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EXTENDED UNEMPLOYMENT BENEFITS AND EARLY RETIREMENT: PROGRAM COMPLEMENTARITY AND PROGRAM SUBSTITUTION†

Abstract

We explore how extended unemployment insurance (UI) benefits for older workers affect early retirement and welfare. We argue that extending UI benefits generates program complementarity (more labor market exits and disability benefit take-up in the future) and program substitution (less disability benefit take-up in the present). Exploiting a policy change in Austria, which extended UI benefits to 4 years, we find program complementarity effects for workers aged 50+ and program substitution effects for workers aged 55+. We apply the Baily-Chetty formula for optimal UI to account for complementarity and substitution, showing that UI benefits for older workers were too generous.

JEL Classification: J14, J26 and J65
Keywords: disability, early retirement, optimal benefits, policy reform and unemployment

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1 Introduction

Extending the potential duration of unemployment insurance (UI) benefits is one of the most frequently adopted 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. Many other UI systems 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] We argue that, in the context of older workers, it is important to broaden this basic logic 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, in particular disability insurance (DI) benefits, but also specific early retirement schemes, 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. 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

[1]While 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; Card and Levine, 2000), only few empirical papers have examined the consumption smoothing benefits of UI benefits (Gruber, 1997; Browning and Crossley, 2001).

[2]When 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.

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. 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, defined as permanent exit from the labor force before the retirement age. The probability that a job loser aged 50-54 permanently withdraws from the labor market increases by 15.6 percentage points when the worker is eligible to the REBP. Among job losers aged 55-57, the incidence of early retirement increases by 14.5 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* – exit from the labor force by combining extended UI with DI and/or retirement benefits – is quantitatively important. The 15.6 percentage point increase in early retirement is associated with a 12 percentage point increase in exits through the DI program. 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 14.5 percentage point increase in early retirement is associated with a 24 percentage point increase in using extended UI benefits to bridge the gap until retirement benefits and a 9.5 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

[3] As 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 regions and non-REBP regions disappear after age 57. This is why our analysis looks at age groups 50-54 and 55-57.

Chetty (2006a) and use information on received transfer payments (UI, DI, and other transfers) associated with REBP eligibility.[4] Using this model, we incorporate both program complementarity and program substitution effects into the social welfare calculation. 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 2.25. 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 conclude that extended UI through the REBP was most likely a suboptimal policy.

We believe that there are two main reasons why our analysis is of general interest. *First*, policy makers in many countries have implemented early retirement schemes and these schemes turned out to be very costly. Many countries are debating (or have already implemented) reforms that reduce the generosity of these schemes with the goal of raising employment rates among older workers. 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. While the Austrian early retirement system created particularly large incentives, the system is qualitatively similar to those of many other countries. Early retirement schemes often feature relaxed DI-eligibility criteria for older workers, including the United States (Chen and van der Klaauw, 2008), and the maximum duration of UI benefits is extended above certain age thresholds, as in Germany, (Schmieder et al., 2012).[5] This suggests that our results illustrate mechanisms of policies that are at work (and under debate) in many other countries.

Second, it is often argued that labor supply responses along the extensive margin are important to reconcile large labor supply elasticities in macroeconomic calibrations with small elasticities often found in micro studies focusing on hours responses (see e.g., Rogerson and Wallenius, 2013). By looking at how the Austrian REBP

[4]Recent applications of the sufficient statistic approach for optimal UI design include Shimer and Werning (2007), Chetty (2008), Kroft (2008), Landais et al. (2014), Kroft and Notowidigdo (2011), Schmieder et al. (2012), and Landais (2014). See the article by Chetty and Finkelstein (2013) for a detailed discussion of this literature.

[5]Countries 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.

affects early retirement, we shed light on the extensive margin of lifetime labor supply. We show how this margin is affected by the interaction of various programs and how lower work incentives generated by one program may either be enhanced by complementary incentives of other programs or dampened by inducing individuals to substitute between programs. Depending on the relative strengths of substitution and complementarity effects, labor supply elasticities may be underestimated or overestimated.

Our paper is related to a growing literature that studies how multiple social insurance programs affect workers' labor supply decisions. It 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. Autor et al. (2014) provide U.S. evidence for program complementarity: recipients of Veterans Affairs' Disability Compensation are significantly more likely to qualify for Social Security Disability Insurance benefits. Using administrative data from the Netherlands, Borghans et al. (2014) 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. Similarly, the results of Staubli (2011) suggests that increasing the minimum age of relaxed DI access in Austria led to a significant decline in DI enrollment but only to a slight increase in employment.

[6]Spillover 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 (2013).

[7]Related to these studies is the work on the extension of UI benefits for older workers by Winter-Ebmer (2003), Kyyrä 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.

Kyyrä 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. Moreover, it uses 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 in the Austrian system and the rules associated with the regional extended benefit program. In Section 3, we describe our data and provide 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 to address the welfare consequences of extending the unemployment benefits duration. Section 7 summarizes the main results and draws policy conclusions.

2 Institutional Background

Austria's Public Pension System. Our study focuses on workers experiencing unemployment during the late 1980s and early 1990s. Hence, it is useful to start with a brief overview of the Austrian pension and UI system during that time period. Regular UI benefits are a function of the wage on the last job and replace approximately 55 percent of the prior net wage, subject to a minimum and maximum. On top of regular UI benefits, family allowances are paid. The UI system plays an important role for the labor market exit of older workers because these workers are subject to more generous UI benefit rules. First, while job losers below age 50 receive at most 39 weeks of regular UI benefits, job losers above age 50 can claim benefits for up to 52 weeks provided they have paid UI contributions for at least 9 years in the last 15 years.[8] Job losers who exhaust the regular UI benefits

[8]More specifically, 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. Furthermore, workers over the age of 40 who worked at least six years in the past ten years are eligible for 39 weeks of benefits. Before August 1989, the maximum duration of UI

can apply for "unemployment assistance" (UA). These means-tested transfers last for an indefinite period and are about 70 percent of regular UI benefits.

Second, unemployed men (women) aged 59 (54) 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. The aim of these transfers is to support unemployed individuals until they become eligible for an old-age pension at age 60 for men and age 55 for women. Special income support is equivalent to an UI spell in legal terms, but with 25 percent higher benefits. Benefits are paid for a period of 12 months, except for workers in the mining sector who can claim special income support for up to 5 years. Special income support can be combined with regular UI and UA benefits. Thus, the UI system essentially allows male (female) workers to withdraw from the labor market at age 58 (53) and bridge the gap until an old-age pension via regular UI benefits followed by special income support.

A second retirement pathway is via the DI program, which grants relaxed access to a DI pension from age 55 onwards. 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 a DI pension if a medically determinable impairment reduces the ability to work by more than 50 percent relative to that of a healthy person with comparable education *in any occupation* that the individual is able to carry out. Applicants above age 55 are classified as disabled if their work capacity is lower than 50 percent compared to a healthy person with comparable education *in the same occupation*. Due to this relaxation in eligibility criteria, disability enrollment rises significantly at age 55.[9] The DI application review process is likely to rely also on informal criteria to evaluate an applicant's medical impairments and ability to work. Such informal criteria may be particularly relevant for applicants with difficult-to-verify medical conditions, such as back pain and depression. However, our data do not allow us to check whether and to what extend informal criteria are relevant.

DI and old-age pensions are calculated in the same way, except for a "special increment" granted to DI claimants below age 55. The benefit amount is determined

benefits was 30 weeks for all individuals. See Lalive et al. (2006) for a detailed description of the policy change and its impact on the unemployment duration of job losers.

[9] In 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.

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 pension. The pension coefficient increases with the number of contribution years (periods of employment, unemployment, sick leave, or maternity leave) up to a maximum of 80 percent. DI and old-age pensions replace on average between 70 and 80 percent of the last net wage, respectively, and each additional contribution year increases the replacement rate by roughly 2 percentage points. While the pension increases when the worker claims at a later age, the increase is far from actuarially fair (Hofer and Koman (2006)). Moreover, pensions are earnings-tested: individuals lose a fraction or all of their pension when labor earnings exceed an exempt amount (about 300 Euros per month). Unsurprisingly, very few individuals return to the labor force once they claim a DI or an old-age pension. Finally, UI benefits depend only on earnings in the previous job, while DI and old-age pensions are based on the entire work history. Thus, an individual's replacement rate of a DI or an old-age pension can be very different from the replacement rate of UI benefits. As a consequence, job losers with otherwise similar characteristics may have quite different incentives to exit the labor market via a particular pathway.

Table 1 illustrates the size of the different programs in terms of average expenditures and enrollment among 50-59 year old men between 1985 and 1995. For workers in this age group, the DI program is substantially larger in size compared to the UI system both in terms of enrollment and spending. Within the UI system, regular UI benefits are the largest program followed by special income support and UA benefits.

Table 1

The Regional Extended Benefit Program and Retirement Pathways. To preclude Soviet appropriation after World War II, Austria nationalized its iron-, steel-, and oil industries. After the mid-1970s, 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 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 implemented the Regional Extended Benefit Program (REBP) in June 1988. The program extended the potential unemployment duration from 52 weeks to 209 weeks for the subgroup of workers who satisfied each of the following criteria at the beginning of their 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 out of about 100 labor market districts. 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. Lalive and Zweimüller (2004b) show that eligible regions were characterized by a relatively high share of employment in the steel sector (around 17 percent in REBP regions versus roughly 5 percent in non-REBP regions).[10] However, they found no differences in the unemployment rate or the percent of long-term unemployed between treated and non-treated regions in the years 1986-88, prior to the start of the REBP.

In November 1991, a reform of the REBP was enacted which became effective in January 1992. The reform left all claims in progress unaffected. For new entrants, the reform abolished the benefit extension in 6 of the originally 28 regions. It 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. The abolishment left all claims in progress unaffected; only new claims were no longer eligible for the benefit extension. We label the regions that kept eligibility after the reform as "TR2s". Regions 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.

[10] The 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 1

The introduction of the REBP dramatically changed 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 by bridging the gap until an old-age pension via regular UI benefits followed by special income support. We call this retirement pathway *early retirement without DI*. 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 percent of 55-57 year old unemployed who retire early without DI. This is an example of a program complementarity effect: extending UI benefits increases permanent exits from the labor force due to the ability to combine extended UI benefits with other public transfer programs in the future.

Due to the relaxed DI-eligibility criteria, job losers above age 55 have a high incentive to apply and perhaps ultimately receive a DI pension. We call this retirement pathway *early retirement with DI*. It is very likely that some 55-57 year old unemployed men who would have retired early with DI in the absence of the REBP may instead have decided to retire early without DI during the REBP. This is an example of a program substitution effect: the more generous UI benefits reduce contemporaneous take-up of another program.

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 retire early with DI at age 54 by claiming UI benefits for 12 months followed by a DI 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 51-53 year old unemployed men. 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. Theory predicts a program complementarity effect among 51-53 year old job losers, but in the empirical analysis below we extend the age range to ages 50-54. This choice of age group is guided by the data because we observe that the REBP also has an impact on the early retirement behavior of 50 and 54 year old unemployed men. Yet, as we will show, the estimates for the age group 51-53 are similar albeit slightly larger.[11]

[11] In principle, unemployed men below age 55 could also consider retiring early without DI.

Figure 2

3 Data and Descriptive Evidence

Data Sources. We combine register data from two different sources. The Austrian Social Security Database (ASSD) provides detailed longitudinal information on the 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 that resulted in a UI claim between 1985 and 1995.[12] These spells are then followed up until the end of 2012. 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 DI pension. Women are only affected by the REBP if unemployment entry occurs in the age range 50-52. (While most of our results will refer to men, we will also briefly present results on women.)

In our observation period 223,069 unemployment spells were started by men in the age group 50-57. From these, we drop 14,147 unemployed men who entered unemployment from a job in the steel sector because they may face worse labor market prospects in TRs due to the steel crisis.[13] We also exclude 43,553 unemployed men with less than 15 employment years in the past 25 years as they are not eligible for the REBP. Focusing on workers with long experience also guarantees that the 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 82,201 men whose last two jobs were with the same employer. These job

However, this option is likely to be less attractive compared to early retirement with DI because 50-54 year old job losers need to rely on UA benefits to bridge the time until they become eligible for an old-age pension. In contrast, 55-57 year old job losers can bridge the time by relying on regular UI only. We see in the data that some 50-54 year old job losers do use UA benefits to retire early without DI. Most of these individuals are close to age 55 at the beginning of the UI spell and therefore need to rely on UA benefits only for a short period.

[12] For part of the empirical analysis we also include male job losers aged 58-59 and extend the sample to UI spells between 1980 to 1998.

[13] The 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 empirical analysis we present results for several robustness checks that address this concern.

seekers are likely on temporary layoff and do not face the trade-off between work and early retirement. We also drop 1,531 unemployed men from the mining sector as this sector has more generous rules for special income support. The final sample comprises 81,637 unemployment spells (58,343 spells of workers aged 50-54 when entering unemployment; and 23,294 spells of workers aged 55-57). Note that individuals can appear multiple times in our sample: we observe two or more job losses for 25 percent of the individuals in the sample.

Panel A of Table 2 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). "Early retirement" is defined as (i) claiming a DI or an old-age pension at the end of the UI spell and (ii) not having earnings above the exempt amount (roughly 300 Euros) in any month after the start of the UI spell.[14] Early retirement is decomposed into "early retirement with DI" which includes only exits to DI pensions and "early retirement without DI" which includes only exits to old-age pensions. Before the REBP the probability of early retirement is 5 percentage points higher in TRs than in CRs because job losers in TRs are more likely to retire early with DI. During the REBP the difference in the probability of early retirement increases to 28.4 percentage points. This increase is primarily driven by an increase in the share of job losers in TRs who claim either a DI 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 there is an increase in the incidence of early retirement in all regions over the entire observation period. This most likely reflects a general deterioration in labor market conditions for older workers and/or an increased propensity to retire early.

Panel B of Table 2 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. However, the overall background characteristics are 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 machinery industry, have earned higher wages, and

[14]Only 6.6 percent of job losers who exit into early retirement have earnings below the exempt amount at some point after the start date of the UI spell. An UI spell is defined as censored if there is no employment, disability pension or old-age pension spell between UI entry and the last year in our data (2012). Censoring in the data occurs because some job losers die during the UI spell.

have longer tenure compared to job losers in CRs. This pattern is consistent with a previous study by Winter-Ebmer (2003) who argues that firms used the REBP to get rid of high-tenured and expensive older workers. Table 2 also illustrates that during the REBP there is a sizeable increase in unemployment inflow in TRs relative to CRs. The ratio of the number of unemployment spells in TRs versus CRs is approximately 1 to 4 before and after the REBP, which roughly reflects differences in the size of the labor force in TRs compared to CRs. This ratio increases to somewhat less than 1 to 3 during the REBP. In Section 5, we will examine the impact of the REBP on unemployment inflow in more detail.

Table 2

Descriptive Evidence. We start with a graphical assessment of the impact of extended UI benefits on early retirement behavior. Figure 3 plots the fraction of transitions from unemployment for three exit destinations: (i) any early retirement (Panel A), (ii) early retirement with DI (Panel B), and (iii) early retirement without DI (Panel C). The graphs report transitions by age at UI entry and region of residence before, during, and after the REBP. Panel A shows that both before and after the REBP transition rates into early retirement are quite similar in TRs and CRs for all entry ages. The transition rate peaks at age 58, which is the earliest age allowing for a permanent exit from the labor market through the UI system in the absence of the REBP (see Figure 2). During the REBP, the transition rate into early retirement between ages 50-57 is substantially higher in TRs, indicating that a significant portion of unemployed men uses the extended UI benefits to permanently exit the labor force. This is in line with evidence for the age group 58-59 where there are only small regional differences. Workers at these ages do no need to have access to the REBP to retire early but can use regular UI benefits and special income support.

Panel B of Figure 3 shows that the incidence of early retirement with DI 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 2 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 early retirement with DI among job losers in TRs starting their UI spell between ages 50-54, suggesting that extended UI benefits serve as a bridge to a DI pension for some unemployed men in this age group. This is evidence for program complementarity.[15] For the age group 55-57 in TRs, there is evidence for program substitution, as there is a non-negligible decline in early retirement with DI. Put differently, the REBP induces some unemployed men who would have claimed a DI pension in the absence of the REBP to stay unemployed until they become eligible for an old-age pension. This substitution away from DI pensions is also reflected in Panel C of Figure 3, which shows that the incidence of early retirement without DI (i.e., direct transitions from UI into old-age pensions) is significantly higher between ages 55-57 in TRs during the REBP period (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 to other industries violating the assumption underlying our empirical approach.

Figure 4 illustrates how transitions into early retirement, early retirement with DI, and early retirement without DI for the age groups 50-54 (Panel A) and 55-57 (Panel B) develop over time by region. Here, we pool all treated regions, but Figures B.1 and B.2 in the Online Appendix B show the effects separately for TR1s and TR2s. The first vertical line denotes the date when the REBP was implemented. The second and the third 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 1988, suggesting that the steel crisis had little impact on other industries in TRs. In the

[15] Notice that for a 50 year old the REBP-induced extension in the maximum duration of UI benefits is too short to bridge the gap until age 55. This individual can follow two strategies: (1) claim a DI pension under the strict eligibility rules at the end of the regular UI spell at age 54 or (2) claim a DI pension at age 55 under the relaxed eligibility rules and rely on one year of UA benefits to bridge the time between age 54 and age 55. We find that during the REBP 71% of 50 year old men in treated regions who retire early via the DI program follow strategy (2) and 29% follow strategy (1).

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, early retirement with DI, and (to a smaller extent) early retirement without DI increase in TRs relative to CRs. For the age group 55-57 there is a program substitution and a program complementarity effect; transitions into early retirement with DI decline and transitions into early retirement without DI 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.

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 maximum duration of UI benefits across Austrian regions generated by the REBP. Our identification strategy relies on a difference-in-differences (DiD) approach. The first difference is over time, because the program was in effect only from June 1988 to July 1993. Since 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 second difference is across geographic areas; only older job seekers living in one of the 28 selected regions were eligible for the benefit extension.

The DiD comparison is implemented by estimating regressions of the following type:

$$y_{it} = \alpha + \beta(A0_t \times TR_i) + \gamma(A1_t \times TR_i) + \lambda_t + \eta_i + X_{it}'\delta + \varepsilon_{it}, \qquad (1)$$

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 withdraws from the labor force after leaving unemployment through the early-retirement pathway of interest and 0 otherwise. We consider three early-retirement pathways: (i) early retirement, (ii) early retirement with DI, and (iii) early retirement without DI, where the latter two pathways are subsets of the first one. The variable TR is an indicator taking the value 1 if an individual lives in a treated region; $A0$ is an indicator taking the value 1 if the UI spell started after the REBP was introduced (June 1988 or later); and $A1$ is an indicator taking the value 1 if the UI 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 permanent region-specific differences, dummies for year-month of unemployment entry (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.[16] Remember that UI spells in progress at the time the REBP was implemented were also eligible for the extended UI benefits. This rule implies that UI spells that started less than 30 weeks (November 1987) before 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 are β and γ. These coefficients capture all variation in the outcome variable specific to older job losers in TRs (relative to CRs) in the years when the REBP was in effect (relative to before the REBP; β) and in the years after which the REBP was abolished (relative to during the REBP; γ). Clearly, if the introduction and abolishment of the REBP have symmetric effects, we have $\beta = -\gamma$. We test this hypothesis when presenting the main results and show that the policy effects are symmetric. Therefore, for all subsequent robustness and placebo tests we impose symmetry, which increases the statistical power. More specifically, we replace $(A0_t \times TR_i)$ and $(A1_t \times TR_i)$ with a single interaction term $(D_t \times TR_i)$ where D is an indicator taking the value 1 for UI spells that started during the REBP.

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 access to a DI pension are relaxed. Job losers in the age group 55-57 can directly apply for a DI pension under the relaxed eligibility criteria or, if eligible, they 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 of 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,

[16] Background characteristics are log previous wage, marital status, education, dummies for weeks of UI eligibility (20, 30, 39, 52 weeks), blue-collar status, work experience in last 13 years, years of service in last job, sick leave history, dummies for previous industry, age-in-year dummies, dummy for spells that start within 30 weeks before REBP introduction.

given that the motivation behind this policy was to provide a better protection to older unemployed in regions with a strong steel sector. Hence, 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 will run several robustness checks to test for this possibility.

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 2 provides some evidence that selection may occur: 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 machinery industry in their last job, have earned higher wages, and have more tenure than job losers in CRs. To ascertain that selective inflow does not affect our results, we identify a subsample of unemployed men whose layoff was likely exogenous and examine the impact of the REBP for this subsample of job losers.

5 The Effect of the REBP on Early Retirement

Main Results. Our main results are summarized in Table 3, with columns 1 through 3 providing the estimates of equation (1) for the age group 50-54 and the next three columns displaying the analogous results for the age group 55-57. The dependent variable is an indicator, which is equal to 1 if an individual exits unemployment through the particular state in question (any early retirement; early retirement with DI; early retirement without DI) and 0 otherwise.

Table 3

Consistent with the graphical evidence from Figure 3, the first row indicates that the REBP increased the probability of early retirement among 50-54 year old male job losers by 15.6 percentage points, or 62% of the baseline early retirement probability in the pre-REBP period. This increase is mostly driven by additional early retirements with DI (i.e., transitions from UI via DI to old-age pensions) which increased by 12 percentage points (column 2) and – to a lesser extent – by additional early retirements without DI (i.e., direct transitions from UI to old-age pensions) of 3.6 percentage points (column 3).[17] This is strong evidence for program complemen-

[17] We also explore the effects for 51-53 year old job losers separately, since, as discussed above, the REBP incentives are particularly strong for this age group. As expected, we find slightly larger

tarity: 50-54 years old unemployed men used extended UI benefits provided by the REBP to bridge the time until becoming eligible for a DI or an old-age pension. The third row shows that the effects on transitions from unemployment to the various exit states are completely reversed after the program is abolished. Compared to the introduction effect, the abolishment effect on the incidence of early retirement with (without) DI benefits is somewhat smaller (higher) in absolute value. However, as reported in the fifth row, F-tests for the null hypothesis that $\beta = -\gamma$ are insignificant at conventional levels of statistical significance, showing that the effects of the REBP introduction and abolishment are symmetric.

A main reason why extended UI benefits lead to complementarity with DI is relaxed DI access after age 55. Hence, early retirement with DI by 50-54 year old job losers in TRs should mainly be driven by an increased inflow into DI after age 55. To explore the impact of the REBP on the age at DI entry, we estimated two versions of equation (1) imposing the symmetry assumption $\beta = -\gamma$. In the first one, the dependent variable is a dummy indicating whether the 50-54 year old job loser enters DI before age 55; in the second version, the dependent variable indicates DI entry after age 55. Consistent with these incentives, the REBP had little impact on DI claiming before age 55, while there is a sizeable increase in DI claiming after age 55. The probability of DI entry after age 55 is 11.7 percentage points higher for job losers eligible to the REBP. (Results are shown in Table *A.1* of the Online Appendix A.)

Columns 4 to 6 of Table 3 present estimates of equation (1) for the age group 55-57. The first row shows that the introduction of the REBP led to an increase in transitions from unemployment into early retirement of 14.5 percentage points among the treated individuals aged 55-57. In this age group, there is clear evidence for both program substitution and program complementarity: in the years during the program there is a 9.5 percentage point decline in the probability to claim a DI pension (program substitution) and a 24 percentage point increase in the probability to claim an old-age pension (program complementarity). Similar to the age group 50-54, the effects are completely reversed after the abolishment of the program, as shown in the third row.

point estimates for this age group. More specifically, the REBP introduction led to a 17.5 percentage point increase in any early retirement, a 14.8 percentage point increase in early retirement with DI, and a 2.6 percentage point increase in early retirement without DI.

The strong substitution effect may be surprising given that UI benefits are smaller than DI benefits for most individuals. For example, among 55-57 year job losers UI benefits are smaller than DI benefits 83% of the time. However, this comparison ignores the fact that each additional year spent on UI benefits, UA benefits, or special income support counts as contribution year, increasing future old-age benefits by around 2%. Comparing the entire stream of benefits up to age 78 (the average life-expectancy of men during that time period), assuming an interest rate of 2.5%, reveals that for the age group 55-57 the pathway early retirement with DI is 52% of the time more generous than the pathway early retirement without DI. This number changes significantly during the REBP: early retirement with DI is only 21% of the time more generous than early retirement without DI, illustrating that using extended UI benefits as a bridge to an old-age pension is appealing.

Results by Age. To further explore the impact of the introduction and abolishment of the REBP, we estimate equation (1) for each age in the interval 45-59 separately. Figure 5 illustrates the results with dots on the solid black line showing the estimates of the interactions ($A0_t \times TR_i$) and the dots on the gray line showing the estimates for the interactions ($A1_t \times TR_i$). The 95% confidence interval is shown by dashed lines. As shown in the first graph, the probability to retire early does not change for workers younger than 50, but for workers between 50 and 57 the increase is significant during the REBP period, suggesting that there are sizeable program complementarity effects. The impact is fully reversed after the program is abolished, as illustrated by the gray line. At ages 58 and 59, when the REBP does not provide differential incentives, we do not see significant differences between eligible and non-eligible workers.

The black line in the second graph of Figure 5 shows that during the REBP there is a significant increase in early retirement with DI for UI entrants aged 50-53, with transitions to DI up to 15 percentage points higher among job losers eligible to the REBP. 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 early retirement with DI are negative, providing evidence for a program substitution effect. More specifically, with the introduction of the REBP, early retirement without DI became financially relatively more attractive than early retirement with DI. The estimated coefficient during the REBP is large and amounts up to 10 percentage points or more.

The third graph of Figure 5 shows the change in the incidence of early retirement without DI. This option is mainly attractive for workers aged 55-57 who could use the REBP to bridge the time until they become eligible for an old-age pension. For these ages, there is more than a 20 percentage point increase in the probability of early retirement without DI during the REBP period. There is also a significant increase in transitions into old-age pensions for 54 (and a slight increase for 53) year old job losers, even though these individuals needed to rely for some time on means-tested UA benefits to bridge the time until they could claim an old-age pension. At ages younger than 53, job losers eligible to the REBP do not exhibit a higher probability of early retirement without DI. The gray line in the third subfigure highlights that the REBP effects are reversed after the abolishment of the program.[18]

Figure 5

Strength of Incentives. We also test whether the size of the estimated REBP effects varies with the strength of incentives (with results shown in Table *A.2* of the Online Appendix A.) We estimate equation (1), assuming symmetric policy effects, and interact $(D_t \times TR_i)$ with an indicator for whether a job loser's predicted DI benefits are above the median in the distribution of predicted DI benefits. We find that REBP responses are stronger for individuals who face stronger incentives. Job losers aged 50-54 with predicted DI benefits above the median are substantially more likely to retire with DI than those with DI benefits below the median. Moreover, the probability of retirement without DI is unaffected by the level of DI benefits.

For job losers aged 55-57 with predicted DI benefits above the median we see a roughly 5 percentage point smaller REBP reduction on early retirement with DI (less program substitution) and also a 5 percentage points smaller increase in early retirement without DI (less program complementarity) than for those with predicted DI benefits below the median. A second exercise explores the idea that REBP incentives should be stronger for healthy workers compared to less healthy job losers who are likely to exit the labor market even without the REBP. We see

[18]For 59 year old job losers, there is a significant decrease (increase) in early retirement without DI (early retirement with DI) after the REBP is abolished. These significant estimates are based on a very small sample, as shown by the wide confidence interval.

indeed weaker REBP effects for less healthy job losers aged 55-57. However, we do not find such a pattern for job losers aged 50-54.

Placebo. In the next step, we run a number of placebo regressions, assuming that the effects of the REBP introduction and abolishment are symmetric (Table *4*). Recall that the criteria for REBP eligibility include (i) a minimum of 15 years of work experience (within the last 25 years) and (ii) age 50 or older. Moreover, the REBP did make a difference only during ages 50-57, while workers above age 57 did not face differential incentives. To check the validity of our empirical strategy, we ran placebo regressions for workers aged 50-57 with less than 15 years of work experience (rows 1 and 2); for workers aged 45-49 (row 3); and for workers aged 58-59 (row 4). Results reported in Table *4* show a consistent picture: living in a REBP region does not per se increase the incidence of early retirement. All point estimates are both small and statistically not different from zero (only for workers aged 55-57 with low experience we see more early retirement without DI, but the effect is relatively small). In sum, the placebo regressions strongly support the claim that REBP incentive effects drive observed early retirement patterns for workers aged 50-57.

Table 4

Women. Up to now, all results referred to male job losers. The reason for the focus on males is that many more males than females were affected by the REBP. This is due to old-age pension rules (see Section 2 above). The rules in place during the 1980s and 1990s allowed women to draw old-age pensions already at age 55 (provided they had contributed enough years to the public pension system). With minimum pension age at 55, the REBP created incentives for females job losers at ages 50-52, while females at ages 53-54 did not need the REBP to bridge the time to the eligibility age of an old-age pension (with one year on regular UI and another year on special income support).

In Table *5*, we explore the REBP effects for women. The left panel of the table presents estimates of $(D_t \times TR_i)$ for ages 50-52, while the right panel reports estimates for ages 53-54. In line with incentives, the REBP generates a very strong increase in early retirement for female job losers aged 50-52 (column 1), while the effect is nil for UI entrants aged 53-54 (column 4). The effect for the age group 50-52 is quantitatively very large with early retirement increasing by 28.6 percentage points. This is mainly due to program complementarity as early retirement without DI increases by 34.5 percentage points. There is also program substitution, a 6 percentage points lower probability that a female job loser takes up DI benefits after UI.

It is interesting to compare the effects for females aged 50-52 to those of males aged 55-57 (see Table *3*, right panel) because these two groups face very similar REBP incentives and because both groups had a similar probability to retire early – slightly above 50% – before the REBP. It turns out that the impact of the REBP on early retirement is about twice as large for females aged 50-52 than for males aged 55-57 which is driven by substantially larger program complementarity. Interestingly, the program substitution effect is substantially smaller for females aged 50-52 than for males aged 55-57. The reason for this latter effect is that job losers aged 55-57 have immediate access to relaxed DI, while job losers aged 50-52 do not. We conclude that female job losers react much more strongly to the REBP than male job losers. This pattern is consistent with existing evidence that women exhibit higher labor supply elasticities than men; a result often explained by females' higher productivity in the household and higher opportunity costs of market work.

Table 5

Other Labor Supply Measures. Our main results focus on the extensive margin of lifetime labor supply, i.e. the incidence of early retirement and its channels (with and without DI take-up). However, we also explore how other outcomes of male job losers are affected by the REBP (results are shown in Table *A.3* of the Online Appendix A assuming symmetric policy effects). We find that the REBP decreased take-up of means-tested UA benefits, particularly among job losers aged 55-57. Moreover, restricting the sample to the first UI spell per individual to avoid double-counting, we find that the REBP reduced the number of years worked until age 65 by 0.723 years for ages 50-54 and by 0.363 years for ages 55-57, reduced cumulative future earnings until age 65 by 15,728 Euros for ages 50-54 and by 8,570 Euros for ages 55-57, and delayed the claiming age of a (DI or old-age) pension by 0.293 years for ages 50-54 and by 0.59 years for ages 55-57.

Differential Trends. The key assumption of our DiD 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, we generalize equation (2) by replacing $(D_t \times TR_i)$ with a set of treatment times year interaction terms for the period 1980 to 1998 (baseline year is 1987):

$$y_{it} \quad = \quad \alpha + \sum_{j=1980\backslash 1987}^{1998} \pi_j (d_{jt} \times TR_i) + \lambda_t + \eta_i + X'_{it}\delta + \varepsilon_{it}, \tag{2}$$

where d_{jt} is a dummy that equals 1 if the unemployment spell starts in year j and 0 otherwise. Here, we set TR equal to 0 in TR1s after the reform of the REBP in December 1991. Figure 6 plots the estimated coefficients of the interaction terms for age groups 50-54 and 55-57 (the 95% confidence interval is shown by dashed lines). The patterns are similar if we estimate equation (2) for TR1s and TR2s separately, as illustrated in Figures B.3 and B.4 in the Online Appendix B. In all six panels the estimated coefficients fluctuate around 0 before the introduction of the REBP (June 1988) and after its complete abolishment (August 1993), providing evidence that the empirical strategy is not simply picking up long-run trends in differences between TRs and CRs.

As shown in the top left and bottom left panels of Figure *6*, the coefficients for early retirement turn significantly positive during the REBP. For the age group 50-54 the effect first increases and then drops sharply 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 early retirement with DI (top middle panel) and, to a lesser extent, by early retirement without DI (top right panel). The bottom middle and the bottom right panel indicate that for the age group 55-57 there is a decline in early retirement with DI and a large increase in transitions in early retirement without DI.

Figure 6

Robustness. Table *6* presents the DiD coefficients of equation (1) (using the symmetry assumption $\beta = -\gamma$) for alternative samples of male job losers aged 50-54 (Panel A) and 55-57 (Panel B). The first row in each panel displays the results of our baseline sample for comparison. Our sample includes multiple observations for individuals with multiple UI spells over the observation period (1985-1995) and in a first robustness test we only include the first UI spell per individual. It turns out that disregarding multiple spells leads to almost identical REBP effects for both age groups. The third row in each panel shows the DiD estimate when we include steel workers. Our baseline sample excluded steel workers to rule out policy endogeneity (as the program was mainly designed to mitigate hardships of workers from the steel industry). However, adding steel workers to the sample leads to almost identical or only slightly higher coefficients. In the fourth row, we add recalls (job losers whose last two jobs were with the same employer). Adding recalls to the sample does indeed reduce the DiD coefficients substantially. This is not really surprising as previously recalled workers are likely to return to their previous employer (rather than retire early), both in treated and control regions. As a result, the REBP effects are driven by non-recalls and much weaker for recalls.

Table 6

One potentially important confounding factor of our analysis are unobserved differences in labor market conditions between treated and control regions. To check the robustness of our results, we compare subsamples among treated and control regions that have arguably more similar labor market conditions. In row 5 of each panel in Table *6* we only include job losers living within 30 minutes driving distance to the border between treated and control regions. A comparison of eligible and non-eligible workers in this reduced sample is unlikely driven by labor market conditions which should be quite similar within this tightly defined geographical area. It turns out that the point estimates are only slightly smaller, suggesting that our main results are unlikely biased by unobserved labor demand factors. In row 6 of Table *6* we replicate our findings for job losers from the tradable-goods sector, excluding the sector "manufacturing of iron and steel products" (due to the close link of this sector to the steel industry). The idea is that labor demand prospects in these sectors are less dependent on local economic conditions and inter-sectoral linkages. 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. It turns out that the estimates are very similar to the baseline estimates. Another concern is that the linear specification in equation (1) may be too restrictive to capture the influence of covariates. To allow for more flexibility, we use a matching DiD approach following Blundell et al. (2004). As row 7 of each panel shows, this approach yields estimates that are very similar to the baseline estimates. Overall, the robustness checks of Table *6* show that our baseline effects are very robust.

Unemployment Inflow. We now examine the impact of the REBP on unemployment inflow. This is potentially important because the REBP might have induced responses by firms and workers resulting in a higher unemployment inflow. 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.

We start by constructing a sample of male workers over the period 1985 to 1995 who are 50-57 years old and who are employed at the beginning of a quarter. The sample comprises 3,707,735 person-quarter observations of 291,095 men.[19] Figure 7 plots the difference in the quarterly unemployment inflow in percent of employment between TRs and CRs.[20] For both age groups there are no particular regional differences in inflow rates before the first quarter of 1988. For the age group 55-57 the difference in UI inflow rates begins to increase when the REBP was introduced, while regional UI inflow rates are unchanged for the age group 50-54. However, for both age groups the difference in inflow rates exhibits a large peak in the last quarter of 1991, which corresponds to the period immediately before the REBP was reformed. This reform was announced in November 1991 and became effective in January 1992. Similarly, the difference in inflow rates also increases in the three quarters before the complete abolishment of the REBP, which was announced June 1993 and became effective August 1993. In the after-REBP period inflow rates are slightly lower in TRs compared to CRs, particularly for the age group 55-57. 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

[19] Consistent with the sample restrictions for the unemployment sample, we focus on non-steel workers with a continuous employment history (at least 15 years in the past 25 years) who are not recalled by their previous employer.

[20] Figures B.5 and B.6 in the Online Appendix B report differences in the quarterly unemployment inflow rate separately for TR1s and TR2s. In TR1s, there are strong seasonal fluctuations in the unemployment inflow rate that are not driven by recalls. The seasonality is not visible in the pooled Figure 7 because the size of the labor force in TR1s is much smaller compared to TR2s.

are still generous.

Figure 7

To quantify the impact of the REBP on UI inflow rates, Table 7 presents OLS estimates of equation (1) for different subgroups. In each case the outcome variable is a dummy equal to 1 if a worker starts a UI benefit claim in a given quarter and 0 otherwise. Result for the age group 50-54 (column 1) show a positive (though not statistically significant) point estimate after the REBP was introduced and a significantly negative reduction after the REBP was abolished. For workers aged 55-57 the effects are higher and significant both after introduction and after abolishment. Since UI inflow in TRs started to increase in the last quarter of 1991, columns 2 and 5 report estimates if we exclude UI spells that started in October 1991 or after. In this case, the inflow effect 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 above the 90^{th} percentile in the tenure or wage distribution or who previously worked in the machinery industry. This finding is consistent with Table 2 which shows that excess UI inflow in TRs is concentrated in the machinery industry and among high-wage earners with high tenure. Based on these results, it is reasonable to assume that prior to October 1991 layoffs of workers below the 90^{th} percentile in the tenure and wage distribution whose last job was not in the machinery industry are exogenous and not determined by the REBP.

Table 7

Panel A of Table 8 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 90^{th} percentile in the tenure or wage distribution. The coefficients in 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 early retirement and early retirement with DI are somewhat smaller if we also exclude high-tenure and high-wage individuals and job losers from the machinery industry (columns 1-3 of panel B), but they are still sizeable in magnitude and statistically significant. As columns 4-6 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 3. Excluding also high-wage and high-tenure workers and workers from the machinery industry from the sample 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 8

6 Fiscal Costs and Welfare Implications

This section discusses the fiscal costs of the REBP for taxpayers and the associated welfare implications of REBP. Baily (1978) and Chetty (2006a) discuss socially optimal insurance as a trade-off between moral hazard costs and the benefits of better insurance. In the basic Baily-Chetty framework, moral hazard costs are captured by the elasticity of benefit duration with respect to the level of UI benefits. In our context, the fiscal costs consist of all costs to taxpayers that are associated with program-complementarity and program-substitution responses. Hence, we proceed by directly estimating the fiscal costs of extended UI benefits. We then use these estimates as sufficient statistics to address the welfare implications of the REBP. In the Online Appendix C we propose a simple model which makes explicit the relationship between the estimated fiscal costs and the behavioral responses due to program substitution and program complementarity.

Estimating the Fiscal Costs of the REBP. Our empirical analysis so far has studied the behavioral responses of the REBP on early retirement and its pathways. We now look at the costs to taxpayers associated with these responses. To estimate overall costs, we need to adopt a forward-looking perspective. Consider a group of 50-54 year old job losers eligible to the REBP. According to the main results of Table 3 a larger fraction of workers in this group will take up early retirement with DI. Additional fiscal costs do not only arise because eligible workers claim regular UI benefits longer, but also because they spend more time on DI, and less time in employment. This implies higher UI and DI payments and lower tax revenues. The REBP may also reduce UA payments (which would have to be paid to the long-term unemployed in the absence of the REBP), and lower old-age benefits (because earlier retirement is associated with lower old-age pensions).

In Table 9 we re-estimate equation (1) using the various components of fiscal costs as a dependent variable (measured in 2014 Euros). Fiscal costs are calculated on an individual basis, given the job loser's observed earnings history (which determines the benefits in the various programs) and the chosen retirement path (which determines the present value associated with each benefit flow). The coefficient of column (A) estimates additional costs to the UI program of 9,227 Euro per worker aged 50-54 eligible to the REBP. The total costs are reduced due to lower payments for UA (column B), but somewhat enhanced by additional costs to the DI program (C). Furthermore, the government needs to spend less on old age pensions (D) but has substantial foregone tax revenues (E). The estimated fiscal costs amount to 13,109 Euros per worker aged 50-54 eligible to the REBP.[21]

Panel B of Table 9 reports the corresponding results for job losers aged 55-57. Since many eligible workers stay on UI until they reach the regular retirement age, there is a huge increase in regular UI benefits. Also in this age group UA payments are lower. Moreover, there are substantially less expenditures on DI though the government spends more money on old-age pensions (D) due to higher old-age benefits (time in UI increases the old-age pension, while time on DI does not). Furthermore, the government loses tax revenue resulting from reduced work incentives. In sum, the estimated fiscal costs amount to 9,465 Euros per worker aged 55-57 eligible to the REBP.

Table 9

Was the REBP Too Generous? We can now address the question whether the REBP was socially optimal in the context of the familiar Baily-Chetty framework. In this approach, the government sets UI parameters to maximize social welfare subject

[21] The variables UI benefits, UA benefits, DI benefits, and payroll taxes measure the total amount of regular UI benefits (including special income support) received, UA benefits received, DI benefits received, and payroll taxes paid until age 65 because after age 65 almost all individuals receive a public pension. For example, for somebody who never claims UA benefits until age 65 we set UA benefits to zero. The variable old-age benefits measures the total amount of old-age benefits received until age 78 (the average life-expectancy of men during that time period). We assume a real interest rate of 2.5% to discount future payment streams. In the spirit of the model presented in the Online Appendix C, we also estimate the financial implications of the REBP in terms of costs per pathway, i.e. return-to-work, early retirement with DI, and early retirement without DI. The results of this specification are shown in Table 9 of the Online Appendix A.

to the constraint that the costs associated with the program have to be financed by taxes paid by employed workers. In our context this means that the government has to take into account that expenditures on UI, DI, and old-age pensions have to be financed by taxes τ paid by the working population.[22]Assuming that individuals do not save, the formula for optimal UI by Baily (1978) and Chetty (2006a) can be written as

$$\frac{u'(b) - u'(w-\tau)}{u'(w-\tau)} = \frac{\mathcal{C}_T}{\mathcal{C}_M} - 1, \tag{3}$$

where $\mathcal{C}_T$ denotes the increase in total net expenditures due to a marginal increase in UI benefits, while $\mathcal{C}_M$ captures the additional costs due to the mechanical effect only (i.e., the hypothetical costs without behavioral responses). The l.h.s. of formula (3) captures the marginal benefit of consumption smoothing while the r.h.s. quantifies the costs associated with distorted labor supply and early retirement choices.

We use the estimates in Table 9 to calculate the increase in total net expenditures $\mathcal{C}_T$. More specifically, $\mathcal{C}_T$ corresponds to the weighted average of the increase in total net expenditures within each age group, using relative sample size as weights (0.72 for age group 50-54 and 0.28 for age group 55-57). This yields an increase in total net expenditures of $\mathcal{C}_T = 12,089$ Euros per 50+ worker eligible for the REBP. To calculate the increase in mechanical costs $\mathcal{C}_M$, we take the labor supply of the control group as a counterfactual for the treatment group in the absence of behavioral responses and calculate the difference in net expenditures with and without the REBP.[23] This procedure yields mechanical costs of 2,073 Euros per unemployed worker in the age group 50-54 and 786 Euros per unemployed worker in the age group 55-57, with a weighted average of 1,713 Euros. The r.h.s. of formula (3) then equals $\mathcal{C}_T/\mathcal{C}_M - 1 = 12,089/1,713 - 1 = 6.06$.

To derive an estimate of the insurance value provided by the REBP, we need to make an assumption on the utility function in equation (3). Assuming CRRA utility $u(c) = c^{1-\gamma}/(1-\gamma)$, the l.h.s. of equation (3) becomes $RR^{-\gamma} - 1$ where γ is the relative risk aversion and $RR = b/(w-\tau)$ denotes the net replacement

[22]In our model, we take into account that only old but not young individuals are eligible to the program. This is captured by the simplifying assumption that there is a period where individuals are young, do pay taxes, but do not face an unemployment risk.

[23]More specifically, we first calculate the number of years unemployed men in CRs spend in UA until age 65 and then multiply this number with 30% of annual UI benefits (future benefits are discounted with an interest rate of 2.5%). The idea behind this calculation is that with the introduction of the REBP UA benefits, which amounts to 70% of UI benefits, are replaced with regular UI benefits.

rate of UI benefits in terms of after tax income.[24] Notice that RR captures the replacement rate over a five-year interval, implying $RR = 0.42$ without the REBP.[25] The preceding calibration allows us to calculate a hypothetical risk aversion level γ^h that satisfies the local optimality condition

$$\gamma^h = -\ln(\mathcal{C}_T/\mathcal{C}_M)/\ln RR = -\ln(7.06)/\ln 0.42 = 2.25. \tag{4}$$

Despite its importance the value of relative risk aversion remains disputed. In particular, previous studies find 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 well above this range ($\gamma = 2.25$), we conclude that providing increased UI generosity through the REBP was a suboptimal policy.

Further Welfare Implications. Our result that the REBP was a suboptimal policy holds under specific assumptions. It is useful to ask whether these assumptions indeed hold. First, our calculation has assumed that workers do not save. When workers can save and have liquid assets, they are at least partly insured against reductions in consumption during unemployment, as consumption during unemployment $c^u > b$ and consumption during employment $c^e < w - \tau$. In that case, the l.h.s. of equation (3) would become lower. In other words, the implied hypothetical risk aversion, γ^h, needed to justify the costs of increased UI generosity, would be even larger than 2.25. In sum, allowing for savings and self-insurance would reinforce the conclusion that the REBP was suboptimal.

Second, our calculation has assumed that the REBP affects the early retirement margin and its particular pathways but does not have any further effects on labor market outcomes. This assumption is problematic because we have documented in

[24] With CRRA utility, the marginal utility gains from UI benefits and after-tax income are $u'(b) = b^{-\gamma}$ and $u'(w-\tau) = (w-\tau)^{-\gamma}$, respectively. Hence, the l.h.s. of (3) becomes $b^{-\gamma}/(w-\tau)^{-\gamma} - 1$ or $RR^{-\gamma} - 1$.

[25] Our calibration intends to represent Austrian UI rules around 1990 with 1/5 UI benefits and 4/5 UA benefits without the REBP and 4/5 UI benefits and 1/5 UA benefits with the REBP. We assume a net replacement rate of UI benefits of 55% and a net replacement rate of UA benefits of 38.5%, or 70% of UI benefits. Hence, the five-year net replacement rate of UI benefits without the REBP is $RR = 1/4 * 0.55 + 4/5 * 0.385 = 0.42$.

Section 5 that the REBP increased the unemployment inflow significantly. This could be the result of firm decisions (firms find it easier to get rid of older workers) or by worker decisions (workers have an incentive to exploit more generous UI to withdraw early from the labor market). Both responses by firms and responses by workers increase the total expenditures of the program. With a higher r.h.s of equation, γ^h needs to increase in order to justify the higher costs.[26] Hence, accounting for inflow effects reinforces the conclusion that the REBP was suboptimal.

A third caveat of the above welfare considerations concerns general equilibrium effects. Notice that the direction of macro responses is not a priori clear. More generous UI could further increase unemployment through wage externalities (workers have better outside opportunities) or mitigate it through positive search externalities (non-eligible workers find jobs more easily).[27] Using the REBP, Lalive et al. (2013) find indeed shorter unemployment durations among non-eligible workers in treated regions (compared to similar workers in control regions) and interpret this finding as evidence for search externalities.[28] Moreover, they argue that comparing eligible workers in treated regions to similar workers in control regions is informative on the macro effect of extended UI. To the extent that macro effects are captured by comparisons of local labor markets with different UI generosity, our welfare analysis incorporates general equilibrium effects. In that case, our conclusion that REBP was suboptimal remains unchanged.

Based on our analysis of program complementarity and program substitution, we think that labor market policies for older workers should address two different issues. First, it is very important to tightly integrate the UI benefit rules with DI benefit and pension rules to provide better work incentives and to avoid expensive program complementarity effects (Hairault et al., 2012). Moreover, UI and DI benefit rules should be aligned to old-age pension rules in pension reforms. This is of particular

[26]In the Online Appendix D we allow for responses along the job separation margin and show that our risk aversion estimate is very likely to be a lower bound.

[27]Landais et al. (2014) show that UI should be more generous when there are positive search externalities (provided that labor market tightness is below its efficient level and the Hosios (1990) condition is violated). Empirical evidence shows that the difference between micro and macro elasticity is positive and countercyclical, hence Landais et al. (2014) conclude that optimal UI should also be countercyclical.

[28]In contrast, our placebo regressions of Table *4* show that non-eligible workers in treated regions do not have a lower incidence of early retirement than comparable workers in control regions. This suggests that the REBP affects non-eligible workers who remain in the labor force but does not affect non-eligible workers who drop out of the labor force. This latter result is consistent with the argument that search externalities are driving the behavior of non-eligible workers.

importance because the explicit goal of pension reforms is to increase the effective retirement age of older workers. Second, policies should think more carefully about the incentive for firms to hire older workers (and also make sure that employers do not have incentives to fire older workers). A policy mix that combines work incentives in UI and DI benefit rules with policies that encourages firms to retain (and train) older workers and discourages firms to fire older workers (through firing taxes) is needed to keep the labor force participation among older workers high (Chéron et al., 2011). To the extent that this policy mix keeps unemployment inflow and durations low, moral hazard costs will be low and UI benefits can provide older workers with a sufficiently high level of insurance against the risk of unemployment.

7 Conclusion

In this paper, we study how extending the maximum duration of 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 program 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 a job loser aged 50-54 (55-57) retires early is 15.6 (14.5) percentage points higher among individuals eligible to the REBP. For job losers aged 50-54, this effect is mainly driven by early retirement with DI: a combination of take-up of extended UI benefits with higher future take-up of DI benefits (program complementarity). Of the 15.6 percentage point increase in early retirement, 12 percentage points are due to an increase in UI take-up followed by DI take-up in the future. For job losers aged 55-57, there is a strong increase in early retirement without DI, while the incidence of early retirement with DI decreases. The former result is due to program complementarity: permanent exit from the labor force by combining extended UI benefits with retirement benefits; the latter result is due to program substitution: take-up of extended UI instead of DI. The 14.5 percentage point increase in early retirement consists of a 24 point increase in the percentage staying on UI before claiming an old-age pension; and a 9.5 point reduction in the percentage claiming a DI pension.

Our empirical estimates help to explore whether extending UI benefits for older workers was a socially optimal policy. We estimate the costs to the government associated with extended UI benefits and derive a formula in the 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 2.25. This estimate is higher than most previous estimates that use labor supply elasticities to identify risk aversion (Chetty, 2006b). We argue that unemployment inflow and general equilibrium effects, which are not taken into account in our formula, are unlikely to overturn this result. We therefore conclude that the REBP was a suboptimal policy.

From a policy perspective, our study suggests that policy reforms aiming at increasing the effective retirement age should take particular care to carefully consider the entire set of welfare programs that impact 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 is the most promising route for policy reforms.

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Table 1: Average annual expenditures on and enrollment in different programs among 50-59 year old men between 1985 and 1995

	UI system			DI program
	UI benefits	UA benefits	Special income support	
Enrollment (in %)	4.6	1.4	2.9	15.6
Spending (in million Euros)	119.9	34.4	119.3	458.6

Source: Own calculations, based on Austrian Social Security Data. All Euro amounts are in 2014 Euros.

Table 2: 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
A. Exit state (%)						
Employment	70.7	65.4	60.6	31.7	54.8	48.2
Early retirement	27.6	32.6	37.4	65.8	43.2	49.5
Early retirement with DI	20.5	24.6	27.5	41.8	30.9	38.2
Early retirement without DI	7.1	8.0	9.9	24.0	12.2	11.3
Censored	1.7	2.0	2.1	2.5	2.0	2.3
B. Background characteristics						
Age at UI entry (years)	53.6	53.5	53.3	53.6	53.6	53.5
Sick days	101.6	92.2	107.9	87.2	93.7	97.2
Married (%)	72.4	74.6	75.1	80.7	75.6	76.9
Daily wage (Euros)	61.1	59.3	68.3	74.2	74.3	73.7
Blue collar (%)	82.6	85.8	74.4	75.2	67.5	72.1
Experience (years)	11.5	11.7	11.2	11.8	11.3	11.3
Tenure (years)	3.5	4.1	3.7	5.1	4.2	4.4
Education						
Low (%)	53.6	57.2	49.4	48.4	42.7	45.6
Medium (%)	33.1	32.4	39.3	42.6	43.9	44.4
High (%)	5.6	3.1	9.2	7.5	12.0	9.5
Industry						
Agriculture (%)	7.1	10.0	6.2	6.6	6.2	5.8
Wholesale and retail trade (%)	13.6	13.0	18.0	14.0	19.8	17.2
Manufacturing (%)	11.1	15.6	11.7	19.0	11.5	16.3
Machinery (%)	5.4	7.4	6.6	22.8	7.0	12.0
Construction (%)	44.2	41.7	34.3	24.4	30.3	30.5
Services (%)	18.7	12.3	23.2	13.2	25.0	18.2
No. of observations	16,107	4,034	27,964	9,764	19,250	4,518

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. Different education categories do not sum to one as education is missing in some cases.

Table 3: Effect on unemployment exit of men in the age groups 50-54 and 55-57

	Age 50-54			Age 55-57		
	Early retirement	Early retirement with DI	Early retirement without DI	Early retirement	Early retirement with DI	Early retirement without DI
REBP introduced	0.156***	0.120***	0.036**	0.145***	-0.095***	0.240***
($A0 \times TR$)	(0.016)	(0.021)	(0.017)	(0.023)	(0.031)	(0.034)
REBP abolished	-0.145***	-0.094***	-0.051***	-0.125***	0.104***	-0.229***
($A1 \times TR$)	(0.015)	(0.018)	(0.009)	(0.018)	(0.021)	(0.024)
p-value of F-test	0.444	0.081	0.209	0.368	0.787	0.734
Mean TRs pre-REBP	0.252	0.217	0.035	0.505	0.315	0.190
R^2	0.200	0.172	0.091	0.255	0.137	0.321
No. of observations	58,343	58,343	58,343	23,294	23,294	23,294

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Control variables: log previous wage, dummies for marital status, dummies for education, dummies for weeks of UI eligibility (20, 30, 39, 52 weeks), blue-collar status at last job, work experience in last 13 years, years of service 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-month of unemployment entry, dummy for spells that start within 30 weeks before REBP introduction, and dummies for labor market districts. F-test tests null hypothesis that the coefficients on REBP introduced and REBP abolished are jointly equal to zero. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 4: Effect on unemployment exit of men, placebo tests

	Early retirement	Early retirement with DI	Early retirement without DI	No. of observations
< 15 employment years, age 50-54	0.011	0.001	0.009	18,393
	(0.018)	(0.015)	(0.013)	
< 15 employment years, age 55-57	0.033	-0.010	0.044**	5,856
	(0.042)	(0.044)	(0.021)	
Age group 45-49	0.004	0.005	-0.000	74,530
	(0.008)	(0.007)	(0.002)	
Age group 58-59	0.001	-0.022	0.023	13,706
	(0.012)	(0.015)	(0.017)	

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Control variables: log previous wage, dummies for marital status, dummies for education, dummies for weeks of UI eligibility (20, 30, 39, 52 weeks), blue-collar status at last job, work experience in last 13 years, years of service 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-month of unemployment entry, dummy for spells that start within 30 weeks before REBP introduction, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 5: Effect on unemployment exit of women in the age groups 50-52 and 53-54

	Age 50-52			Age 53-54		
	Early retirement	Early retirement with DI	Early retirement without DI	Early retirement	Early retirement with DI	Early retirement without DI
During REBP	0.286***	-0.060***	0.346***	0.003	-0.011	0.014
($D \times TR$)	(0.018)	(0.010)	(0.018)	(0.011)	(0.007)	(0.014)
Mean TRs pre-REBP	0.514	0.073	0.441	0.932	0.018	0.914
R^2	0.265	0.072	0.302	0.203	0.077	0.233
No. of observations	24,049	24,049	24,049	17,854	17,854	17,854

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Control variables: log previous wage, dummies for marital status, dummies for education, dummies for weeks of UI eligibility (20, 30, 39, 52 weeks), blue-collar status at last job, work experience in last 13 years, years of service 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-month of unemployment entry, dummy for spells that start within 30 weeks before REBP introduction, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 6: Effect on unemployment exit of men, robustness checks

	Early retirement	Early retirement with DI	Early retirement without DI	No. of observations
A. Age 50-54				
Main results	0.149***	0.103***	0.046***	58,343
	(0.014)	(0.018)	(0.011)	
Only one spell	0.157***	0.116***	0.041***	42,899
	(0.014)	(0.019)	(0.011)	
With steel workers	0.163***	0.102***	0.061***	67,778
	(0.019)	(0.021)	(0.013)	
With recalls	0.093***	0.068***	0.025***	115,896
	(0.012)	(0.013)	(0.007)	
30 min driving distance to border	0.132***	0.075***	0.056***	14,393
	(0.021)	(0.024)	(0.013)	
Only tradable goods	0.156***	0.114***	0.042***	27,630
	(0.019)	(0.022)	(0.011)	
Propensity score matching	0.148***	0.107***	0.041***	58,343
	(0.012)	(0.012)	(0.007)	
B. Age 55-57				
Main results	0.132***	-0.101***	0.233***	23,294
	(0.017)	(0.018)	(0.024)	
Only one spell	0.137***	-0.110***	0.247***	15,175
	(0.018)	(0.024)	(0.032)	
With steel workers	0.140***	-0.120***	0.260***	27,400
	(0.015)	(0.017)	(0.023)	
With recalls	0.116***	-0.035***	0.151***	46,226
	(0.016)	(0.013)	(0.020)	
30 min driving distance to border	0.111***	-0.102***	0.213***	6,028
	(0.024)	(0.024)	(0.026)	
Only tradable goods	0.129***	-0.121***	0.250***	11,362
	(0.020)	(0.027)	(0.029)	
Propensity score matching	0.114***	-0.111***	0.226***	23,294
	(0.016)	(0.022)	(0.020)	

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Control variables: log previous wage, dummies for marital status, dummies for education, dummies for weeks of UI eligibility (20, 30, 39, 52 weeks), blue-collar status at last job, work experience in last 13 years, years of service 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-month of unemployment entry, dummy for spells that start within 30 weeks before REBP introduction, and dummies for labor market districts. For the propensity score matching we follow Blundell et al. (2004) and match on two propensity scores to estimate the effects of the REBP. These propensity scores balance the distribution of observable characteristics in the treated and non-treated regions before/after and during the REBP. We estimate the propensity score with a probit model and use radius matching with a radius of 0.02. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 7: Effects of REBP on unemployment entry for men in the age groups 50-54 and 55-57

	Age 50-54			Age 55-57		
	Full sample	Pre 10/91	Pre 10/91 low tenure/wage excl. machinery industry	Full sample	Pre 10/91	Pre 10/91 low tenure/wage excl. machinery industry
REBP introduced	0.001	-0.002	-0.003	0.006***	0.004**	0.002
($A0 \times TR$)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
REBP abolished	-0.005***			-0.010***		
($A1 \times TR$)	(0.001)			(0.002)		
p-value of F-test	0.005			0.001		
Mean TRs pre-REBP	0.024	0.024	0.024	0.020	0.021	0.021
R^2	0.079	0.081	0.090	0.083	0.085	0.096
No. of observations	3,707,735	2,040,874	1,649,450	1,509,371	936,780	762,889
No. of individuals	291,095	206,024	181,019	193,299	125,595	109,663

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Control variables: log wage, dummies for weeks of UI eligibility (20, 30, 39, 52 weeks), blue-collar status, work experience in last 13 years, years of service current job, number of days receiving sick leave past two years, dummies for industry, age-in-year dummies, year-quarter dummies, and dummies for labor market districts. F-test tests null hypothesis that the coefficients on REBP introduced and REBP abolished are jointly equal to zero. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 8: Effects for unemployed entering before 10/1991

	Age 50-54			Age 55-57		
	Early retirement	Early retirement with DI	Early retirement without DI	Early retirement	Early retirement with DI	Early retirement without DI
A. Inflow prior to 10/1991						
During REBP	0.137***	0.104***	0.033***	0.145***	-0.129***	0.274***
$(D \times TR)$	(0.017)	(0.018)	(0.012)	(0.025)	(0.032)	(0.033)
Mean TRs pre-REBP	0.252	0.217	0.035	0.505	0.315	0.190
R^2	0.188	0.165	0.080	0.281	0.151	0.358
No. of observations	28,528	28,528	28,528	12,040	12,040	12,040
B. tenure/wage below 90^{th} percentile, excl. machinery industry						
REBP introduced	0.112***	0.079***	0.033***	0.139***	-0.115***	0.254***
$(D \times TR)$	(0.017)	(0.017)	(0.011)	(0.027)	(0.027)	(0.032)
Mean TRs pre-REBP	0.229	0.201	0.028	0.456	0.297	0.159
R^2	0.173	0.151	0.079	0.264	0.162	0.353
No. of observations	22,582	22,582	22,582	9,604	9,604	9,604

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Control variables: log previous wage, dummies for marital status, dummies for education, dummies for weeks of UI eligibility (20, 30, 39, 52 weeks), blue-collar status at last job, work experience in last 13 years, years of service 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-month of unemployment entry, dummy for spells that start within 30 weeks before REBP introduction, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table 9: Effects on program costs and payroll taxes for unemployed men in the age groups 50-54 and 55-57

	UI benefits (A)	UA benefits (B)	DI benefits (C)	Old-age benefits (D)	Payroll taxes (E)	Net expenditures (A+B+C+D-E)
A. Age 50-54						
During REBP	9,227***	-1,405***	1,035	-939	-5,190***	13,109***
$(D \times TR)$	(697)	(303)	(1,742)	(1,317)	(899)	(2,243)
Mean TRs pre-REBP	13,611	1,984	38,981	93,361	18,763	129,175
R^2	0.278	0.210	0.159	0.251	0.215	0.241
No. of observations	42,899	42,899	42,899	42,899	42,899	42,899
B. Age 55-57						
During REBP	13,019***	-1,759***	-11,653***	7,029**	-2,828***	9,465***
$(D \times TR)$	(1,166)	(315)	(2,140)	(2,831)	(483)	(2,676)
Mean TRs pre-REBP	11,152	1,189	32,063	126,619	6,997	164,025
R^2	0.465	0.214	0.187	0.397	0.185	0.417
No. of observations	15,175	15,175	15,175	15,175	15,175	15,175

Notes: The variables UI benefits, UA benefits, DI benefits, and payroll taxes measure the total amount of UI benefits received, UA benefits received, DI benefits received, and payroll taxes paid until age 65. The variable old-age benefits measures the total amount of old-age benefits received until age 78 (the average life-expectancy of men during that time period). All amounts are in 2014 Euros. We assume a real interest rate of 2.5% to discount future payment streams. Standard errors adjusted for clustering within labor market districts. Controls: log previous wage, dummies for marital status, dummies for education, dummies for weeks of UI eligibility (20, 30, 39, 52 weeks), blue-collar status at last job, work experience in last 13 years, years of service 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-month of unemployment entry, dummy for spells that start within 30 weeks before REBP introduction, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

Figure 1: Regional distribution of REBP eligibility

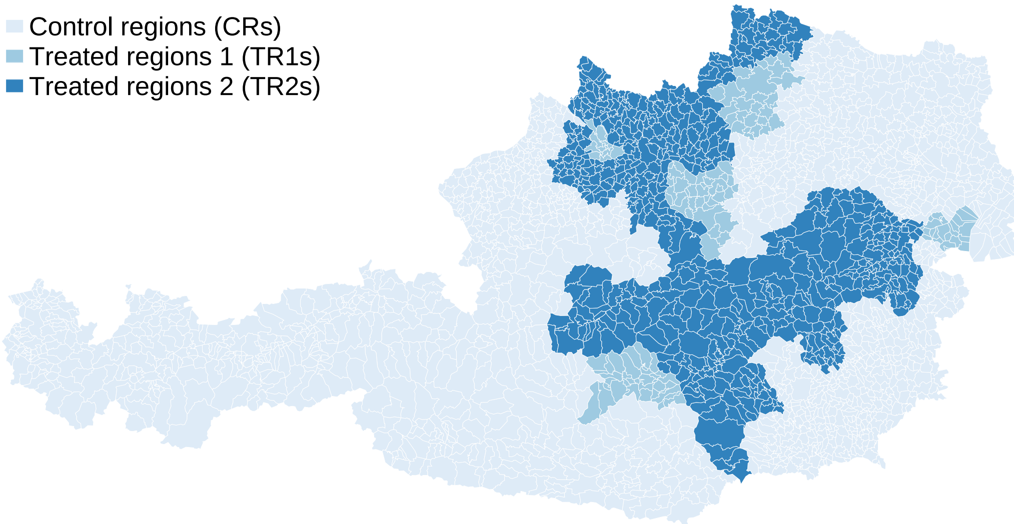
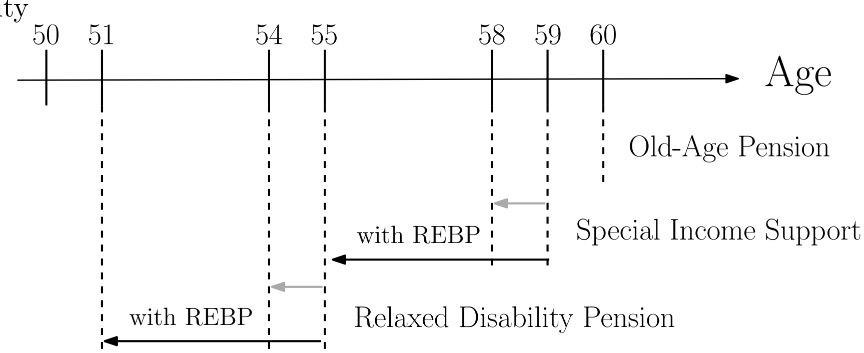


Figure 2: Early retirement pathways for unemployed men with/without REBP-eligibility



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 retire early with DI at age 54 without the REBP and age 51 with the REBP by claiming regular UI benefits followed by a DI pension at age 55 (=early retirement with DI). Unemployed men can retire early without DI at age 58 without the REBP and age 55 with the REBP by claiming regular UI benefits followed by special income support at age 59 and an old-age pension at age 60 (=early retirement without DI).

Figure 3: Transitions into early retirement (Panel A), early retirement with DI (Panel B), and early retirement without DI (Panel C) by age in TRs and CRs before, during, and after REBP.

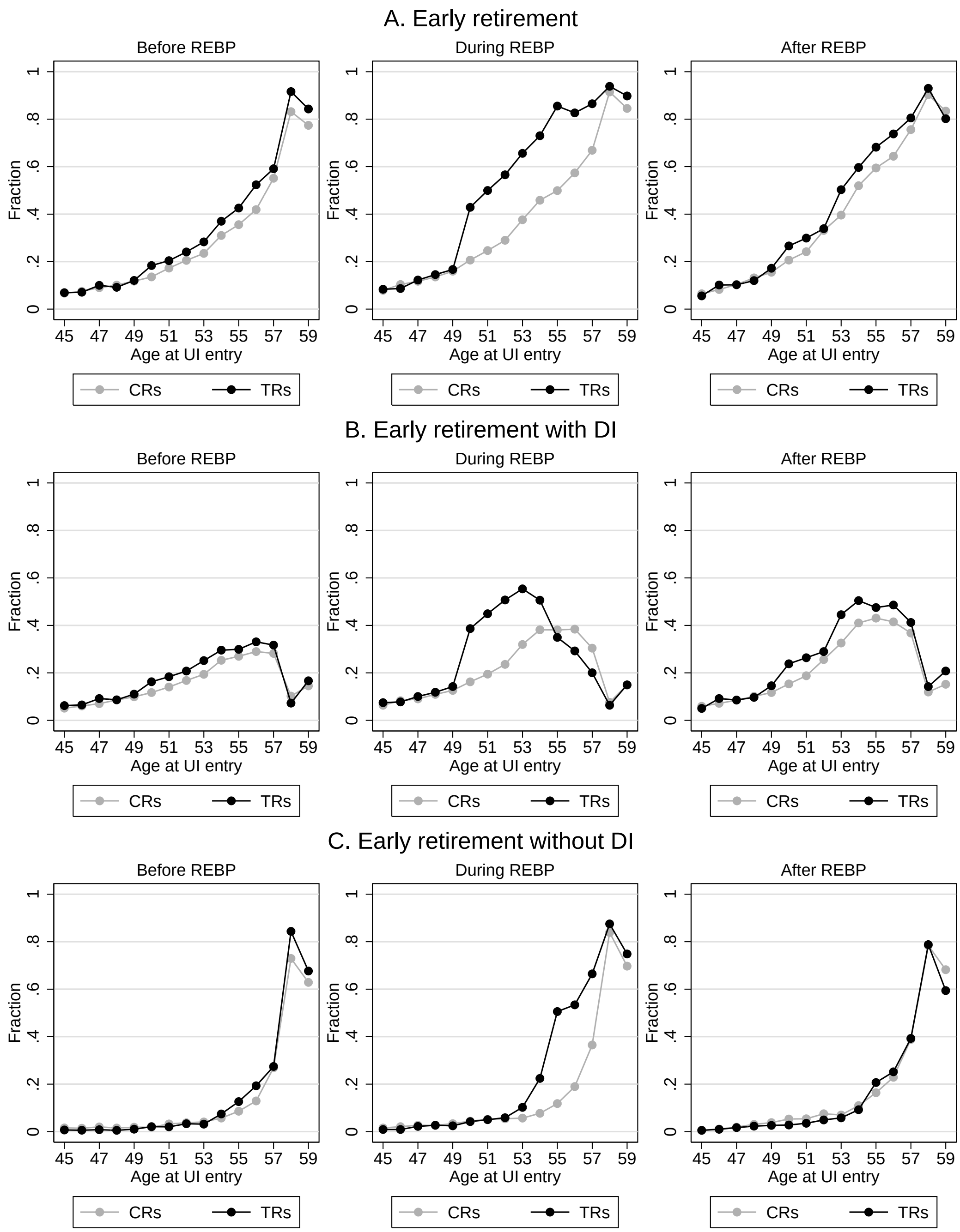
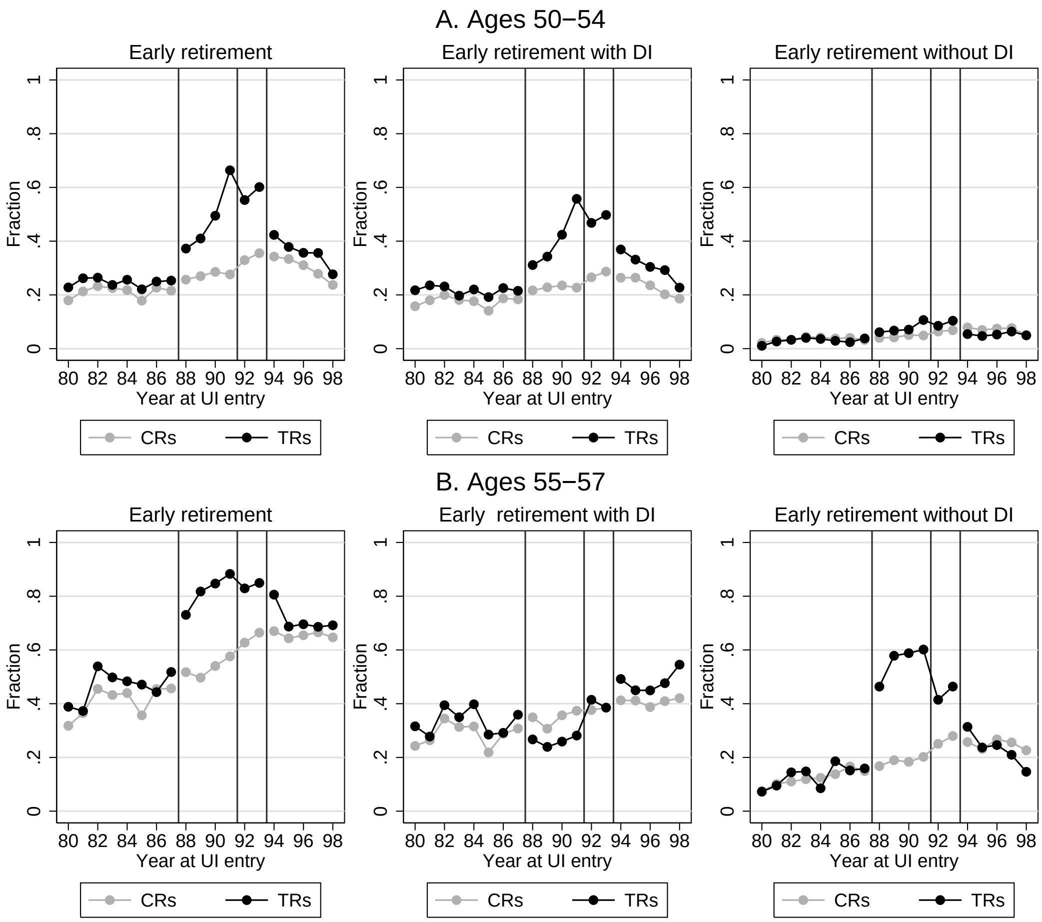
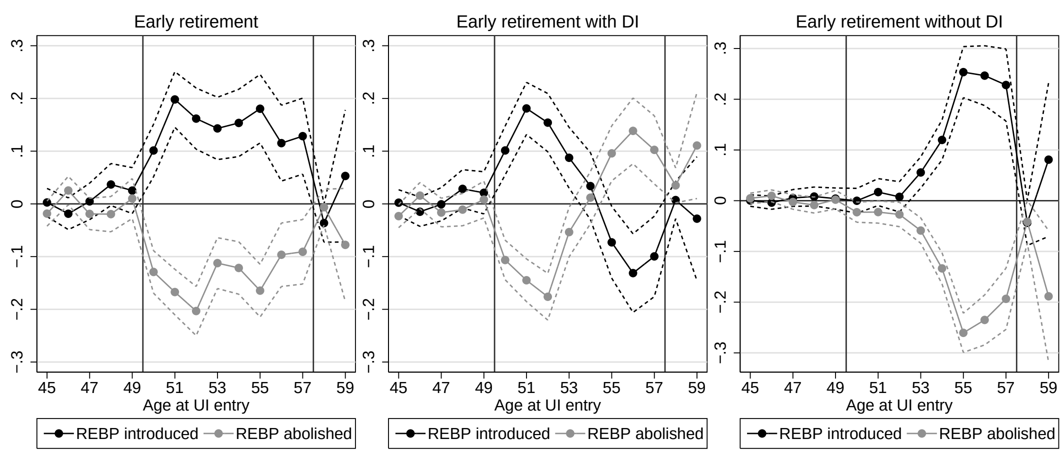


Figure 4: Trends in transitions into early retirement, early retirement with DI, and early retirement without DI in TRs and CRs by year and age group



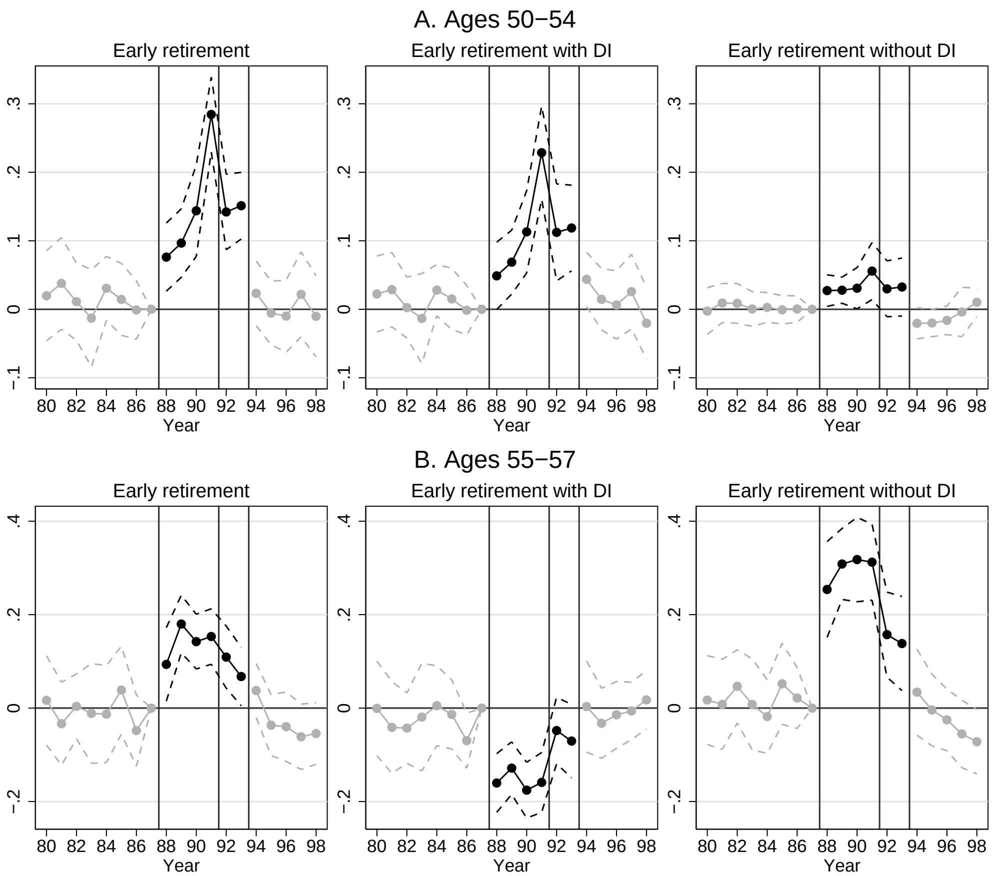
Notes: First vertical line denotes the date when the REBP was implemented. The second and the third vertical line denote the dates when the REBP was abolished in TR1s and TR2s, respectively.

Figure 5: Coefficients of the interactions $(A0_t \times TR_i)$ and $(A1_t \times TR_i)$ from estimating equation (1) for each age separately



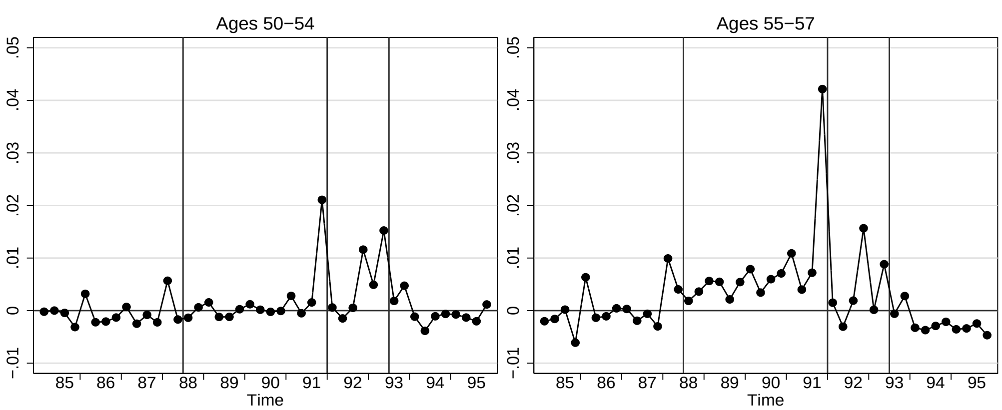
Notes: The dashed lines represent a 95% confidence interval. Unemployed men aged 45-49 are not eligible for the REBP; unemployed men aged 58-59 do not need the REBP to retire early.

Figure 6: Coefficients of the interactions ($d_{jt} \times TR_i$) in equation (2) by age group



Notes: The dashed lines represent a 95% confidence interval. First vertical line denotes the date when the REBP was implemented. The second and the third vertical line denote the dates when the REBP was abolished in TR1s and TR2s, respectively.

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



Notes: First vertical line denotes the date when the REBP was implemented. The second and the third vertical line denote the dates when the REBP was abolished in TR1s and TR2s, respectively.

Online Appendix:

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

Lukas Inderbitzin, Stefan Staubli, and Josef Zweimüller

June 1, 2015

A Additional Tables

Table A.1: Exit to early retirement with DI for age group 50-54

	DI-entry at age 50-54	DI-entry at age 55+
During REBP	-0.014**	0.117***
($D \times TR$)	(0.006)	(0.017)
Mean TRs pre-REBP	0.084	0.133
R^2	0.057	0.172
No. of observations	58,343	58,343

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. Control variables: log previous wage, dummies for marital status, dummies for education, dummies for weeks of UI eligibility (20, 30, 39, 52 weeks), blue-collar status at last job, work experience in last 13 years, years of service 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-month of unemployment entry, dummy for spells that start within 30 weeks before REBP introduction, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table A.2: Heterogeneous effects on unemployment exit by generosity of DI pensions and health status for unemployed men

	Age 50-54			Age 55-57		
	Early retirement	Early retirement with DI	Early retirement without DI	Early retirement	Early retirement with DI	Early retirement without DI
A. Low versus high DI pension						
During REBP	0.110***	0.068***	0.042***	0.126***	-0.130***	0.256***
	(0.013)	(0.014)	(0.010)	(0.020)	(0.019)	(0.022)
During REBP× (DI pension>median)	0.070***	0.064***	0.006	-0.003	0.046**	-0.050**
	(0.023)	(0.023)	(0.009)	(0.022)	(0.019)	(0.020)
Mean TRs pre-REBP	0.252	0.217	0.035	0.505	0.315	0.190
R^2	0.205	0.177	0.091	0.258	0.140	0.321
No. of observations	58,343	58,343	58,343	23,294	23,294	23,294
B. Healthy versus sick						
During REBP	0.151***	0.101***	0.049***	0.146***	-0.092***	0.238***
	(0.016)	(0.019)	(0.012)	(0.018)	(0.019)	(0.025)
During REBP× (sick leave days>0)	-0.002	0.011	-0.013	-0.048**	-0.021	-0.027
	(0.016)	(0.016)	(0.009)	(0.021)	(0.020)	(0.019)
Mean TRs pre-REBP	0.252	0.217	0.035	0.505	0.315	0.190
R^2	0.205	0.180	0.091	0.260	0.146	0.322
No. of observations	58,343	58,343	58,343	23,294	23,294	23,294

Notes: The Table reports coefficients from a linear probability model. Standard errors adjusted for clustering within labor market districts. "DI pension>0" is equal to one if the expected DI pension is above the median and zero otherwise. "Sick leave days>0" is equal to one if the number of sick leave days in the year before UI entry is positive and zero otherwise. Controls: log previous wage, dummies for marital status, dummies for education, dummies for weeks of UI eligibility (20, 30, 39, 52 weeks), blue-collar status at last job, work experience in last 13 years, years of service 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-month of unemployment entry, dummy for spells that start within 30 weeks before REBP introduction, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

Table A.3: Effects on other labor supply measures of unemployed men in the age groups 50-54 and 55-57

	Pr(claim UA)	Years working	Earnings	Claiming age DI or old age pension
A. Age 50-54				
During REBP	-0.084***	-0.723***	-15,728***	0.293***
$(D \times TR)$	(0.018)	(0.099)	(2,723)	(0.083)
Mean TRs pre-REBP	0.253	2.871	56,857	57.640
R^2	0.220	0.222	0.215	0.174
No. of observations	58,343	42,899	42,899	42,899
B. Age 55-57				
During REBP	-0.195***	-0.363***	-8,570***	0.590***
$(D \times TR)$	(0.028)	(0.066)	(1,463)	(0.087)
Mean TRs pre-REBP	0.236	0.949	21,205	58.839
R^2	0.254	0.203	0.185	0.212
No. of observations	23,294	15,175	15,175	15,175

Notes: The Table reports the impact of the REBP on different measures of labor supply. "Pr(claim UA)" is an indicator for whether an individual receives UA benefits during the unemployment spell, "years working" is the number of years spent working until age 65, and "earnings" measures the total earnings until age 65 in 2014 Euros. Future earnings are discounted using an interest rate of 2.5%. Standard errors adjusted for clustering within labor market districts. Controls: log previous wage, dummies for marital status, dummies for education, dummies for weeks of UI eligibility (20, 30, 39, 52 weeks), blue-collar status at last job, work experience in last 13 years, years of service 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-month of unemployment entry, dummy for spells that start within 30 weeks before REBP introduction, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

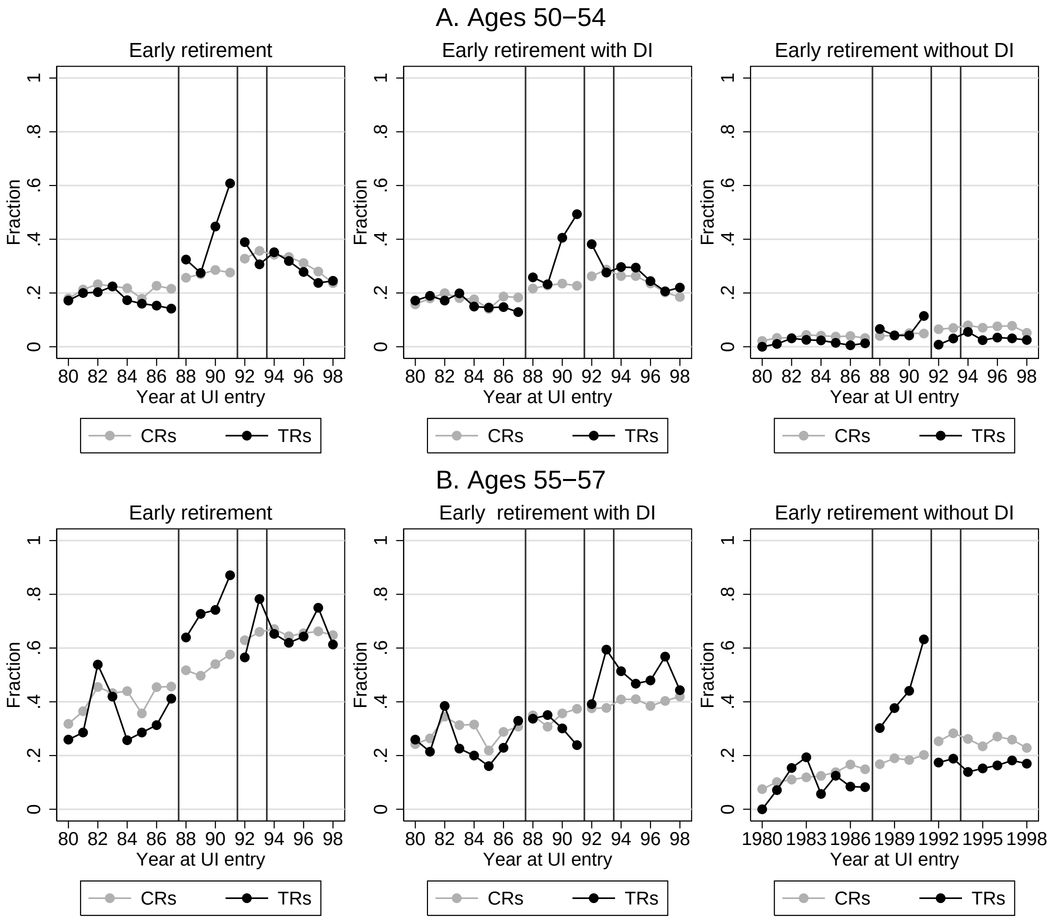
Table A.4: Effects on pathway costs for unemployed men in the age groups 50-54 and 55-57

	Age 50-54			Age 55-57		
	Return to work	Early retirement with DI	Early retirement without DI	Return to work	Early retirement with DI	Early retirement without DI
During REBP	-22,106***	27,538***	7,541***	-21,766***	-19,278***	50,435***
($D \times TR$)	(2,230)	(4,812)	(2,493)	(3,248)	(5,614)	(7,513)
Mean TRs pre-REBP	90,105	31,653	7,141	66,314	54,962	42,666
R^2	0.137	0.207	0.105	0.223	0.144	0.350
No. of observations	42,899	42,899	42,899	15,175	15,175	15,175

Notes: Return to work, early retirement with DI, and early retirement without DI measure the total government net expenditures for an unemployed men until age 78 if he returns to work after the UI spell, retires early with DI, and retires early without DI, respectively. All amounts are in 2014 Euros. Future benefits and taxes are discounted using an interest rate of 2.5%. Standard errors adjusted for clustering within labor market districts. Controls: log previous wage, dummies for marital status, dummies for education, dummies for weeks of UI eligibility (20, 30, 39, 52 weeks), blue-collar status at last job, work experience in last 13 years, years of service 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-month of unemployment entry, dummy for spells that start within 30 weeks before REBP introduction, and dummies for labor market districts. Significance levels: *** = 1%, ** = 5%, * = 10%.

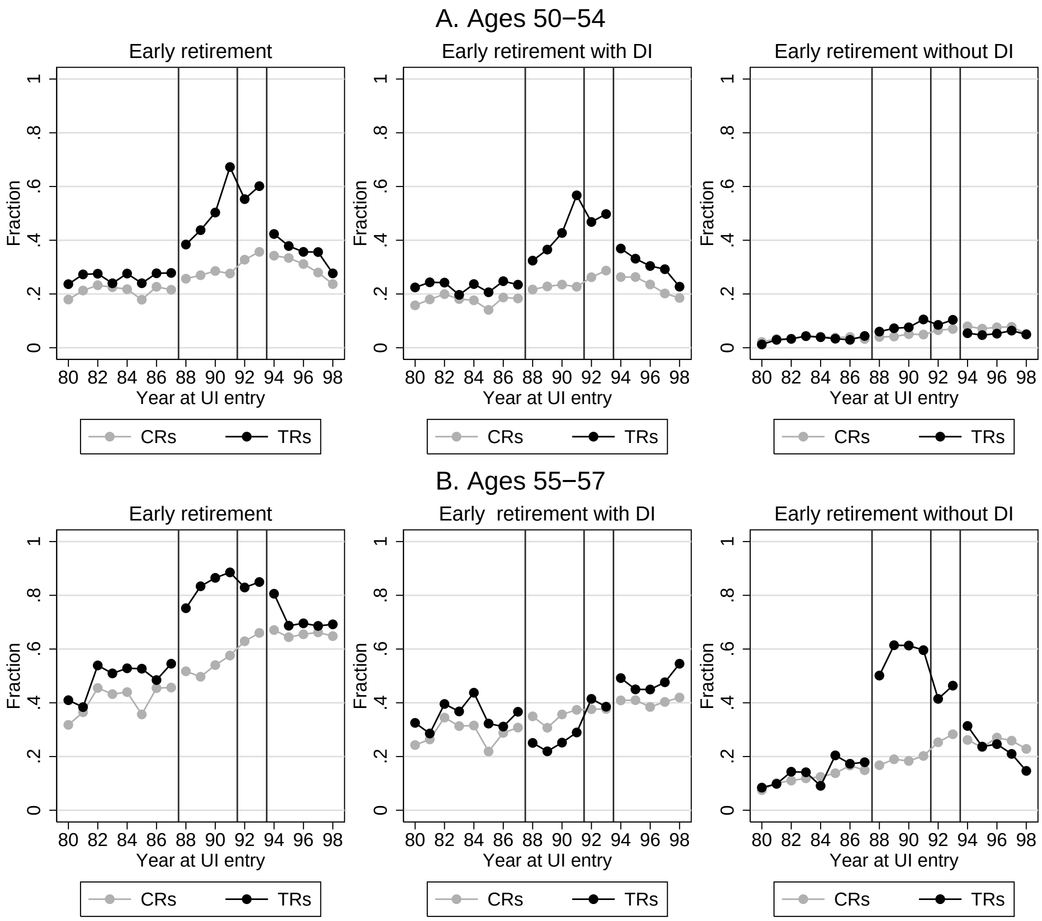
B Additional Figures

Figure B.1: Trends in transitions into early retirement, early retirement with DI, and early retirement without DI in TR1s and CRs by year and age group



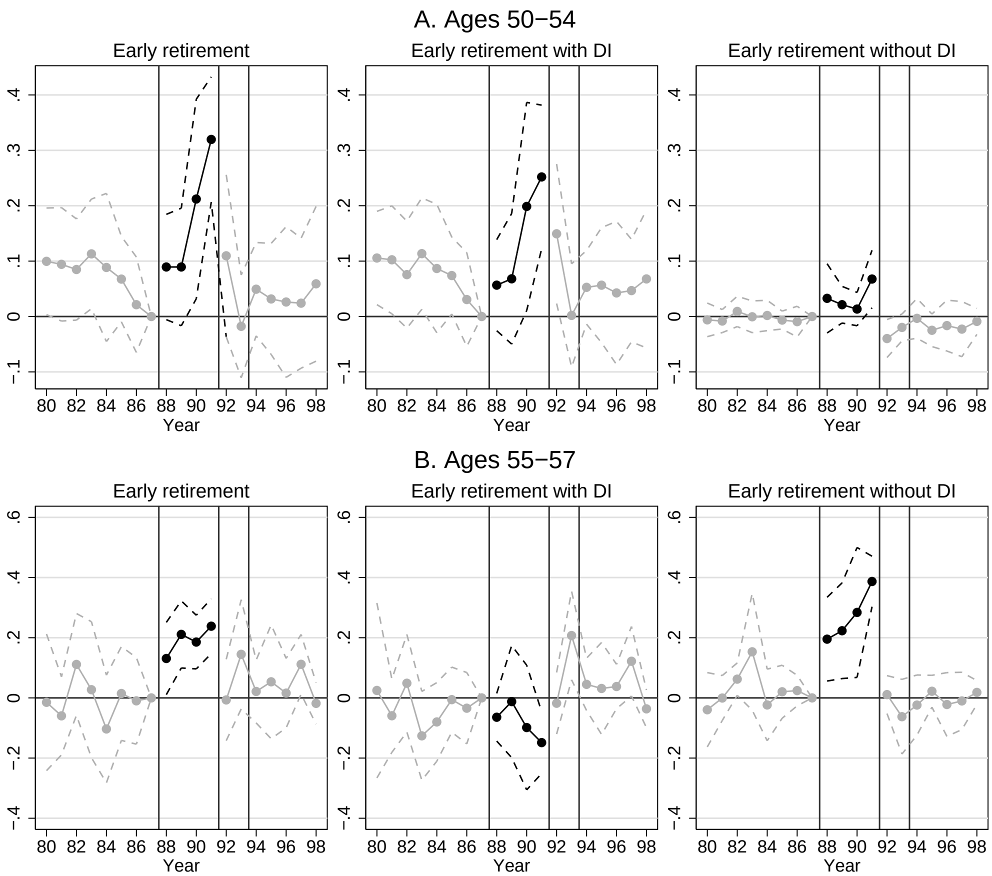
Notes: First vertical line denotes the date when the REBP was implemented. The second and the third vertical line denote the dates when the REBP was abolished in TR1s and TR2s, respectively.

Figure B.2: Trends in transitions into early retirement, early retirement with DI, and early retirement without DI in TR2s and CRs by year and age group



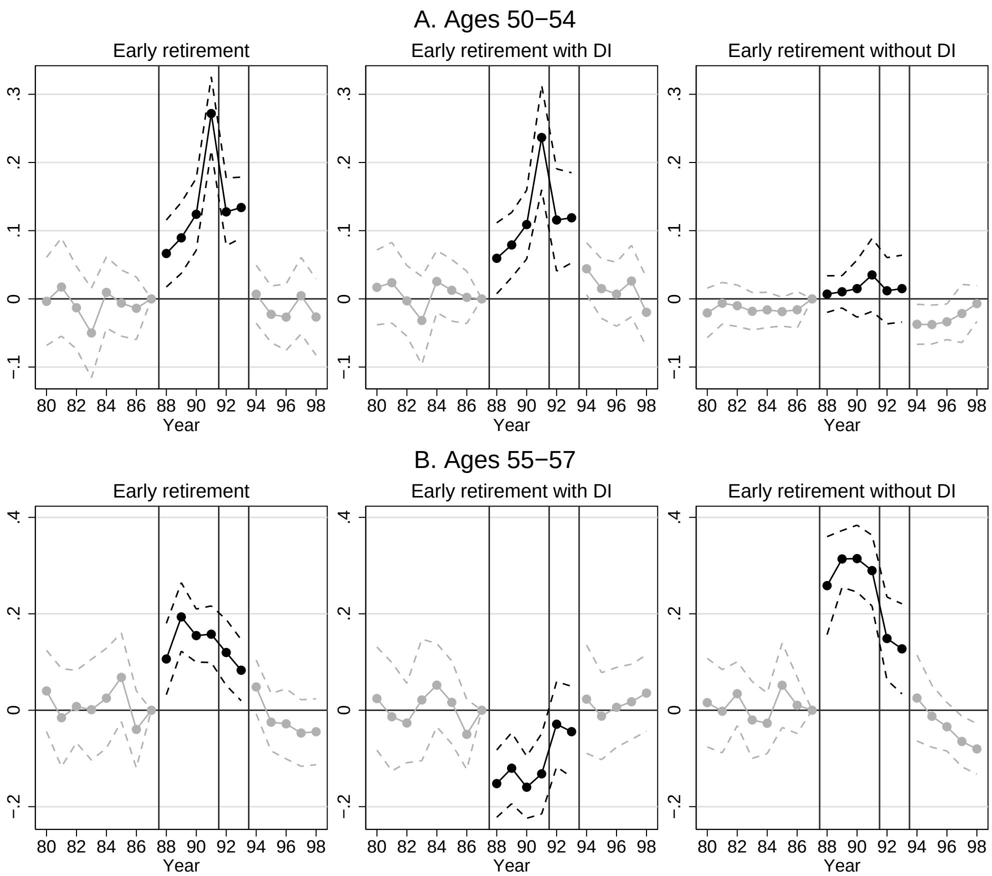
Notes: First vertical line denotes the date when the REBP was implemented. The second and the third vertical line denote the dates when the REBP was abolished in TR1s and TR2s, respectively.

Figure B.3: Coefficients of the interactions ($d_{jt} \times TR_i$) in equation (2) by age group, TR1s.



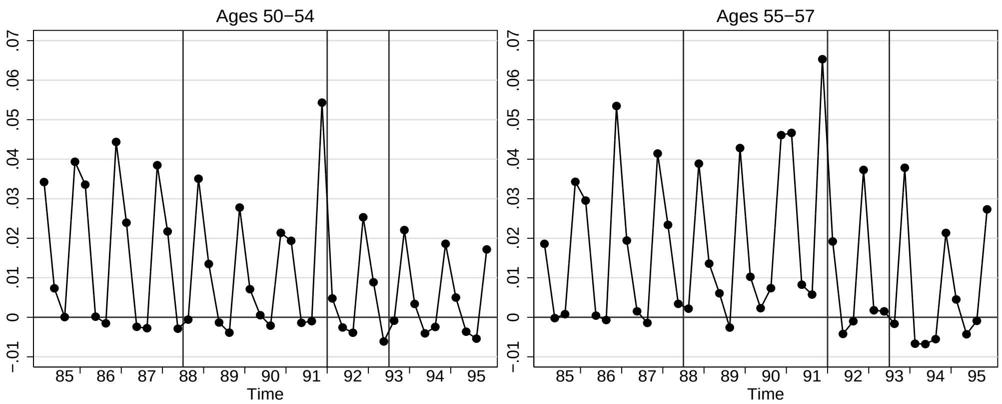
Notes: The dashed lines represent a 95% confidence interval. First vertical line denotes the date when the REBP was implemented. The second and the third vertical line denote the dates when the REBP was abolished in TR1s and TR2s, respectively.

Figure B.4: Coefficients of the interactions ($d_{jt} \times TR_i$) in equation (2) by age group, TR2s



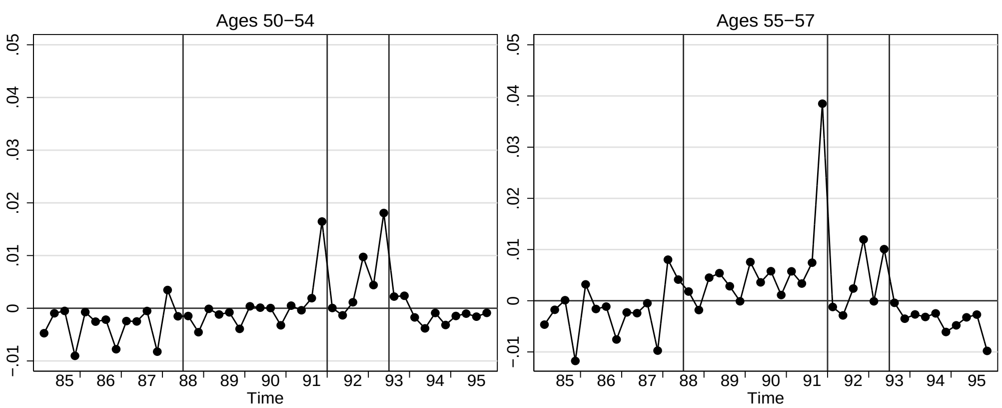
Notes: The dashed lines represent a 95% confidence interval. First vertical line denotes the date when the REBP was implemented. The second and the third vertical line denote the dates when the REBP was abolished in TR1s and TR2s, respectively.

Figure B.5: Regional difference in quarterly unemployment inflow rate (% of employment) by age group, TR1s.



Notes: First vertical line denotes the date when the REBP was implemented. The second and the third vertical line denote the dates when the REBP was abolished in TR1s and TR2s, respectively.

Figure B.6: Regional difference in quarterly unemployment inflow rate (% of employment) by age group, TR2s.



Notes: First vertical line denotes the date when the REBP was implemented. The second and the third vertical line denote the dates when the REBP was abolished in TR1s and TR2s, respectively.

C Retirement Model and Welfare Analysis

The following sections outline the retirement model and welfare analysis discussed in Section 6.We proceed in three steps. In Section C.1 we derive a simple retirement model and discuss substitution and complementarity effects triggered by the REBP. Second, we discuss the social planner's optimization problem and derive the sufficient statistic (3) in Section C.2.[1]

C.1 The Retirement Decision

Suppose the worker's remaining lifetime consists of two working periods, $t = 0$ and $t = 1$, and a retirement period, $t = 2$.[2] 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 immediately or retires early. During both periods, the worker can be in only one of three states: UI, DI, or working during each period. At the beginning of $t = 2$, all remaining workers retire and draw an 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 $\theta_1 \sim F(\theta)$ has to be incurred. 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. Early retirement through the UI system yields a benefit b (any costs associated with claiming UI benefits are normalized to zero).[3]

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,

[1] A more detailed derivation of the key reults is available upon request from the authors.

[2] Period $t = 0$ 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.

[3] We 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 UA benefits 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).

U_1, are given by:

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

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. Hence, 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 $p^W = p^U = \alpha d$. Given these rules, heterogeneity in disability pensions and old-age pensions is captured by the parameter d. The following lemma describes optimal behavior given individual's location in (θ_1, 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 $\hat{\theta}_1 = u(\omega) - u(b)$ 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 $1 - (\alpha - 1)T \geq 0$.*

Proof. We proceed in two steps to derive the thresholds. First, we compute $\hat{d}$ as the implicit threshold value between claiming a DI pension (D_1) and claiming unemployment benefits (U_1), i.e. $u(b)+\kappa = u(\hat{d}) - (u(\alpha\hat{d}) - u(\hat{d}))T$. Next, we compare the value of working ($W_1 - \theta_1$) conditional on the best early retirement option, e.g. UI benefits if $d < \hat{d}$ and DI pension otherwise. This yields the $\hat{\theta}_1$-threshold:

$$\hat{\theta}_1 = \begin{cases} u(\omega) - u(b) & \text{if } d < \hat{d} \\ u(\omega) - u(d) + (u(\alpha d) - u(d))T + \kappa & \text{if } d \geq \hat{d} \end{cases}. \tag{5}$$

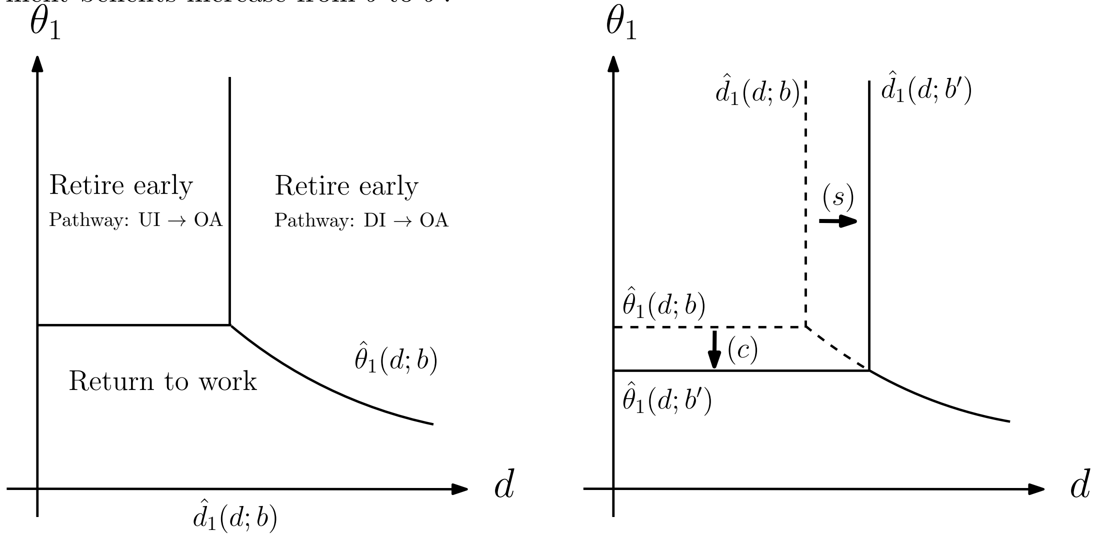
This function is constant over d for values $d < \hat{d}$ and decreasing in d for $d \geq \hat{d}$ because the implicit differentiation yields

$$d\hat{\theta}_1/dd = -u'(d) + (\alpha u'(\alpha d) - u'(d))T < -u'(d)(1 - (\alpha - 1)T) < 0$$

if we assume $1 - (\alpha - 1)T \geq 0$. □

Figure C.1 illustrates individuals' optimal choices in $t = 1$ given their location in space. The critical value $\hat{d}$ simply represents the minimal pension d above which D_1 becomes larger than 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.[4]

Figure C.1: 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'.



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.

[4] A 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).

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.*

Proof. Implicit differentiation of the $\hat{d}$ threshold, given by $u(\hat{d}) - (u(\alpha\hat{d}) - u(\hat{d}))T - u(b) - \kappa = 0$, yields

$$\frac{\partial \hat{d}}{\partial b} = \frac{u'(b)}{u'(\hat{d}) - (\alpha u'(\alpha\hat{d}) - u'(\hat{d}))T} > \frac{u'(b)}{u'(\hat{d})\,(1 - (\alpha - 1)\,T)} \geq 0$$

under $1 - (\alpha - 1)\,T \geq 0$. The threshold (5) becomes $\partial\hat{\theta}_1/\partial b = -u'(b) < 0$ for $d < \hat{d}$ and $\partial\hat{\theta}_1/\partial b = 0$ otherwise. □

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 $t = 1$.[5] In $t = 2$ the workers 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 workers keeps his job with probability $1 - q$ and is fired with probability q. We abstract from selective firing, hence q is the same for all workers. If the worker keeps his job, he earns a wage w also in $t = 1$ without having to bear search costs. If fired, the worker faces exactly the same decision problem as described 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 $t = 0$.[6] In $t = 2$ the worker draws an old-age pension that depends on

[5]This 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 UA benefits are 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.

[6]This implies that average search costs for worker fired in $t = 1$ are higher than the average search costs when fired in $t = 0$. Workers fired in $t = 1$ must have been re-employed after being fired in $t = 0$ meaning their draw θ_0 must have been sufficiently low to induce them going back to

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:

$$W_0 - \theta_0 = u(w) - \theta_0 + q\mathrm{E}_\theta V_1 + (1-q)W_1, \quad R_0 = u(b) + (1+T)u(d) - \kappa,$$

whereas $\mathrm{E}_\theta V_1 \equiv \int \max(W_1 - \theta, D_1, U_1)dF(\theta)$ 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. 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

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

To calculate $\mathrm{E}_\theta V_1$, 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

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

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

work. Average search costs conditional on re-employment are $\mathrm{E}_\theta(\theta \mid \theta \leq \theta_0)$. 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 $\mathrm{E}_\theta(\theta) > \mathrm{E}_\theta(\theta \mid \theta \leq \theta_0)$.

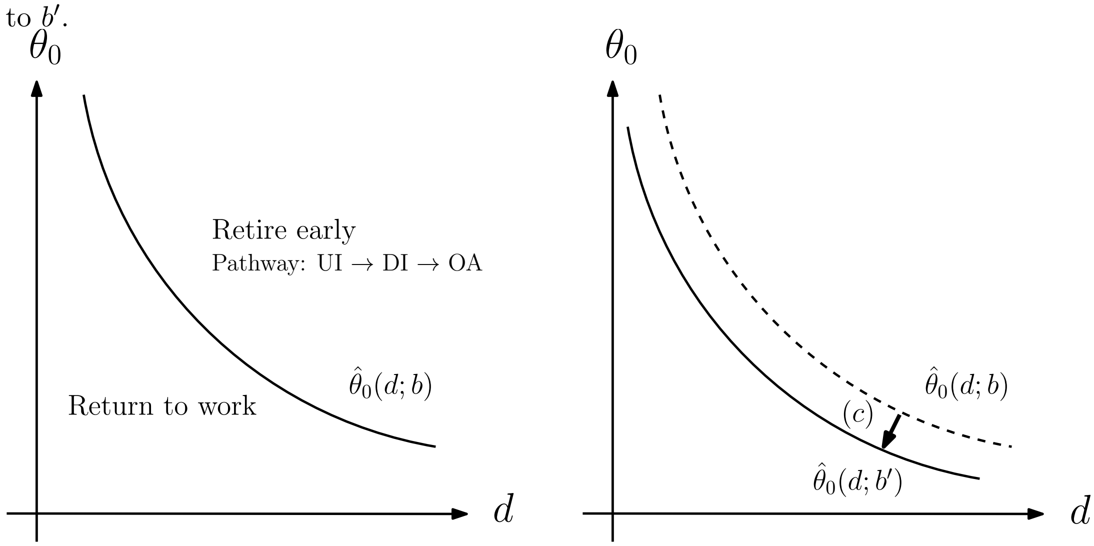
through DI rather than UI in $t = 1$. The same reasoning as above yields[7]

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

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 $\partial\hat{\theta}_0/\partial d < -(1-q(1-F_1(\hat{\theta}_1)))u'(d)(1-(\alpha-1)T) < 0$. $\square$

Figure C.2 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 C.1 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 C.2: 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'.



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

[7]There 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).

$\hat{\theta}_0$. 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. One 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. Differentiation of $\hat{\theta}_0$ with respect to b yields $\partial\hat{\theta}_0/\partial b = q \cdot (\partial \mathrm{E}_\theta V_1/\partial b) - u'(b)$. As in Lemma 2, there are two cases. *Case 1* ($d < \hat{d}$) we obtain $\partial \mathrm{E}_\theta V_1/\partial b = (1 - F(\hat{\theta}_1))(\partial U_1/\partial b)$ 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 $\partial \mathrm{E}_\theta V_1/\partial b = 0$ as the UI pathway is never chosen and therefore $\partial\hat{\theta}_0/\partial b = -u'(b)$. $\square$

C.2 Welfare Analysis

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 $[\underline{d}, \overline{d}]$. The utilitarian social welfare equals

$$\mathcal{W} = \int_{\underline{d}}^{\overline{d}} \left(\varphi u\left(w - \tau\right) + q \int_0^\infty V_0(d,\theta) dF(\theta) + (1-q) W_0(d) \right) dG(d) \qquad (6)$$

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.[8] As outlined in Section C.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 working population. This can be written as

$$(\Pi_0^U + \Pi_1^U)b + N = (\varphi + \Pi_0^W + \Pi_1^W)\tau, \tag{7}$$

where N denotes government expenditures on disability and old-age pensions and Π_t^i the *mass* of workers in state $i = U, D, W$ at date t.[9] 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:

$$N_0 = \Pi_0^U \mathrm{E}_0((1 + T)d \mid \theta \geqslant \hat{\theta}_0(d))\cdot$$

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

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

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

[9] The 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, $i = U, D, W$.

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:

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

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

Deriving Equation (3). In a first step, we derive the first-order condition of (6) subject to the behavioral retirement responses. This procedure yields:

$$\frac{d\mathcal{W}}{db} = (\Pi_0^U + \Pi_1^U)u'(b) - (\varphi + \Pi_0^W + \Pi_1^W)u'(w - \tau)\frac{d\tau}{db}. \tag{8}$$

Equation (8) yields the familiar result that optimal UI balances the marginal social benefits of better insurance to the marginal social costs of higher taxes.

Next differentiate both sides of the budget constraint (7) with respect to b:

$$(\varphi + \Pi_0^W + \Pi_1^W)\frac{d\tau}{db} = \Pi_0^U + \Pi_1^U + b\frac{d(\Pi_0^U + \Pi_1^U)}{db} - \tau\frac{d(\Pi_0^W + \Pi_1^W)}{db} + \frac{dN}{db}. \tag{9}$$

The above equation can be decomposed into two parts:

1. The mechanical effect, $\mathcal{C}_M = \Pi_0^U + \Pi_1^U$, represents the additional program expenditures if the government increases the UI benefits marginally and workers would not adjust their retirement choices to the new incentives.

2. The behavioral effect, $\mathcal{C}_B = b\frac{d(\Pi_0^U+\Pi_1^U)}{db} - \tau\frac{d(\Pi_0^W+\Pi_1^W)}{db} + \frac{dN}{db}$, captures the marginal program expenditures due to higher UI benefits which are caused by pathway switching. We distinguish two sub-categories:

   (a) Additional expenditures due to increase in unemployment and decrease in employment: $b\frac{d(\Pi_0^U+\Pi_1^U)}{db} - \tau\frac{d(\Pi_0^W+\Pi_1^W)}{db}$

(b) Additional expenditures due to changes in pension behavior: dN/db

Using the above notation, we rewrite equation (9) as:

$$(\varphi + \Pi_0^W + \Pi_1^W)\frac{d\tau}{db} = \mathcal{C}_M + C_B.$$

Inserting the above equation into (8) yields:

$$\frac{d\mathcal{W}}{db} = \mathcal{C}_M \cdot u'(b) - u'(w-\tau)(\underbrace{\mathcal{C}_M + \mathcal{C}_B}_{\mathcal{C}_T}).$$

Note that mechanical and behavioral effects sum up (by definition) to the total effect, i.e. $\mathcal{C}_M + \mathcal{C}_B = \mathcal{C}_T$. Finally, impose optimality $d\mathcal{W}/db = 0$ and subtract 1 on both sides to obtain equation (3).

D Endogenous UI Inflow

Assume a standard Baily-Chetty framework with endogenous unemployment inflow as the only modification. The job separation rate q becomes endogenous with respect to the unemployment benefits b. The government maximizes:

$$\max_b \{q(b)\,[e \cdot u(w-t) + (1-e)\cdot u(b)] + (1-q(b))\cdot u(w-t)\}$$

subject to individual optimization behavior $\max_e \{e \cdot u(w-t) + (1-e)\cdot u(b) - \varphi(e)\}$ and the budget constraint $q(b)\,[e \cdot t - (1-e)\cdot b] + (1-q(b))\cdot t = 0$. Solving the optimization problem yields the sufficient statistic:

$$\frac{u'(b) - u'(w-t)}{u'(w-t)} = \varepsilon\frac{b+t}{b} + \underbrace{\frac{dq}{db}\frac{1}{q}\left\{\frac{u(w-t)-u(b)}{u'(w-t)} + (b+t)\right\}}_{\text{job separation externality}}.$$

To the extent that job separations react to benefit generosity ($dq/db > 0$), the r.h.s of the above equation becomes larger which reduces the optimal level of UI benefits even further.