^W - \tau)) + (1 - q)(T p_0^W - \tau). \quad (9)$$

The first component captures government expenditures caused by individuals retiring in $t = 1$ through claiming DI-benefits; the second term captures expenditures caused by early retirees who claim UI benefits in $t = 1$; and the third term captures expenditures caused by workers retiring not until the regular retirement age $t = 2$. To calculate $\mathcal{T}_0$, we set the probability of job loss $q = 0.15$ (see footnote 28). We estimate $\hat{\pi}^i$ by the observed take-up probabilities of 55-57 year old job losers living in REBP regions. This yields $\hat{\pi}^D = 0.28$, $\hat{\pi}^U = 0.59$, and $\hat{\pi}^W = 0.13$. Moreover we use $T = 3.56$, $d = p^D = 0.7$, and $p^U = p^W = \alpha d = 0.77$, see Table 10.

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

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

To calculate $E_\theta V_1$, we need to distinguish two cases (see Lemma 1).

Case 1 ($d < \hat{d}$): This is the subset of job losers who strictly prefer to retire through UI rather than DI in $t = 1$. The back-to-work probability equals to $F(\hat{\theta}_1)$ while early retirement occurs with probability $1 - F(\hat{\theta}_1)$. The expected marginal utility corresponds to the sum of the marginal utility of continuing work and the marginal utility of retiring through UI, weighted by their respective take-up probabilities

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

with $\partial W_1 / \partial d = \partial U_1 / \partial d = \alpha T u'(\alpha d)$. Collecting $\partial \hat{\theta}_0 / \partial d$ -terms, and noting that $u'(\alpha d) < u'(d)$ and $1 - (\alpha - 1)T \geq 0$, we get $\partial \hat{\theta}_0 / \partial d < -u'(d)(1 - (\alpha - 1)T) < 0$.

Case 2 ($d > \hat{d}$): This is the subset of job losers who strictly prefer to retire through DI rather than UI in $t = 1$. The same reasoning as above yields²⁹

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

with $\partial W_1 / \partial d = \alpha T u'(\alpha d)$ and $\partial D_1 / \partial d = (1 + T)u'(d)$. Collecting $\partial \hat{\theta}_0 / \partial d$ -terms and again using $1 - (\alpha - 1)T \geq 0$ yields $\partial \hat{\theta}_0 / \partial d < -(1 - q(1 - F_1(\hat{\theta}_1)))u'(d)(1 - (\alpha - 1)T) < 0$. $\square$

B.2 Proposition 2

Proof. Differentiation of $\hat{\theta}_0$ with respect to b yields $\partial \hat{\theta}_0 / \partial b = q \cdot (\partial E_\theta V_1 / \partial b) - u'(b)$. As in Lemma 2, there are two cases. *Case 1* ($d < \hat{d}$) we obtain $\partial E_\theta V_1 / \partial b = (1 - F(\hat{\theta}_1))(\partial U_1 / \partial b)$ 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 $\partial \hat{\theta}_0 / \partial b = -u'(b)$. $\square$

²⁹There is one subtle difference to Case 1: the threshold $\hat{\theta}_1$ becomes a function of d over the domain $d > \hat{d}$. However, 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

First, we assume that $d\tau/db$ does not generate an increase in the mass of individuals claiming DI rather than returning to work; see discussion in footnote (25). Second, the elasticities ε_1^s and ε_1^c capture pathway changes holding the $t = 1$ inflow of displaced workers fixed (more precise definition). A detailed proof can be found in the Mathematical Appendix.

Proof. Differentiation of the budget constraint (4) with respect to b yields

$$(\varphi + \Pi_0^W + \Pi_1^W) \frac{d\tau}{db} + \tau \frac{d(\Pi_0^W + \Pi_1^W)}{db} = \Pi_0^U + \Pi_1^U + b \frac{d(\Pi_0^U + \Pi_1^U)}{db} + \frac{dN}{db}. \quad (10)$$

In a first step, we calculate the marginal pension expenditures dN/db (pensions see Appendix A.1). Deriving N_0 with respect to b yields

$$dN_0/db = \Pi_0^U(\varepsilon_0^c/b)(1+T)d_0 \quad (11)$$

which are additional pension expenditures $(1+T)d_0$ caused by more early retirees in $t = 0$. Deriving $N_1 + N_2$ with respect to b yields

$$\begin{aligned} d(N_1 + N_2)/db &= \Pi_1^U(\varepsilon_1^s/b)(Tp_1^U - d_1 - Tp_1^D) \\ &\quad - \Pi_0^U(\varepsilon_0^c/b)(q(\hat{\pi}^D(d_0 + Tp_0^D) + \hat{\pi}^U Tp_0^U + \hat{\pi}^W Tp_0^W) + (1-q)Tp_0^W) \end{aligned} \quad (12)$$

which are additional DI and old-age pension expenditures caused by the change in the number of (early) retirees in $t = 1$ and $t = 2$. $\hat{\pi}^D$ denotes the fraction of DI pension take-up in $t = 1$ of individuals who react to program complementarity effects in $t = 0$. $\hat{\pi}^U$ and $\hat{\pi}^W$ capture the unemployment and work margin. The above formula shows two channels affecting total pension expenditures accruing from retirement in $t = 1, 2$. The first term captures the costs of program substitution (change in DI plus old-age pension expenditures) from retirees that use UI instead of DI to retire early. The second term captures the fact that, when there are more retirees in $t = 0$, there are fewer retirees in $t = 1$ and $t = 2$ which reduces the government expenditures $N_1 + N_2$.

In the second step, we calculate the additional UI expenditures caused by labor supply responses

$$d(\Pi_0^U + \Pi_1^U)/db \times b = \Pi_0^U(\varepsilon_0^c/b)(1 - q\hat{\pi}^U)b + \Pi_1^U((\varepsilon_1^c + \varepsilon_1^s)/b)b. \quad (13)$$

Again, the first term captures net costs due to early retirement in $t = 0$ including savings due to non-retirement in $t = 1$, captured by $q\hat{\pi}^U$. The second term represents additional UI benefits expenditures due to substitution and complementarity effects in $t = 1$. Applying the same procedure:

$$d(\Pi_0^W + \Pi_1^W)/db \times \tau = -\Pi_0^U(\varepsilon_0^c/b)(1 - q(1 - \hat{\pi}^W))\tau - \Pi_1^W(\varepsilon_1^c/b)\tau. \quad (14)$$

Finally, insert equations (11) to (14) into (10) to obtain (6) with $\Delta_0^c = b + \tau + d_0 + Tp_0^D - \mathcal{T}_0$, $\Delta_1^c = b + \tau$, $\Delta_1^s = b + Tp_1^U - d_1 - Tp_1^D$, and (9). $\square$

Table 1: Sample statistics in treated (TRs) and control regions (CRs) before, during, and after REBP

	Before REBP		During REBP		After REBP	
	CRs	TRs	CRs	TRs	CRs	TRs
<u>A. Exit state after UI (%)</u>						
Employment	72.1	66.8	61.0	31.7	56.1	48.9
Early retirement	27.9	33.2	39.0	68.3	43.9	51.1
Disability pension	18.8	23.1	27.1	42.0	30.2	37.8
Old-age pension	7.9	8.6	9.7	23.4	10.7	10.4
Censored	1.2	1.5	2.2	2.9	3.0	2.9
<u>B. Background characteristics</u>						
Age at UI entry	53.5	53.5	53.3	53.6	53.6	53.5
Sick days	103	96	110	89	96	99
Married	0.777	0.802	0.763	0.810	0.767	0.774
Daily wage	57.0	55.9	63.1	68.8	68.6	68.3
Blue collar	0.822	0.857	0.744	0.755	0.682	0.730
Experience (years)	11.5	11.6	11.2	11.8	11.3	11.3
Tenure (years)	3.4	4.0	3.6	5.0	4.0	4.3
Education						
Low	0.580	0.621	0.505	0.493	0.435	0.461
Medium	0.359	0.345	0.401	0.432	0.445	0.443
High	0.061	0.035	0.094	0.075	0.120	0.095
Industry						
Agriculture	0.069	0.095	0.062	0.066	0.061	0.058
Wholesale and retail trade	0.138	0.130	0.178	0.141	0.196	0.169
Manufacturing	0.109	0.152	0.116	0.187	0.113	0.162
Machines	0.055	0.074	0.064	0.225	0.067	0.116
Construction	0.439	0.424	0.346	0.248	0.310	0.314
Services	0.190	0.125	0.234	0.134	0.254	0.183
No. of Obs.	14,894	3,843	27,003	9,762	18,123	4,449

Notes: “Before” denotes unemployment spells starting in January 1985 to May 1988. “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.

Table 2: 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 ($D \times TR$)	0.162*** (0.018)	0.122*** (0.022)	0.034** (0.017)	-0.005 (0.009)	-0.002 (0.008)	0.002 (0.002)
REBP abolished ($A \times TR$)	-0.155*** (0.018)	-0.098*** (0.021)	-0.043*** (0.009)	0.008 (0.010)	0.003 (0.008)	0.004 (0.003)
Anticipation effects	0.015 (0.019)	-0.010 (0.021)	0.027** (0.013)	-0.017 (0.012)	-0.006 (0.010)	-0.007* (0.004)
R ²	0.204	0.171	0.092	0.086	0.066	0.027
Mean in TRs pre-REBP	0.265	0.210	0.037	0.104	0.083	0.008
No. of Obs.	56,102	56,102	56,102	72,535	72,535	72,535

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Controls: dummies for marital status, dummies for education, log previous wage, dummies for weeks of UI eligibility (30, 39, 52 weeks), blue collar status at last job, work experience in last 13 years, years of tenure in last job, number of days receiving sick leave benefits prior to UI entry, dummies for previous industry, age-in-year dummies, dummies for year and month of unemployment entry, quarter of unemployment inflow, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 3: Exit to disability pensions for age group 50-54

	DI-entry at age 50-54	DI-entry at age 55+
REBP introduced ($A \times TR$)	-0.015* (0.009)	0.137*** (0.022)
REBP abolished ($D \times TR$)	0.009 (0.007)	-0.107*** (0.022)
Anticipation effects	-0.026* (0.015)	0.016 (0.016)
R ²	0.051	0.171
Mean in TRs pre-REBP	0.076	0.134
No. of Obs.	56,102	56,102

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Controls: dummies for marital status, dummies for education, log previous wage, dummies for weeks of UI eligibility (30, 39, 52 weeks), blue collar status at last job, work experience in last 13 years, years of tenure in last job, number of days receiving sick leave benefits prior to UI entry, dummies for previous industry, age-in-year dummies, dummies for year and month of unemployment entry, quarter of unemployment inflow, and dummies for labor market districts. 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 ($D \times TR$)	0.148*** (0.024)	-0.097*** (0.033)	0.240*** (0.032)	-0.016 (0.021)	-0.007 (0.014)	-0.012 (0.024)
REBP abolished ($A \times TR$)	-0.121*** (0.019)	0.095*** (0.019)	-0.222*** (0.022)	-0.025** (0.013)	0.037* (0.020)	-0.064*** (0.023)
Anticipation effects	0.006 (0.041)	-0.102* (0.052)	0.097 (0.071)	0.003 (0.023)	-0.006 (0.026)	0.005 (0.031)
R ²	0.261	0.132	0.317	0.196	0.156	0.261
Mean in TRs pre-REBP	0.497	0.283	0.207	0.905	0.066	0.833
No. of Obs.	21,972	21,972	21,972	12,322	12,322	12,322

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Controls: dummies for marital status, dummies for education, log previous wage, dummies for weeks of UI eligibility (30, 39, 52 weeks), blue collar status at last job, work experience in last 13 years, years of tenure in last job, number of days receiving sick leave benefits prior to UI entry, dummies for previous industry, age-in-year dummies, dummies for year and month of unemployment entry, quarter of unemployment inflow, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 5: Difference-in-differences matching

	Age 50-54			Age 55-57		
	Early retirement	Disability pension	Old-age pension	Early retirement	Disability pension	Old-age pension
REBP introduced	0.176*** (0.019)	0.138*** (0.019)	0.042*** (0.011)	0.121*** (0.034)	-0.142*** (0.036)	0.250*** (0.036)
REBP abolished	-0.162*** (0.012)	-0.100*** (0.012)	-0.044*** (0.007)	-0.138*** (0.019)	0.090*** (0.022)	-0.228*** (0.020)

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: dummies for marital status, dummies for education, log previous wage, dummies for weeks of UI eligibility (30, 39, 52 weeks), blue collar status at last job, work experience in last 13 years, years of tenure in last job, number of days receiving sick leave benefits prior to UI entry, dummies for previous industry, age-in-year dummies, an quarter of unemployment inflow. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 6: 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 ($A \times TR$)	0.139*** (0.025)	0.075** (0.030)	0.059*** (0.017)	0.119*** (0.033)	-0.095*** (0.028)	0.204*** (0.035)
REBP abolished ($A \times TR$)	-0.139*** (0.024)	-0.086*** (0.027)	-0.050*** (0.012)	-0.092*** (0.025)	0.104*** (0.025)	-0.202*** (0.025)
R ²	0.238	0.194	0.113	0.305	0.179	0.351
Mean in TRs pre-REBP	0.257	0.201	0.037	0.463	0.261	0.193
No. of Obs.	14,117	14,117	14,117	5,888	5,888	5,888

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Controls: interaction term for anticipation effects, dummies for marital status, dummies for education, log previous wage, dummies for weeks of UI eligibility (30, 39, 52 weeks), blue collar status at last job, work experience in last 13 years, years of tenure in last job, number of days receiving sick leave benefits prior to UI entry, dummies for previous industry, age-in-year dummies, dummies for year and month of unemployment entry, quarter of unemployment inflow, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 7: 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 ($D \times TR$)	0.175*** (0.023)	0.147*** (0.027)	0.025 (0.019)	0.111*** (0.029)	-0.142*** (0.039)	0.253*** (0.037)
REBP abolished ($A \times TR$)	-0.167*** (0.025)	-0.099*** (0.029)	-0.043*** (0.009)	-0.136*** (0.021)	0.113*** (0.030)	-0.250*** (0.033)
R ²	0.214	0.193	0.094	0.269	0.163	0.319
Mean in TRs pre-REBP	0.515	0.392	0.090	0.825	0.279	0.531
No. of Obs.	26,341	26,341	26,341	10,606	10,606	10,606

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Controls: interaction term for anticipation effects, dummies for marital status, dummies for education, log previous wage, dummies for weeks of UI eligibility (30, 39, 52 weeks), blue collar status at last job, work experience in last 13 years, years of tenure in last job, number of days receiving sick leave benefits prior to UI entry, dummies for previous industry, age-in-year dummies, dummies for year and month of unemployment entry, quarter of unemployment inflow, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 8: Effects of REBP on unemployment entry

	Age 50-54			Age 55-57		
	Full sample	Pre 10/91	Pre 10/91, low tenure/wage,w/o machine industry	Full sample	Pre 10/91	Pre 10/91,low tenure/wage,w/o machine industry
REBP introduced ($D \times TR$)	0.003** (0.001)	-0.001 (0.001)	-0.005 (0.003)	0.009*** (0.002)	0.008*** (0.002)	0.003 (0.004)
REBP abolished ($A \times TR$)	-0.006*** (0.001)			-0.011*** (0.002)		
R ²	0.100	0.104	0.114	0.105	0.107	0.121
Mean in TRs pre-REBP	0.027	0.027	0.027	0.024	0.024	0.024
No. of Obs.	3,807,272	2,104,699	1,710,906	1,553,979	961,640	795,027

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Controls: interaction term for anticipation effects, log wage, dummies for weeks of UI eligibility (30, 39, 52 weeks), blue collar status, work experience in last 13 years, years of tenure current job, dummies for industry, number of days receiving sick leave past two years, age-in-year dummies, year-quarter dummies, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 9: Effects for unemployed entering before 10/1991

	Age 50-54			Age 55-57		
	Early retirement	Disability pension	Old-age pension	Early retirement	Disability pension	Old-age pension
<u>A. Inflow prior to 10/1991</u>						
REBP introduced ($D \times TR$)	0.150*** (0.019)	0.106*** (0.018)	0.034*** (0.012)	0.147*** (0.026)	-0.126*** (0.035)	0.271*** (0.032)
R ²	0.191	0.158	0.080	0.292	0.133	0.351
Mean in TRs pre-REBP	0.265	0.210	0.037	0.497	0.283	0.207
No. of Obs.	27,334	27,334	27,334	11,260	11,260	11,260
<u>B. Only low tenure/wage</u>						
REBP introduced ($D \times TR$)	0.097*** (0.027)	0.056** (0.023)	0.031** (0.012)	0.161*** (0.035)	-0.093*** (0.034)	0.245*** (0.037)
R ²	0.163	0.134	0.078	0.237	0.136	0.274
Mean in TRs pre-REBP	0.252	0.197	0.035	0.461	0.277	0.177
No. of Obs.	23,788	23,788	23,788	9,244	9,244	9,244

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Controls: interaction term for anticipation effects, dummies for marital status, dummies for education, log previous wage, dummies for weeks of UI eligibility (30, 39, 52 weeks), blue collar status at last job, work experience in last 13 years, years of tenure in last job, number of days receiving sick leave benefits prior to UI entry, dummies for previous industry, age-in-year dummies, dummies for year and month of unemployment entry, quarter of unemployment inflow, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 10: Financial impact of program complementarity and program substitution

	Percent of net wage	In Thousands of Euros (year 2000)
$\Delta_0^c = b + \hat{\tau} + (d + Tp^D) - \mathcal{T}_0$	$0.42 + 0.33 + 0.70 + 2.49 - 2.51 = 1.44$	181
$\Delta_1^c = b + \hat{\tau}$	$0.42 + 0.33 = 0.75$	95
$\Delta_1^s = b + Tp^U - (d + Tp^D)$	$0.42 + 2.74 - 0.70 - 2.49 = -0.03$	-4

Notes: The second column reports the financial effects in units of the net (after-tax wage). Hence $b = 0.42$ denotes the UI benefits replacement ratio; $d = p^D = 0.7$ the DI benefit replacement ratio for individuals reacting to the UI benefits change. In 1990, the conditional lifetime expectation of a 60 year old male individual was about 17.8 years (see STATISTIK AUSTRIA, 2012), which yields $T = 3.56$ capturing the duration of $t = 2$ in terms of 5-year periods. It follows that $Tp^D = 0.7 \times 3.56 = 2.49$ and $Tp^U = \alpha Tp^D = 2.74$. Payroll taxes are recalculated as a fraction of net-wages, hence we get $\hat{\tau} = \tau/(1 - \tau) = 0.33$. $\mathcal{T}_0$ denotes the expected net transfer in the counterfactual scenario when a job loser goes back work (rather than retiring early) in $t = 0$. See Appendix A.2 for a comprehensive calibration of this term. The Δ -terms Euro are transferred into year-2000 Euros by multiplying the Δ -terms by 1825 (number of days in a five-year interval) and by 68.8 (the average daily wage in TRs during the REBP, see Table 1).

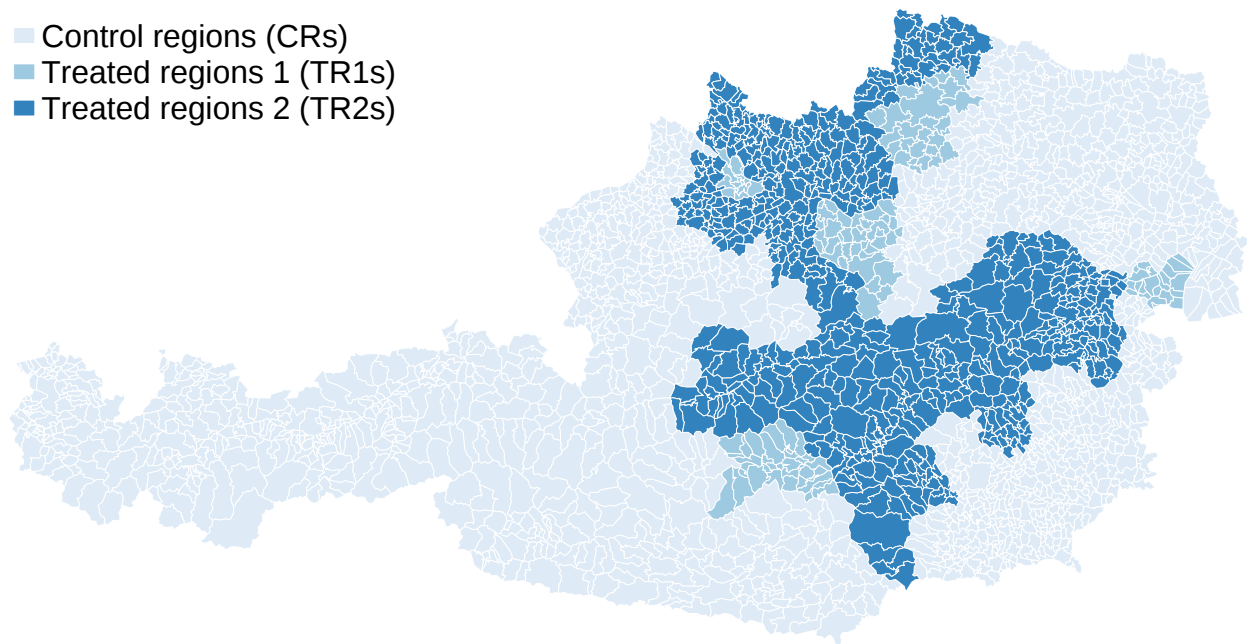


Figure 1: Regional distribution of REBP eligibility

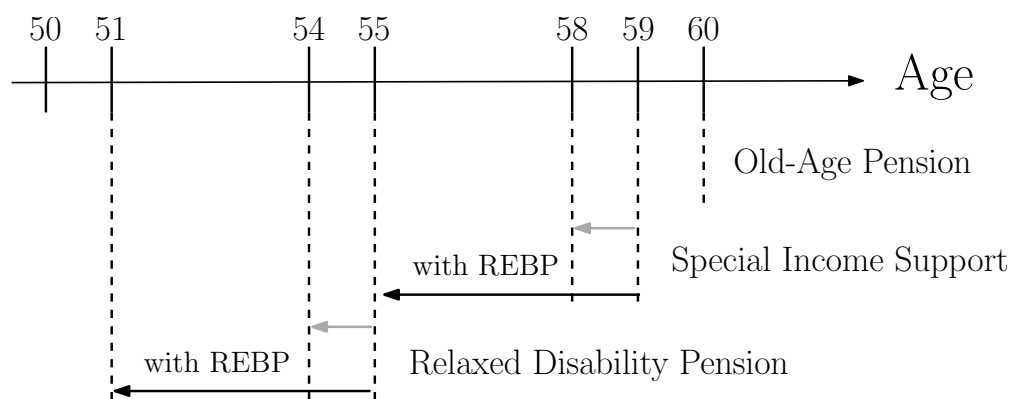


Figure 2: Early retirement pathways for unemployed men with/without REBP-eligibility

Notes: Gray arrows denote maximum duration of regular UI benefits without REBP (1 year) and black arrows denote maximum duration of regular UI benefits with REBP (4 year). Unemployed men can withdraw by claiming a disability pension at age 54 without the REBP and at age 51 with the REBP. Unemployed men can permanently withdraw from the labor market by claiming an old-age pension at age 58 without the REBP and at age 55 with the REBP.

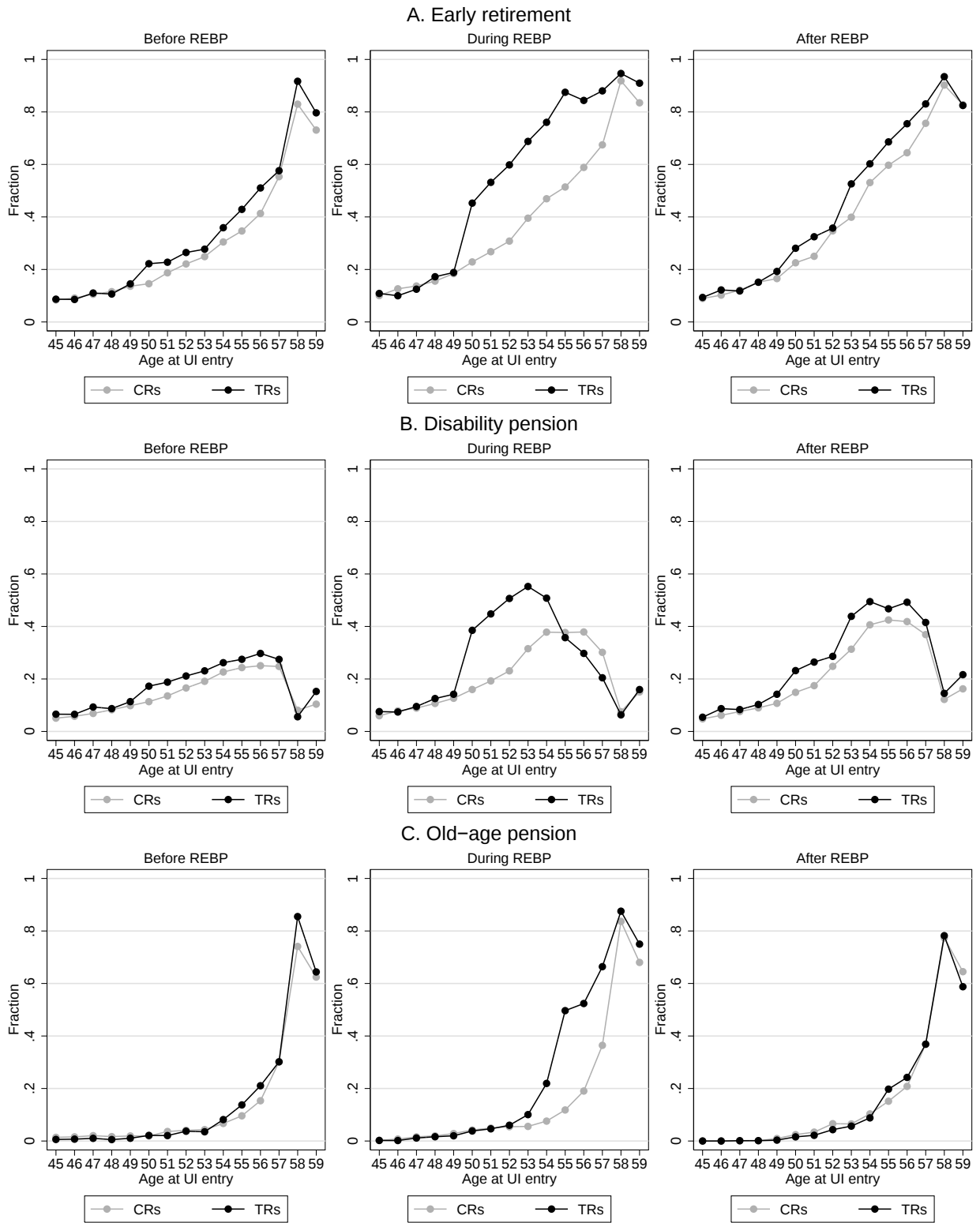


Figure 3: Transitions into early retirement (Panel A), disability pensions (Panel B), and old-age pensions (Panel C) by age in treated (TRs) and control regions (CRs) before, during, and after REBP

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

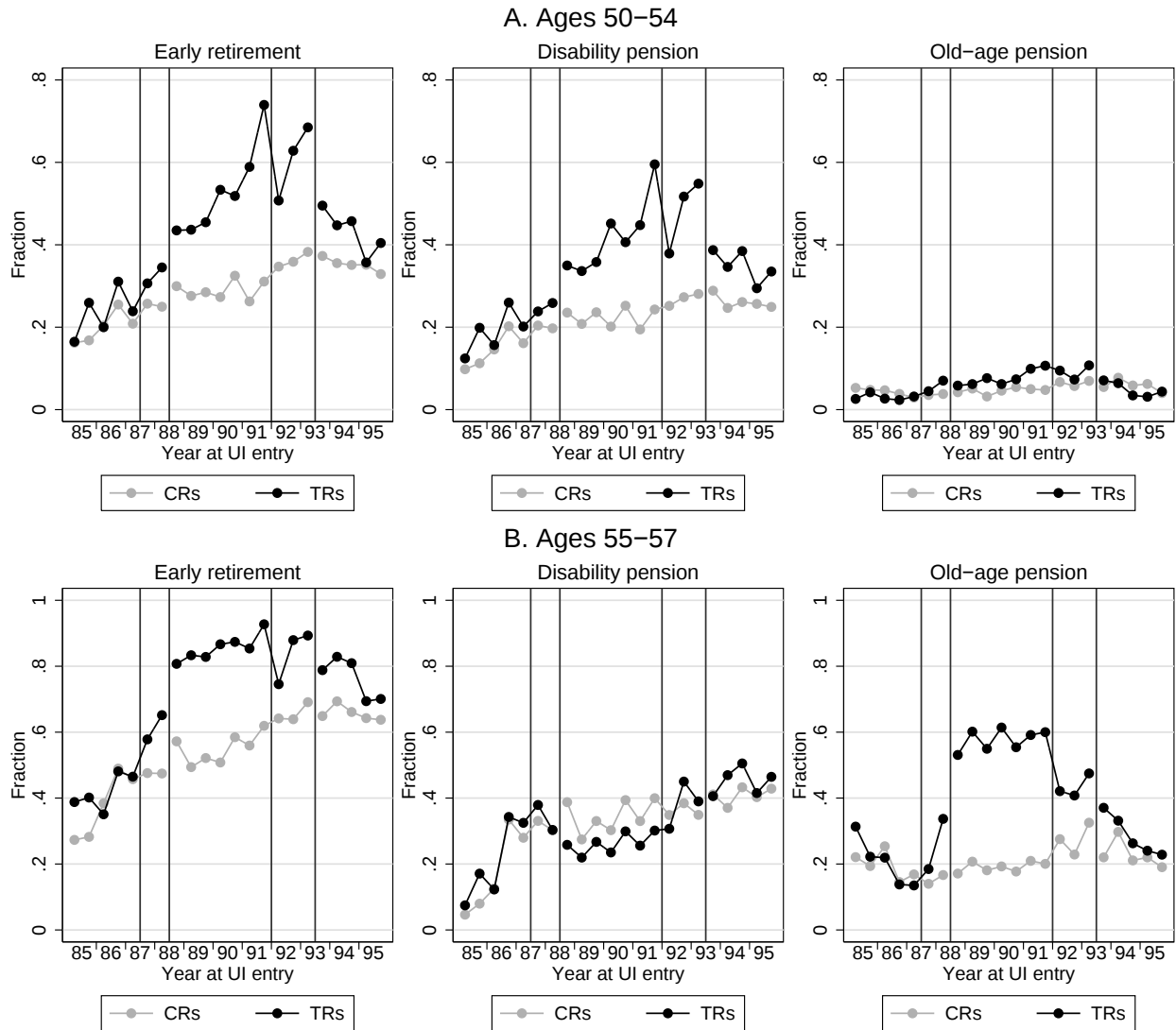


Figure 4: Trends in transitions into early retirement, disability pensions, and old-age pensions in treated (TRs) and control regions (CRs) by year and age group

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

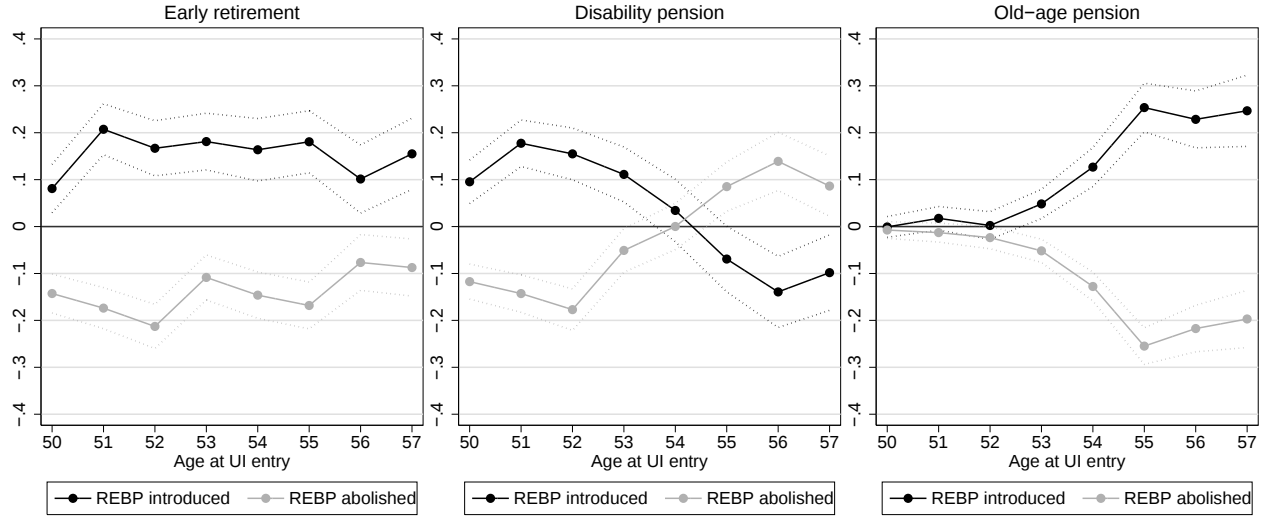


Figure 5: Coefficients of the interactions $(D_t \times TR_i)$ and $(A_t \times TR_i)$ from estimating equation (1) for each age separately. The dotted lines represent a 95-percent confidence interval.

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

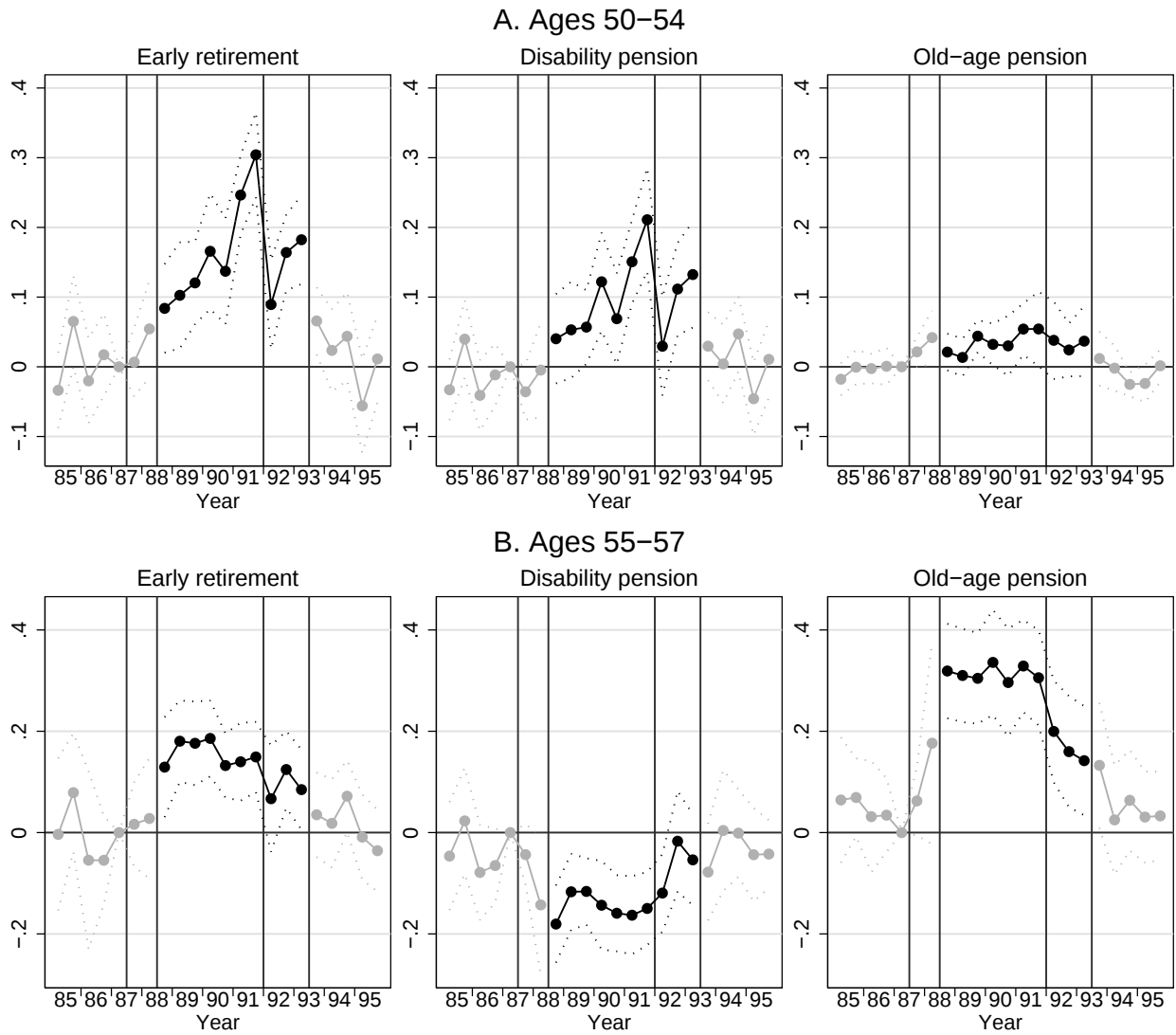


Figure 6: Coefficients of the interactions ($d_{jt} \times TR_i$) in equation (2) for transitions into early retirement, disability pensions, and old-age pensions by age group. The dotted lines represent 95-percent confidence interval.

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

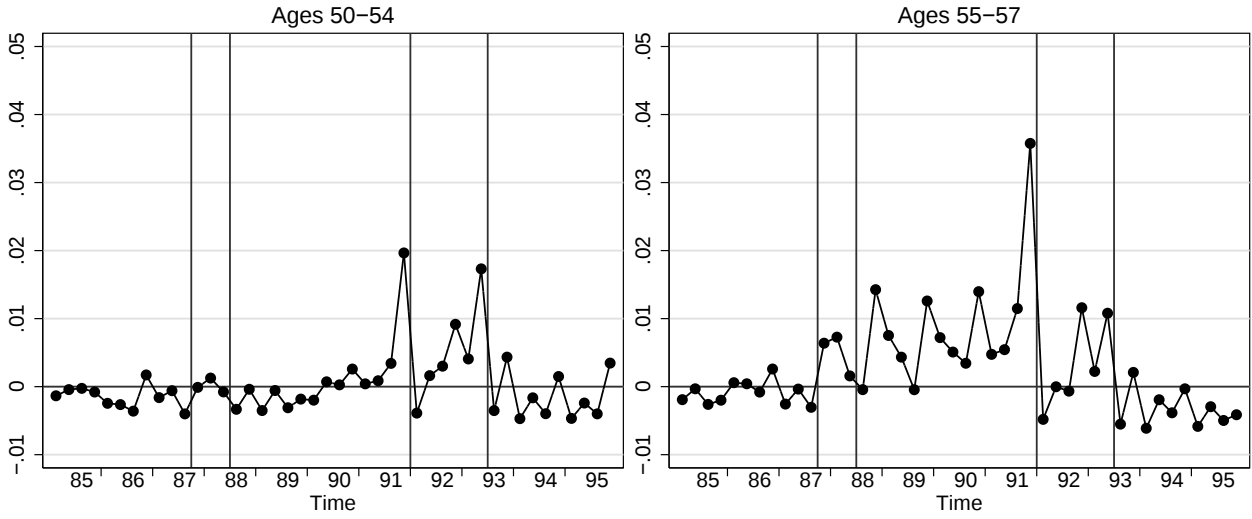


Figure 7: Regional difference in quarterly unemployment inflow rate (% of employment) by age group.

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

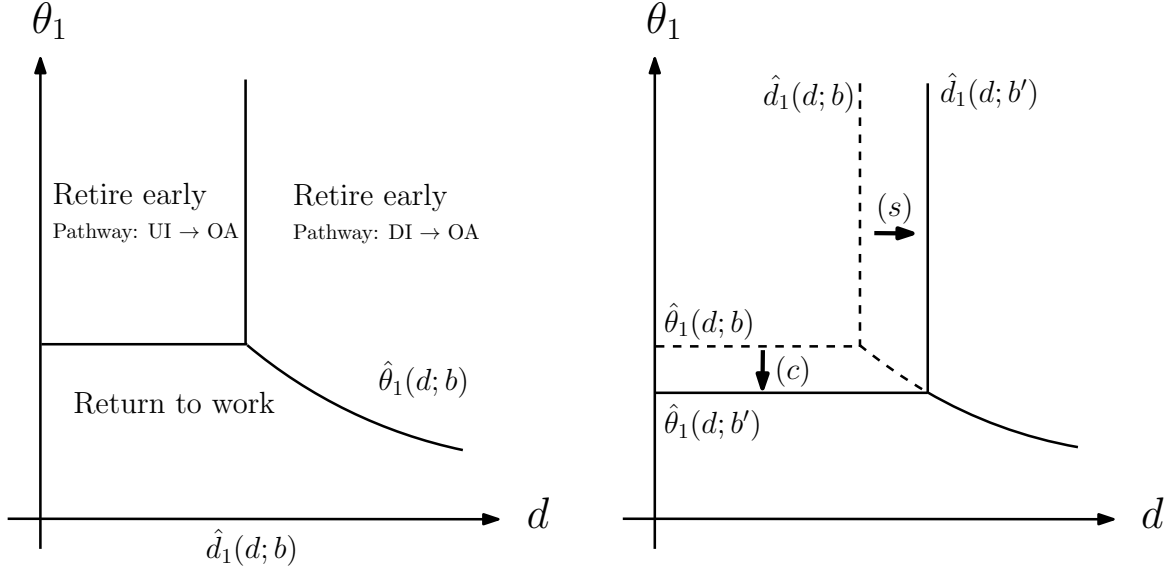


Figure 8: Left panel: early retirement thresholds in $t = 1$. Right panel: program complementarity effects (c) and program substitution effects (s) when unemployment benefits increase from b to b' .

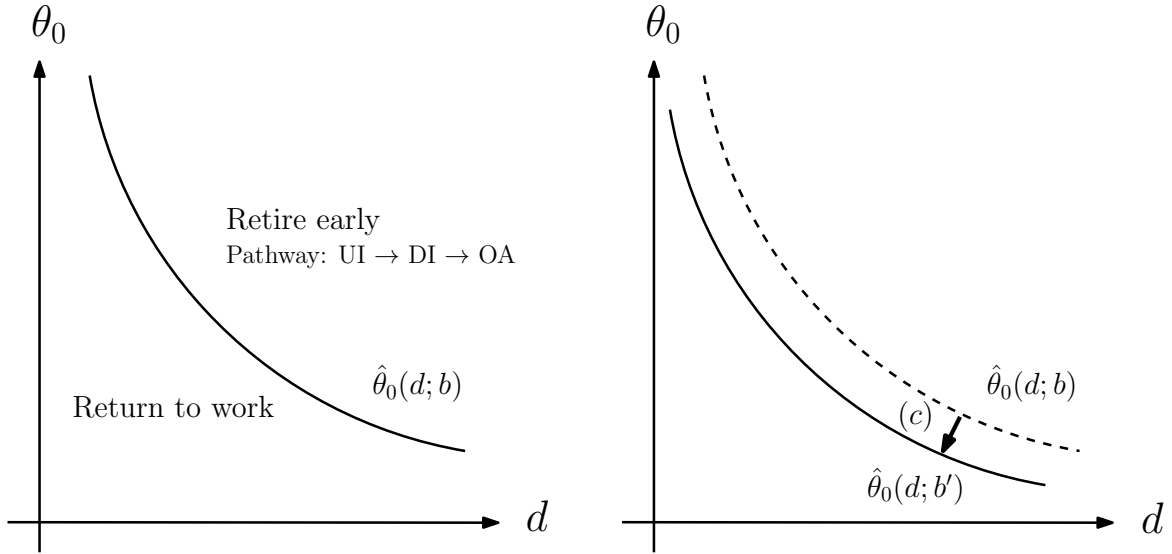


Figure 9: Left panel: early retirement threshold $\hat{\theta}_0(d; b)$ in $t = 0$. Right panel: program complementarity effects (c) when unemployment benefits increase from b to b' .