Job Loss and Retirement*

Lea Nassal[‡]

November 24, 2025

Job Market Paper

Please click here for most recent version

Abstract

This paper provides the first evidence of the long-term effects of job loss on age at retirement, pension benefits and lifetime income. Exploiting plant closures and using German administrative data, I compare displaced workers with similar non-displaced workers. I show that displaced workers delay their retirement in response to the shock and ineligibility for early pension claims is the main driver of this response. Despite adjustments in retirement behavior, displaced workers face significant losses in pension benefits and lifetime income. Compared to similar non-displaced workers, displaced workers experience losses in the present discounted value of their lifetime income of 25%.

Keywords: job loss, plant closure, retirement
JEL codes: J18, J26, J63, J65

* I am grateful to my advisors Marie Paul and Philip Jung for their guidance and support. I thank Sonia Bhalotra, Lukas Buchheim, Arnaud Chevalier, Martin Karlsson, Matthew Notowidigdo, Martin Salm, Ija Trapeznikova, and seminar participants at Bergen, Duisburg, Tilburg and EALE, ESPE, EEA, RES, and SOLE conferences for helpful comments. I thank the Research Data Center of the Institute for Employment Research (IAB) for generously providing the data and support with running programs remotely. The usual caveat applies.
‡ University of Warwick, Email: Lea.Nassal@warwick.ac.uk

1 Introduction

Job loss is a persistent negative career shock that affects many workers. In the US, for example, around 8.6 million workers involuntarily lost their jobs between 2019 and 2021 (US Bureau of Labor Statistics 2022).[1] A number of studies establish that displaced workers experience significant reductions in earnings and employment (e.g., Jacobson et al. 1993; Couch and Placzek 2010; Schmieder et al. 2023; Jarosch 2023; Salvanes et al. 2024).[2] Yet, there is no evidence on the lifetime impacts of job loss, as most studies follow individuals for no more than 10 to 15 years after the event. In particular, it remains unclear how job loss earlier in life affects retirement, pension benefits, and overall lifetime income. Understanding these effects is important, as job loss may not only lead to substantial income losses during working life, but also to reduced pension benefits. For some workers, this could increase the risk of old-age poverty, a major issue given increasing life expectancy and reduced pension replacement rates.

In this paper, I shed light on two key questions: first, do displaced workers adjust their retirement behavior in response to the job loss? Second, how large are the lifetime costs associated with job loss? Answering these questions is challenging, as there is little comprehensive data to track workers from job loss to retirement. To make progress, I leverage German administrative data spanning over more than 40 years, which allow me to analyze how job loss among young and middle-aged workers affects their retirement decision and assess its full lifelong impact. This contrasts work that thus far examined the short-term impacts of job loss on workers close to retirement (Chan and Huff Stevens 2001; Chan and Stevens 2004; Merkurieva 2019).

I begin my analysis by examining the long-term effects of job loss during working life, tracking workers' labor market outcomes for up to 25 years after displacement. To do so, I use social security data and leverage quasi-exogenous variation in job loss due to plant closures. I identify young and middle-aged workers who have been displaced and match them with observably similar non-displaced workers. This allows me to compare the career trajectories of displaced workers with those of otherwise similar workers who did not experience job loss.

[1] 3.6 million of the 8.6 million were workers with more than three years of tenure (US Bureau of Labor Statistics 2022).

[2] Throughout the paper, I refer to displaced workers as high-tenured workers who lose their jobs.

I show that job loss has long-lasting career costs. On average, displaced workers lose about €4,700 in earnings per year over the 25 years following job loss, a 12% reduction relative to their pre-displacement mean. These long-term earnings losses are mainly driven by large and persistent wage losses. Wages drop sharply after displacement and show little recovery even two decades later. In contrast, employment gradually recovers. In the very long run, the earnings gap between displaced and non-displaced workers narrows, suggesting that differences in retirement timing become increasingly important.

Next, I move beyond working-age outcomes and examine how job loss affects retirement decisions. I show that displaced workers delay their retirement. Between the ages of 60 and 64, displaced workers are about 4 percentage points (pp) (10%) less likely to be retired compared to similar non-displaced workers. This delay in retirement is equally driven by extended periods of employment and unemployment, with displaced workers being about 2 pp more likely to be employed and 2 pp more likely to be unemployed. The delay in retirement is similar for men and women but it is only observed among earlier birth cohorts. As statutory retirement ages have increased over time, these earlier birth cohorts had more flexibility in their retirement timing, giving them a greater margin to adjust. After age 64, the retirement probability no longer differs between displaced and non-displaced workers.

In my setting, most workers can only retire early between the ages of 60 and 64 if they meet certain eligibility criteria (e.g., a specific number of contribution years). However, in most cases, they still have to accept pension deductions. After the age of 64, workers are entitled to their full pension benefits under less stringent conditions, requiring only five contribution years. The delay in retirement among displaced workers suggests that displaced workers retire later to avoid additional income losses and/or to meet less stringent eligibility criteria.

I provide evidence that the latter is the primary driver. To evaluate the role of the two mechanisms – lack of pension benefits eligibility and financial incentives – I complement my analysis with administrative pension data. This dataset provides detailed information on the full contribution history of each worker, allowing me to observe the amounts and eligibility of pension benefits. First, I examine the effect on pension benefits eligibility and show that displaced workers are about 9% less likely to qualify for pension benefits between the ages of 60 and 64. This difference in eligibility accounts for roughly half of the gap in the retirement probability between displaced and non-displaced workers.

Second, I assess the role of financial incentives and show that they play a less important role. Financial incentives for retirement are influenced by a worker's cumulative income and their wage income near retirement. A substantial reduction in cumulative income is expected to decrease retirement incentives, as the negative wealth effect increases the need for additional income. In contrast, a reduction in wage income near retirement is expected to increase retirement incentives, as a lower wage income compared to potential pension benefits implies a high pension replacement rate and thus relatively low opportunity costs of retirement. I show that, compared to non-displaced workers, displaced workers experience significant cumulative income losses, but there is no impact on the pension replacement rate. Financial incentives explain only little of the gap in the retirement probability, suggesting that the lack of pension benefits eligibility is the main factor mediating the impact of job loss on retirement.

In the second part of the paper, I quantify the losses in pension benefits and lifetime income. First, I show that although displaced workers delay their retirement, they still face losses in annual pension benefits of approximately €1,500 (12%). Put differently, this is equivalent to roughly 1.5 months of pension payments. The losses are similar in proportional terms for men and women, but smaller for earlier birth cohorts, who are responsible for the delay in retirement.

Second, I track workers throughout their entire life and show that displaced workers face substantial losses in lifetime income. My estimates go beyond medium-term effects documented in previous research (Davis and von Wachter 2011; Jarosch 2023) by capturing not only earnings losses, but also delayed retirement and reductions in pension benefits. I find that displaced workers experience a reduction in the present discounted value (PDV) of income of approximately €130,000 (25%) relative to the non-displaced counterfactual. Lifetime income losses are larger for women in proportional terms, driven by larger post-displacement earnings losses.

Given these large losses, I examine the role of the unemployment insurance (UI) system in mitigating long-term income losses. I show that, in the absence of the UI system, the loss in the PDV of income would increase from 25% to 29%, demonstrating that the UI system partially mitigates long-term income losses. Finally, to assess whether delayed retirement helps offset income losses, I construct a counterfactual income scenario using non-displaced workers. The analysis reveals that lifetime income losses would increase by only 2 pp without delayed retirement. This suggests that delaying retirement cannot offset the substantial costs of job loss, which are primarily driven by persistent reductions in post-displacement earnings.

The results of this paper are related to two strands of literature. First, this paper shows that job loss leads to substantial lifetime costs. As such, it improves our understanding of the long-term effects of job loss and relates to a large body of work that examines the impacts of job loss. Prior research has shown that job loss leads to large and long-lasting earnings losses (e.g., Couch and Placzek 2010; Lachowska et al. 2020; Jacobson et al. 1993), higher job instability (Jarosch 2023), higher incidence of future job losses (Stevens 1997, 2001), and more severe losses during economic downturns (Davis and von Wachter 2011; Schmieder et al. 2023). Most closely related within this literature are studies that examine the effects of late-career job loss on workers' retirement decision. These studies document that job loss later in life leads to significantly lower probabilities of reemployment (Chan and Huff Stevens 2001) and earlier retirement (Chan and Stevens 2004; Merkurieva 2019).[3][4] In addition, my findings complement existing papers on life-cycle differences in the effects of job loss (Salvanes et al. 2024; Ichino et al. 2017). For example, Salvanes et al. (2024) find that job loss at different career stages influences life choices differently: early-career job loss promotes human capital investment, mid-career job loss triggers family adjustments, and late-career job loss leads to earlier retirement. My findings highlight a previously overlooked margin: early-career job loss leads to later retirement.

I contribute to the job loss literature in two ways. First, I provide new insights into the full extent of the lifetime costs associated with job loss, explicitly accounting for changes in retirement timing and pension benefits. Second, while existing studies focus on the immediate effects of job loss on retirement, I use data spanning over 40 years to provide the first evidence on its long-term impact, particularly for young and middle-aged workers.

Next, this paper examines how job loss affects retirement behavior and thereby contributes to a large literature on retirement decisions. Much of this literature studies how pension system features shape retirement behavior. In particular, many studies examine the role of statutory retirement ages and financial incentives (e.g., Coile and Levine 2007; Staubli and Zweimüller 2013; Gelber et al. 2016; Seibold 2021; Ye 2022; Lalive et al. 2023; Rabaté et al. 2024). Other work highlights the importance of occupational characteristics for retirement timing (Jacobs 2023; Sauré et al. 2025). More broadly, studies analyzes the determinants of retirement ages, such as health, education, job characteristics, and retirement policies (e.g., Coile et al. 2020).

[3] Chan and Stevens (2004) highlight that, beyond financial incentives, barriers to reemployment, such as age discrimination and high search costs, are crucial to understanding behavior after late-career job loss.

[4] Rege et al. (2009) examine the short-term effects of firm downsizing on disability pension utilization. They focus on both laid off workers and those who remain in the firm after downsizing, finding that downsizing increases disability pension utilization for up to four years after the event.

Many of the studies on retirement responses exploit pension reforms that simultaneously shift statutory retirement ages and alter financial incentives. As a result, many papers estimate large responses due to shifts in the statutory retirement age, larger than my estimated response to job loss. While these studies capture short-term effects on individuals close to retirement, my analysis examines the long-term impact of job loss, which operates through career disruptions, that alter pension benefits eligibility. I contribute to this literature by studying how a negative labor market shock occurring far from retirement affects behavior two to three decades later.

The remainder of the paper proceeds as follows. Section 2 describes the institutional setting. Section 3 describes the different datasets and analysis samples. The empirical strategy is described in section 4. Section 5 presents the results and section 6 concludes.

2 Institutional Setting

Key Features of the Public Pension System The German public pension system has a pay-as-you-go scheme and covers most private sector employees. For most retirees, the public pension is the most important income source, with the income of occupational pensions or individual retirement accounts not playing a major role. In this system, pension benefits are determined by a pension formula based on a worker's lifetime contribution history. Hence, pensions are roughly proportional to lifetime income and there is relatively little redistribution (Börsch-Supan and Wilke 2004).

There are two types of statutory retirement ages: the normal retirement age (NRA) and the early retirement age (ERA), which depend on the birth cohort, gender, and contribution history of the worker. The NRA is the age at which an individual can claim the full pension. For workers in the analysis samples, whose birth cohort is between 1938 and 1954, the NRA varies between 60 and 65. In general, the retirement age has increased over time, allowing earlier cohorts to retire at earlier ages.[5]

[5] See appendix table B2 for more information on how the ERA and NRA vary by birth cohort and pathway.

In contrast to the NRA, the ERA is the age at which a worker can claim a pension at the earliest point, but only with deductions. Specifically, a 0.3% deduction is imposed for each month a worker retires before reaching the NRA. For example, if a worker decides to go into early retirement two years before reaching the NRA, the pension benefits would be 7.2% less. For workers in the analysis samples, the ERA varies between 60 and 63. In addition to retiring earlier, it is also possible for workers to work beyond the NRA, if an employer agrees to extend their contract. For each month a worker retires after the NRA, a reward of 0.5% is paid.

Depending on workers' pathway into retirement, they have to meet different requirements to claim a pension.[6] For claiming a regular pension, the only requirement is to have at least five contribution years (Rentenversicherung 2021b). Early pension claiming has stricter requirements and generally requires more contribution years.[7] If job loss leads to losses in contribution years, displaced workers may face difficulties in retiring early.

Calculation of Pension Benefits Pension benefits are calculated according to a pension formula based on the worker's lifetime contribution history:

$$B_i(R_i) = \sum_{t=0}^{R_i-1} p_{it} \times a(R_i) \times PV,$$

where $B_i(R_i)$ are pension benefits of worker i retiring at age R_i, p_{it} are worker i's contribution points at age t, $a(R_i)$ is the adjustment factor, and PV the pension value.

This formula has three components: the first component is the sum of the contribution points, which is the main determinant of a worker's pension.[8] In Germany, all pension contributions collected throughout working life are taken into account to calculate pension benefits. Pension contributions cannot only be acquired during periods of employment, but also during other insur-

[6] There is more information on the different pathways in appendix B.1.

[7] In Germany, there is an earnings test for pensioners between the ERA and NRA, under which earnings above €450 per month result in reductions to pension benefits. Early retirement while working in a regular job is therefore not attractive.

[8] Contribution points are determined by an individual's income relative to the average income of all insured individuals. For example, a person will receive exactly one contribution point in a year if their yearly income is equal to the average yearly income of all insured individuals.

ance periods such as unemployment, sickness, military service, or child raising. The number of pension contribution points is roughly proportional to workers' earnings or replacement payments, but there is a maximum number of points a worker can contribute per year. In general, workers with only a few contribution points will receive a low pension.

The second part of the formula is the adjustment factor ($a(R_i)$), which depends on the age of the worker at the time of pension claim. Workers have to a bear a penalty for claiming early, whereas they receive a reward if they retire after the NRA.[9] The third part of the formula is the current pension value (PV), which translates the adjusted contribution points into euros of pension benefits.

UI Benefits as Bridge to Retirement Some workers do not directly transition from employment to retirement but use unemployment insurance (UI) benefits as a stepping stone to retirement (Hairault et al. 2010; Giesecke and Kind 2013; Inderbitzin et al. 2016; Gudgeon et al. 2023). In Germany, unemployed workers receive about 60% of their last net earnings as replacement payments and job search requirements are very low for older workers. Depending on workers' birth cohort and age, the maximum duration of UI benefits ranged from 18 to 32 months for workers aged 55 or above. During periods of receiving UI benefits, workers continue to acquire pension contributions, which increase future pension benefits and make it attractive to use unemployment as a stepping stone into retirement. However, because UI benefits are lower than earnings, pension contributions made during unemployment will be lower.

3 Data

This paper uses two administrative datasets from Germany to estimate the effect of job loss on retirement and to measure the lifetime costs of job loss. These datasets have several valuable, complementary features. The following sections describe each dataset and the analysis samples.

[9] $a(R_i) < 1$ if a worker retires at the ERA, $a(R_i) = 1$ if a worker retires at the NRA, and $a(R_i) > 1$ if a worker retires after the NRA.

3.1 SIAB

The first dataset comprises a 2% random sample of employment biographies from 1975 to 2021 (SIAB) (Graf et al. 2023), provided by the Institute for Employment Research.[10] This dataset allows me to follow each worker from the time of displacement until their exit from the labor market. It consists of daily information on all periods in employment covered by social security, all periods of receiving UI benefits, and all periods registered as searching for a job. Each period contains information on the corresponding wages and benefit levels. The wage information is very accurate, as employers have to report wages for social security purposes. However, wages are right-censored at the social security contribution ceiling, so I impute right-censored wages.[11] The dataset also includes a rich set of personal and job-related characteristics, such as gender, education, occupation, and year of birth. Finally, the data allows to identify plant closures, which I use as exogenous job separations.[12]

A caveat is that the data does not include information on pension claims and pension benefits. Therefore, I use the year of labor market exit as a proxy for the year of retirement.[13] In addition to retirement, there are few other reasons why people can exit the dataset, such as becoming self-employed, starting a civil service job, emigrating, or dying. For these individuals, the year of retirement entry is not correctly identified. To avoid misclassification, I exclude workers in the public sector (where transitions to civil service jobs are likely) and deceased workers.

If the degree of misclassification would differ systematically between displaced and non-displaced workers, this would bias my estimates. However, as shown in appendix figure A-1, the data exit rates after job loss are very similar between the treatment and control group, suggesting no differential attrition. Finally, results are very similar using an alternative sample that includes only those workers who exit the data specifically due to retirement.[14]

[10] This study uses the weakly anonymous version of the Sample of Integrated Labour Market Biographies (SIAB) – Version 7521 v1 (DOI: 10.5164/IAB.SIAB7521.de.en.v1) The data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently remote data access. This dataset does not include civil servants and self-employed people.

[11] For example, in 2021, the social security contribution ceiling was € 85,000 in West Germany and € 80,000 in East Germany. In my sample, only 11% of wages for displaced and matched non-displaced workers are right-censored. For the imputation of right-censored wages and other data preparation steps, I follow the suggestions in Dauth and Eppelsheimer (2020).

[12] To identify plant closures, I use an extension file that contains information on the type of plant exit (Hethey-Maier and Schmieder 2013).

[13] I allow workers to work in small, irregular employment relationships while in retirement. More specifically, I consider workers as retired if they only work in marginal employment in a given year and have already reached the normal retirement age.

[14] There is more information on this alternative sample in section 5.5.

3.2 VSKT

To complement my analysis, I use administrative pension data, provided by the German Federal Pension Register. I use a 25% sample of individuals with a public pension insurance account (SUFVSKT), covering those who had an active insurance account between the ages of 15 and 67 at the time of data collection.[15]

The dataset consists of monthly information on all periods of employment, periods of receiving UI benefits, and other insurance periods, such as sickness, child care, caregiving, and military service. Each individual account can be observed from the age of 14. The dataset includes some personal characteristics such as gender and year of birth.

Unlike the SIAB, this dataset contains precise information on the exact age at which individuals first claim their pension, as well as their accumulated pension points and contribution years. I use the pension claim age reported in this dataset to define retirement: an individual is considered retired in the year in which they first claim their pension. This also allows me to compute each worker's pension benefit amount directly from their recorded contribution history. I therefore use this dataset to examine the effects of job loss on pension benefits and the associated lifetime costs of job loss. However, the dataset does not include information on employers, which means that I cannot link plant closures to workers, nor can I match individuals across the two datasets.

3.3 Analysis Samples

In my analysis, displaced workers are considered workers who (involuntarily) separate from their long-term jobs. For these workers, job loss is likely to be unexpected and costly, as they would most likely not have changed jobs otherwise. To focus on this group, I consider workers with at least three years of tenure in the year before the job loss ($t-1$). In my analysis, I aim to estimate the long-term effects of job loss. Therefore, I focus on workers aged 35 to 45 (in $t-1$), excluding those closer to retirement.[16] I consider all birth cohorts that can be observed from ages 35 to 66 to be able to identify workers' retirement entry. In the SIAB, this includes birth cohorts between

[15]The main dataset is assembled from 15 years of cross-sectional waves (2004-2018) (SUFVSKT2004-SUFVSKT2019) (Forschungsdatenzentrum der Rentenversicherung FDZ-RV).

[16]The SIAB does not allow identification of job loss at earlier ages for all birth cohorts.

1943 and 1954. In the VSKT, this includes birth cohorts between 1938 and 1952. In the following, I explain how displaced workers are defined in each dataset. The definitions differ slightly between the datasets due to their specific characteristics.

SIAB In the SIAB, I exploit plant closures as quasi-random job losses. A plant closure is defined as an establishment with at least 10 employees that closes between June 30 of two consecutive years.[17] I then define a worker as displaced in year t if he leaves the plant in year t and the plant has a closure in year t or $t+1$.

For each worker, I consider the first displacement, as future outcomes may be influenced by this initial event. To construct a control group of non-displaced workers, each non-displaced worker is randomly assigned a "placebo job loss". I only consider non-displaced workers who are also employed at plants with at least 10 employees and meet the sample restrictions. The control group consists of never treated individuals (i.e. workers who never experience a plant closure). Before matching, the sample consists of 1,981 displaced and 59,616 non-displaced workers.[18]

VSKT In the VSKT, I identify job losses through transitions between employment and unemployment, as I cannot link workers to plant closures. Unlike the SIAB sample, which includes only individuals who involuntarily lost their job due to plant closures, the VSKT sample captures both voluntary and involuntary job separations. As in the SIAB sample, the analysis is restricted to high-tenured workers (those with at least three years of employment tenure).

In the VSKT sample, a worker is defined as displaced in year t if he transitions from employment to unemployment between year $t-1$ and t. For each worker, I consider the first job loss and randomly assign each non-displaced worker a "placebo job loss". I only consider non-displaced workers who fulfill the sample restrictions. Before matching, the final sample consists of $2,299$ displaced and $19,061$ non-displaced workers.

[17] The definition also requires that no more than 40% of the outflow is to one particular establishment (Hethey-Maier and Schmieder 2013). This restriction is to identify "true" closures from those that could be spin-offs of existing plants, takeovers, or ID changes.

[18] The relatively small sample size compared to other studies on the effects of job loss comes from the fact that I have to restrict my analysis to cohorts that I can observe until their retirement.

4 Empirical Strategy

My analysis focuses on estimating the causal effect of job loss on retirement. To estimate this effect, ideally, I would randomly assign job losses to workers. As this is not feasible in practice, I use a setting where high-tenured workers lose their jobs (due to plant closures) and employ a matching procedure to compare displaced workers with similar non-displaced workers. In this section, I describe the matching procedure, the main empirical specifications, and the main identification assumption.

4.1 Matching procedure

Even though a setting where high-tenured workers lose their jobs (due to plant closures) leads to plausibly exogenous events for those workers, there are still observable differences between displaced and non-displaced workers that make comparison difficult. For example, displaced workers tend to be older, less educated, and have lower earnings. These differences may affect retirement choices.

To address this, I employ coarsened exact matching (Iacus et al. 2011, 2012) and match displaced workers with similar non-displaced workers. I match exactly on the worker's age, gender and birth cohort, and coarsely on the worker's cumulative pension contribution points, tenure, age at data entry, education (all measured in $t-1$), and log earnings (in $t-1$ and $t-2$).[19]

Matching exactly on the birth cohort is important for the analysis, as statutory retirement ages vary from one cohort to another. If displaced and non-displaced workers are from different birth cohorts, comparison could be biased due to different retirement rules. Matching on cumulative contribution points and age at data entry ensures that each displaced worker is paired with control workers who have similar contribution histories before the job loss. Finally, matching on tenure and earnings ensures that displaced workers are compared to non-displaced workers with similar work experience and earnings histories. By matching exactly on age and birth cohort, I also ensure that the comparison between displaced and matched control workers occurs at the exact same age and calendar year. In robustness checks (see section 5.5), I also match workers on 2-digit occupation codes and control for plant characteristics (plant size and industry), finding very similar results.

[19] There are three education categories in the SIAB: compulsory schooling, high school/vocational training, and college. In the VSKT, I can only distinguish between those with and without a college degree. In the SIAB, I use tertiles of cumulative contribution points, tenure and age of data entry, and quantiles of log earnings. In the VSKT, I use only two groups for all covariates due to the smaller pool of potential control workers.

The matching procedure creates cells in which displaced and non-displaced workers have identical coarsened characteristics. The matched sample includes all displaced and non-displaced workers in cells containing at least one displaced and one non-displaced worker. Non-displaced workers are weighted to account for the different numbers of displaced and non-displaced workers within each cell.[20] After matching, the SIAB sample includes 1,658 displaced and 13,001 non-displaced workers, and the VSKT sample includes 1,961 displaced and 7,301 non-displaced workers.

Summary Statistics before and after Matching Table 1 and table 2 present summary statistics for the SIAB and VSKT sample before and after matching. The first three columns report statistics before matching and columns 5 to 7 after matching. Before matching, displaced workers are somewhat negatively selected compared to non-displaced workers. They have lower earnings and are less likely to have a college degree. They tend to retire later than non-displaced workers.

After matching, only small differences remain between displaced and non-displaced workers. By construction, displaced and non-displaced workers are identical in terms of all coarsened covariates used in the matching procedure. On average, workers are around 40 to 41 years old, meaning that they are roughly 20 years away from the earliest retirement age.[21] After matching, the gap in the retirement age between displaced and non-displaced workers becomes smaller, suggesting that part of the unconditional gap can be attributed to pre-displacement differences in worker characteristics.

Comparison of the two analysis samples shows that the VSKT sample includes a larger share of women and has lower earnings compared to the SIAB sample. Since the SIAB starts in 1975, some variables are left-censored, leading to differences in these variables across the samples.

[20] Each displaced worker is assigned a weight of one. In cells where there are more displaced workers than non-displaced workers, each non-displaced worker receives a weight greater than one. Conversely, in cells with more non-displaced workers, each non-displaced worker receives a weight smaller than one. This matching procedure successfully matches 84% of displaced workers in the SIAB sample and 85% of displaced workers in the VSKT sample to similar control workers.

[21] Appendix figure A-2 shows the age distribution in the year before the job loss ($t-1$) for the two analysis samples.

Table 1: Summary Statistics SIAB

	Before Matching			After Matching		
	Displaced	Controls	p-value	Displaced	Controls	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Matched Variables:						
Age	40.75	40.34	0.00	40.72	40.72	1.00
	(3.21)	(3.29)		(3.28)	(3.27)	
Birth year	1949.38	1948.89	0.00	1949.27	1949.27	1.00
	(3.45)	(3.50)		(3.51)	(3.51)	
Female	0.35	0.37	0.04	0.34	0.34	1.00
	(0.48)	(0.48)		(0.47)	(0.47)	
Education						
Compulsory schooling	0.19	0.17	0.01	0.17	0.17	1.00
	(0.39)	(0.38)		(0.38)	(0.38)	
High school/vocational training	0.75	0.72	0.00	0.78	0.78	1.00
	(0.43)	(0.45)		(0.41)	(0.41)	
College	0.06	0.11	0.00	0.05	0.05	1.00
	(0.24)	(0.31)		(0.21)	(0.21)	
Yearly labor earnings (in 1000s)	38.90	45.20	0.00	38.70	39.15	0.47
	(21.47)	(29.49)		(21.75)	(23.51)	
Job tenure*	8.92	8.70	0.04	9.12	9.09	0.82
	(4.90)	(4.60)		(5.02)	(5.03)	
Cumulative pension contribution points*	12.15	12.52	0.02	12.20	12.10	0.65
	(7.46)	(7.10)		(7.78)	(7.71)	
Unmatched Variables:						
Experience in unemployment*	0.20	0.20	0.92	0.18	0.18	0.89
	(5.33)	(4.83)		(5.48)	(5.46)	
Non-Native	0.13	0.11	0.02	0.11	0.11	0.88
	(0.34)	(0.32)		(0.31)	(0.31)	
Outcome Variables:						
Retirement age	60.82	60.28	0.00	60.86	60.53	0.04
	(5.97)	(6.43)		(5.90)	(6.18)	
Observations	1981	59616		1658	13001	

Notes: This table displays means and standard deviations (in parentheses) for different variables in the year before the job loss ($t-1$) for the SIAB sample. For the variable retirement age, right-censored observations contribute one observation at age 66 to the sample. Variables marked with * are left-censored in 1975. Columns (1) - (3) show the unmatched sample and columns (4) - (6) the matched sample. Columns (4) - (6) are weighted. Columns (3) and (6) test for differences in means between displaced and control workers. Earnings are measured in 2015 Euros.

Table 2: Summary Statistics VSKT

	Before Matching			After Matching		
	Displaced	Controls	p-value	Displaced	Controls	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Matched Variables:						
Age	40.42	39.99	0.00	40.40	40.40	1.00
	(3.23)	(3.32)		(3.28)	(3.28)	
Birth year	1946.04	1944.75	0.00	1945.94	1945.94	1.00
	(4.43)	(4.28)		(4.42)	(4.42)	
Female	0.56	0.48	0.00	0.58	0.58	1.00
	(0.50)	(0.50)		(0.49)	(0.49)	
Education						
No college	0.92	0.89	0.00	0.95	0.95	1.00
	(0.27)	(0.31)		(0.22)	(0.22)	
College	0.08	0.11	0.00	0.05	0.05	1.00
	(0.27)	(0.31)		(0.22)	(0.22)	
Yearly labor earnings (in 1000s)	30.45	34.12	0.00	30.27	30.51	0.50
	(12.64)	(13.72)		(12.99)	(13.40)	
Employment tenure	7.96	8.95	0.00	7.98	8.07	0.59
	(5.39)	(5.82)		(5.37)	(5.73)	
Cumulative pension contribution points	19.26	21.06	0.00	19.30	19.50	0.32
	(7.23)	(7.28)		(7.46)	(7.44)	
Unmatched Variables:						
Experience in unemployment	0.20	0.12	0.00	0.19	0.17	0.27
	(0.59)	(0.47)		(0.57)	(0.58)	
Outcome Variables:						
Retirement age	62.96	62.46	0.00	62.90	62.58	0.00
	(2.45)	(2.31)		(2.46)	(2.40)	
Yearly pension benefits (in 1000s)	16.99	22.10	0.00	16.91	19.15	0.00
	(7.88)	(9.14)		(7.97)	(8.55)	
Observations	2299	19061		1961	7301	

Notes: This table displays means and standard deviations (in parentheses) for different variables in the year before the job loss ($t-1$) for the VSKT sample. Columns (1) - (3) show the unmatched sample and columns (4) - (6) the matched sample. Columns (4) - (6) are weighted. Columns (3) and (6) test for differences in means between displaced and control workers. Earnings and pension benefits are measured in 2015 Euros.

4.2 Empirical Specifications

This section describes the main specifications and identification assumption used to estimate the impact of job loss.

Long-term Labor Market Impact of Job Loss To examine the impact of job loss, I use quasi-experimental variation in job loss induced by plant closures (using the SIAB). I match displaced workers to non-displaced workers, which enables me to compare similar workers, with some experiencing the shock and the others not. To show the long-term labor market impact of job loss, I estimate the following specification:

$$y_{i,k} = \sum_{k=-5,k\neq-1}^{25} \gamma_k \times \mathbb{1}[\text{Event time} = k] + \sum_{k=-5,k\neq-1}^{25} \beta_k \times \mathbb{1}[\text{Event time} = k] \times \text{Disp}_i + \psi_i + \delta_t + \varepsilon_{i,k}, \quad (1)$$

where $y_{i,k}$ is the outcome of worker i in event time k, $\mathbb{1}$ is an indicator equal to one in event time k and zero otherwise, and Disp_i is an indicator equal to one if worker i has been displaced. I control for individual (ψ_i) and year fixed effects (δ_t) and cluster standard errors at the level of the displacing plant.[22][23]

In this specification, the main coefficients of interest are the β_k's, which measure the effect of job loss on the outcome of interest in event time k. More precisely, the coefficient β_k estimates the change in the outcome of displaced workers relative to similar non-displaced workers in event time k.[24]

Retirement Timing To examine the effect of job loss on retirement timing, I change from event time to age and focus on the ages relevant for retirement. I simply compare the (weighted) means of displaced and matched non-displaced workers (using the SIAB). The specification is:

[22] I weight workers to account for the different numbers of treated and control workers within each matching cell.

[23] Results are very similar when standard errors are clustered at the individual level.

[24] A recent literature shows that event study estimates can be biased if the timing of treatment is staggered and treatment effects are heterogeneous or evolve over time (Goodman-Bacon 2021). To address this concern, I use a matched control group of never-treated individuals (i.e., individuals who never experience a plant closure), which ensures that comparisons are always made between treated and never-treated individuals.

$$y_{i,k} = \sum_{k=55}^{66} \gamma_k \times \mathbb{1}[\text{Age} = k] + \sum_{k=55}^{66} \beta_k \times \mathbb{1}[\text{Age} = k] \times \text{Disp}_i + \varepsilon_{i,k}, \tag{2}$$

where $y_{i,k}$ is an indicator equal to one if worker i is retired at age k and zero otherwise, $\mathbb{1}$ is an indicator equal to one at age k and zero otherwise, and Disp_i is an indicator equal to one if worker i has been displaced.[25] Standard errors are clustered at the level of the displacing plant.

In this specification, the main coefficients of interest are the β_k's, which measure the effect of job loss on the probability to be retired at age k. More precisely, the coefficient β_k estimates the change in the retirement probability of displaced workers relative to similar non-displaced workers at age k.

Pension Benefits To examine the effect of job loss on pension benefits, I compare displaced workers to similar non-displaced workers using the VSKT. The specification is:

$$y_i = \beta_0 + \beta_1 \times \text{Disp}_i + \varepsilon_i, \tag{3}$$

where y_i are annual pension benefits of worker i, and Disp_i is an indicator equal to one if worker i has been displaced. In this specification, β_1 measures the effect of job loss on pension benefits.

Lifetime Costs of Job Loss In the final part of the paper, I provide summary measures of the lifetime costs associated with job loss. To do this, I use the VSKT and estimate the difference in the present discounted value (PDV) of lifetime income for displaced workers relative to matched control workers. I begin by computing the PDV of income for each worker i:

$$PDV(y_i) = \sum_{t=D}^{T} \frac{1}{(1+r)^{(t-D)}} y_i,$$

where y_i is income, D is the year of job loss, T the year of the final pension payment, and r the discount rate. Since workers can only be observed until they retire, I assume that all workers receive pension benefits until the age of 80 ($T = 80$). I assume a discount rate of 3%.[26]

[25] Since displaced and non-displaced workers are of exactly the same age and birth cohort, the inclusion of year fixed effects does not change the results.

[26] Appendix table A-6 and A-7 show that the results remain largely unchanged when using alternative assumptions regarding the discount rate and the age until which workers would receive pension benefits.

I then simply use the values of $PDV(y_i)$ to estimate the difference between the PDV of income of displaced workers and that of matched non-displaced workers:

$$PDV(y_i) = \beta_0 + \beta_1 \times \text{Disp}_i + \varepsilon_i, \tag{4}$$

where Disp_i is an indicator equal to one if worker i has been displaced.

Identification Assumption For the analyzes, the key identification assumption is that, without job loss, the change in the outcome variables (e.g. earnings, retirement probability, pension benefits, lifetime income) would have been comparable between displaced and matched non-displaced workers. While I cannot directly test this assumption, I can examine how labor market outcomes for displaced and matched non-displaced workers evolve around the time of the job loss. Ideally, pre-displacement trends for both groups should be very similar.

5 Results

In this section, I first examine the long-term impact of job loss, tracking its effects for up to 25 years. Then, I turn to analyze its influence on workers' retirement behavior, showing that displaced workers tend to delay retirement in response to the shock. I explore the factors driving this delay and find that it is primarily due to lost eligibility for early pension claims. I show that despite postponing retirement, displaced workers still experience significant reductions in pension benefits. Finally, I quantify the lifetime costs of job loss, taking into account both changes in retirement timing and pension benefits.

5.1 Long-term Labor Market Impact of Job Loss

I begin by exploring the impact of job loss on earnings, employment, and wages. Figure 1 shows the estimated effects of job loss relative to matched non-displaced workers, controlling for individual and year fixed effects. The coefficients from estimating equation (1) are plotted relative to the average of the outcome variable in the year before displacement ($t-1$).

As a first step, I verify that the matching procedure produces a comparable control group. Figure 1 shows that the pre-displacement differences in the outcomes are close to zero, suggesting that, absent the plant closure, displaced and non-displaced workers would have followed similar trajectories.[27]

The figure shows that job loss causes long-term reductions in earnings and wages. Panel (a) shows a sharp decline in the earnings of displaced workers relative to their non-displaced counterparts. Displaced workers experience average annual earnings losses of around €4,700 over the 25 years after job loss, a 12% reduction relative to their pre-displacement average. Panels (b) and (c) show how much of the earnings losses are driven by losses in employment and wages. Panel (b) shows that displaced workers experience large immediate employment losses, but employment recovers over time. The gap in employment nearly closes as workers approach retirement age. In the analysis sample, the first birth cohort becomes eligible for early retirement at event time 15, and all individuals reach the normal retirement age by event time 35.[28]

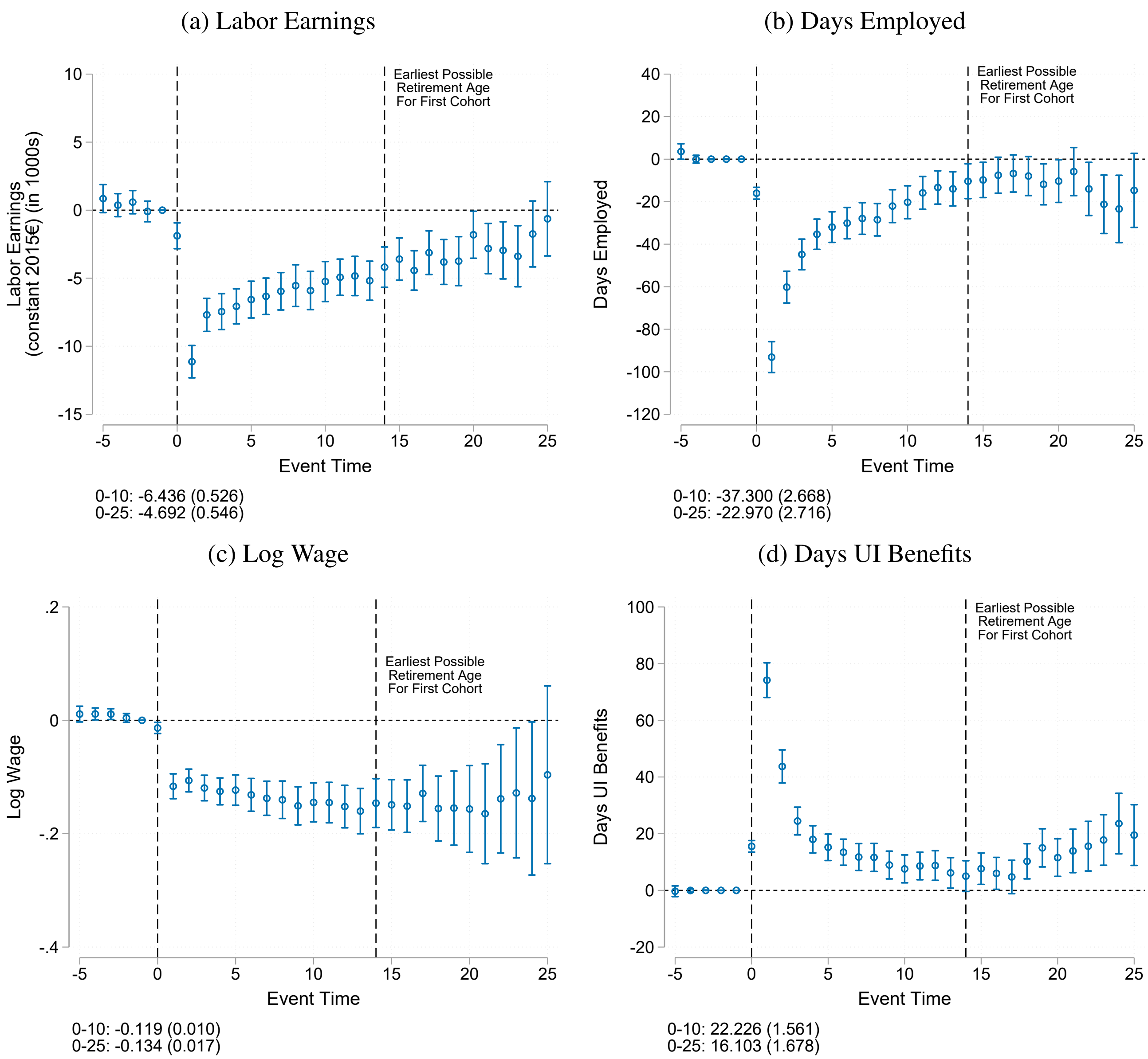
Panel (c) shows that long-term earnings losses can be attributed to substantial wage losses, consistent with recent evidence (Schmieder et al. 2023; Lachowska et al. 2020; Jarosch 2023). On average, displaced workers experience wage losses of about 12% over the 25 years following job loss. Finally, panel (d) indicates that the initial job loss is followed by extended periods of unemployment benefit receipt, suggesting that displaced workers experience repeated job separations (Stevens 1997; Jarosch 2023). As workers reach retirement age, unemployment increases more among displaced than non-displaced workers, suggesting that some may delay retirement by remaining unemployed longer. Initially, displaced workers are also more likely to switch industries or occupations (see appendix figure A-4).[29]

[27] Appendix figure A-3 shows raw means for the same outcomes and appendix figure A-5 shows results for the VSKT sample.

[28] I treat all individuals who are not observed in the data in a given year (e.g., due to self-employment) as working zero days or earning zero income.

[29] Appendix figure A-4 also presents results for additional outcomes, such as cumulative earnings.

Figure 1: Impact of Job Loss on Labor Earnings, Employment, and Wage



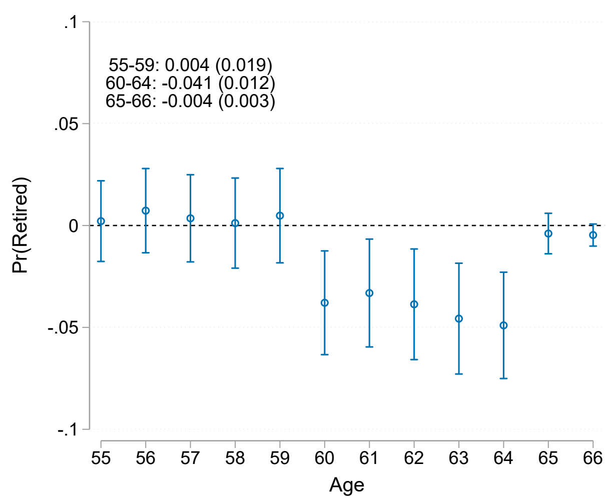
Notes: This figure shows the effect of job loss on different outcomes for displaced workers relative to matched control workers using the SIAB. Coefficients are estimated using specification (1). 95% confidence intervals are derived from standard errors clustered at the level of the displacing plant. The coefficients and standard errors (in parentheses) in the lower left corner are averages of the point estimates for 0–10 years, and 0–25 years after job loss.

Overall, my findings are broadly consistent with recent evidence from Schmieder et al. (2023) and Jarosch (2023), who document large losses following job displacement in Germany.[30] I further show that, in the very long run, the gap in earnings and employment between displaced and non-displaced workers narrows, suggesting that labor market outcomes increasingly reflect retirement behavior.

5.2 Impact of Job Loss on Retirement Timing

I begin by investigating the impact of job loss on retirement timing. Figure 2 shows the difference in the retirement probability between displaced and matched non-displaced workers, estimated using specification (2). The figure shows that before age 60, the difference in the retirement probability is close to zero. However, after the age of 60, the probability of retirement decreases significantly for displaced workers relative to their matched control workers, indicating that displaced workers are less likely to retire. Displaced workers are about 4 percentage points (pp) (10%) less likely to be retired from ages 60 to 64, a period in which most workers can only retire early. Early retirement is only possible with pension deductions and for those who meet the eligibility criteria.

Figure 2: Effect of Job Loss on Retirement



Notes: This figure shows the effect of job loss on the retirement probability of displaced workers relative to matched control workers using the SIAB. Coefficients are estimated using specification (2). 95% confidence intervals are derived from standard errors clustered at the level of the displacing plant. The coefficients and standard errors (in parentheses) in the upper left corner are averages of the point estimates from age 55-59, 60-64, and 65-66.

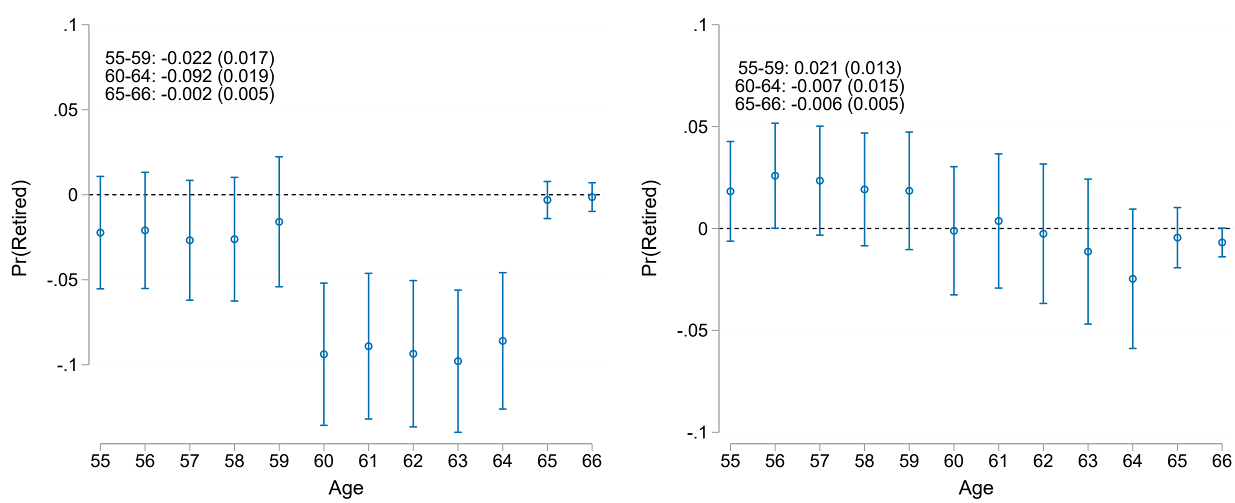
[30] To put my findings into perspective, Schmieder et al. (2023) estimate earnings losses of about 12%, while Jarosch (2023) estimate earnings losses of about 15% 15 years after job loss.

After age 64, when all workers are eligible for their full pension under less stringent criteria, the difference in the retirement probability diminishes. This pattern suggests that displaced workers tend to delay their retirement to avoid pension deductions and/or to meet less stringent eligibility criteria.[31] Appendix figure A-7 shows similar findings when using the VSKT sample and for men and women.

After presenting the overall effect, I next explore whether the effect on retirement varies by birth cohort. Statutory retirement ages have increased over time and some early retirement options have been abolished for later cohorts. As a result, individuals born later have fewer choices in their retirement decision, which should limit displaced workers' ability to adjust. Figure 3 presents the results for early and late birth cohorts. I define early birth cohorts as those born between 1943 and 1947 and late birth cohorts as those born between 1948 and 1954.[32] The results indicate that the delay in retirement is entirely driven by the earlier birth cohorts, who had a greater margin to adjust their retirement.

Figure 3: Effect of Job Loss on Retirement by Birth Cohort

(a) Early Birth Cohorts (b) Late Birth Cohorts



Notes: This figure shows the effect of job loss on the retirement probability of displaced workers relative to matched control workers by birth cohorts using the SIAB. Coefficients are estimated using specification (2). 95% confidence intervals are derived from standard errors clustered at the level of the displacing plant. The coefficients and standard errors (in parentheses) in the upper left corner are averages of the point estimates from age 55-59, 60-64, and 65-66.

[31] Appendix figure A-6 shows descriptive figures for the retirement probability for the matched and unmatched sample.

[32] This split is made to ensure comparable group sizes and is not related to any discontinuous change in the pension rules between the two groups.

Pathways into Retirement The results showed that displaced workers respond to job loss by delaying retirement. They can do this by working longer or taking up other social insurance programs, such as UI benefits, often referred to as program substitution (Inderbitzin et al. 2016). In both cases, future pension benefits will increase, and displaced workers can avoid the penalty for early pension claiming if they delay retirement to the normal retirement age. Future pension benefits will increase more if they stay in employment longer, since pension contributions from wage income are higher than those from UI benefits.

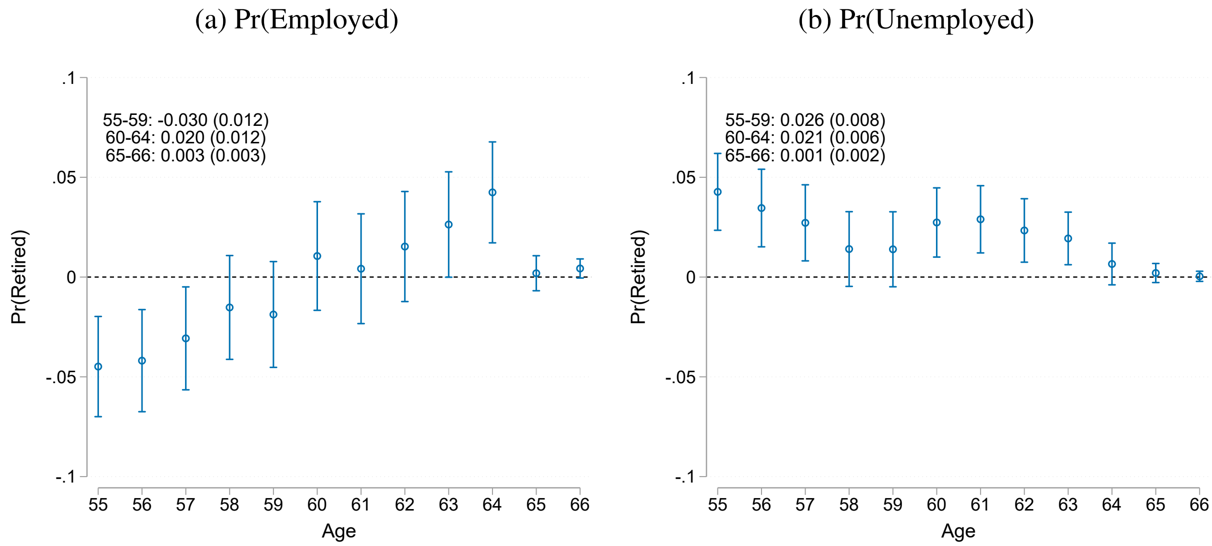
To understand how much of the decrease in the retirement probability is driven by increases in employment versus increases in unemployment, figure 4 shows the impact of job loss on the probability of being employed or unemployed. Figure 4 shows that displaced workers are less likely to be employed and more likely to be unemployed before the age of 60, resulting in a retirement probability close to zero.[33] After age 60, displaced workers delay retirement, which can be attributed to an equal increase in both employment and unemployment.[34] From ages 60 to 64, displaced workers are approximately 2 pp more likely to be employed and 2 pp more likely to be unemployed, explaining the overall 4 pp decrease in the retirement probability. This suggests that while some displaced workers delay retirement by staying in the workforce longer, others do so by using UI benefits.

Comparison with Late-Career Job Loss Previous studies have examined how job loss late in one's career affects retirement decisions (Chan and Huff Stevens 2001; Chan and Stevens 2004; Merkurieva 2019). These studies find that late-career job loss significantly increases the likelihood of exiting employment and retiring earlier. For comparison, appendix figure A-9 presents the effects of late-career job loss on retirement, estimated using specification (2) for a sample of workers who experience job loss between ages 50 and 59. The figure shows that displaced workers are more likely to be retired than similar non-displaced workers between ages 60 and 64. After age 64, the estimated treatment effect is close to zero.

[33]Note that the effects on employment and unemployment are not fully symmetric before age 60, as there is a small effect on retirement.

[34]The increase in employment among displaced workers relative to non-displaced workers is driven by a reduction in employment among non-displaced workers, rather than an increase in employment among displaced workers (see appendix figure A-8).

Figure 4: Pathways into Retirement



Notes: This figure shows the effect of job loss on the probability to be employed (panel a) and the probability to be unemployed (panel b) for displaced workers relative to matched control workers using the SIAB. Coefficients are estimated using specification (2). 95% confidence intervals are derived from standard errors clustered at the level of the displacing plant. The coefficients and standard errors (in parentheses) in the upper left corner are averages of the point estimates from age 55-59, 60-64, and 65-66.

5.3 What Influences Displaced Worker's Delay in Retirement?

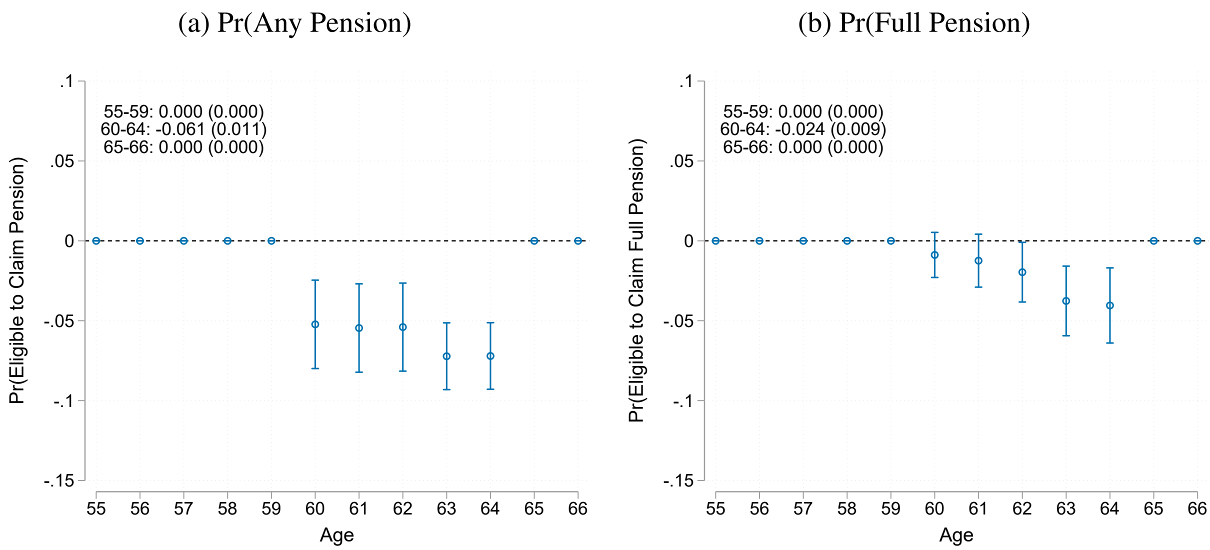
The previous section showed that displaced workers react to job loss by delaying retirement. I now examine factors that may influence this response.

Pension Benefits Eligibility I begin by examining how pension benefits eligibility influences displaced workers' delay in retirement. Workers who experience job loss may face difficulties in meeting the eligibility criteria for claiming pension benefits at the early retirement age (60-64). Generally, early retirement eligibility is more stringent than normal retirement eligibility, and displaced workers may struggle to meet these requirements due to periods of non-employment or irregular work. To investigate the effect of job loss on pension benefit eligibility, I use the VSKT data. This dataset provides precise information on all contribution periods necessary to determine eligibility.

Figure 5 presents the results. Panel (a) shows the effect of job loss on the probability of being eligible to claim any pension (early or full), and panel (b) shows the probability of being eligible to claim a full pension. Age 60 marks the earliest possible claim age, and age 65 marks the age at which all workers in the sample can claim a pension without deductions.[35]

Figure 5 shows that workers who experience job loss are significantly less likely to be eligible for pension benefits between the ages of 60 and 64. They are about 6 pp (9%) less likely to qualify for any pension benefits and about 2 pp (11%) less likely to qualify for a full pension. This suggests that eligibility for pension benefits may explain the observed delay in retirement of displaced workers.[36]

Figure 5: Impact of Job Loss on Pension Benefits Eligibility



Notes: This figure shows the effect of job loss on the probability to be eligible to claim any pension (early or normal) (panel a) and the probability to be eligible to claim a full pension (panel b) for displaced workers relative to matched control workers using the VSKT. Coefficients are estimated using specification (2). 95% confidence intervals are derived from standard errors clustered at the worker level. The coefficients and standard errors (in parentheses) in the upper left corner are averages of the point estimates from age 55-59, 60-64, and 65-66.

[35] The only requirement to claim a pension at the normal retirement age is to have at least five contribution years, which all workers in the sample fulfill.

[36] Appendix figure A-10 shows that the loss in eligibility is driven by workers who experience large initial earnings losses after job loss.

To further explore the role of pension benefits eligibility in mediating the delay of retirement for displaced workers, I correlate pension benefits eligibility with the retirement probability and estimate the following specification:

$$R_i = \beta_0 + \beta_1 \times \text{Disp}_i + \beta_2 \times \text{X}_i + \varepsilon_i, \tag{5}$$

where R_i is an indicator equal to one if worker i is retired, Disp_i is an indicator equal to one if worker i has been displaced, and X_i includes variables that are tested for correlation with workers' change in retirement. The specification is estimated from age 60 to 64, as the delay in retirement is observed during this age window.

I include the eligibility for pension claiming (early and full) as variables (X_i). Table 3 shows the results. Column 2 suggests a strong correlation between the change in eligibility for pension benefits and the change in the retirement probability. Once I include pension benefits eligibility as a control variable, the treatment effect decreases by approximately half relative to the baseline in column 1. This provides suggestive evidence of the role of pension benefits eligibility in mediating the impact of job loss. These findings are consistent with evidence from Seibold (2021), who shows that responses to statutory retirement ages in Germany are seven times larger than responses to purely financial incentives. However, the results of this analysis should be interpreted with caution. Drawing causal conclusions requires making strong assumptions about the source of variation in the mediating variable. Omitted variables such as differences in contribution points could affect both eligibility and retirement decisions, meaning that the relationship between eligibility and retirement is not necessarily causal.

Financial Incentives In addition to displaced workers being less likely to qualify for early pension claiming, financial incentives may also influence their delay in retirement. According to theory, job loss affects financial incentives for retirement through its effect on cumulative income and wage income near retirement. A substantial reduction in cumulative income due to job loss is expected to decrease retirement incentives because the large negative wealth effect increases the need for additional income. Hence, if displaced workers experience large cumulative income losses, this may explain their delay in retirement.

Table 3: Correlates of Workers Response to Job Loss

	(1) Pr(Retired)	(2) Pr(Retired)	(3) Pr(Retired)	(4) Pr(Retired)
Displaced - Non-displaced	-0.0598	-0.0312	-0.0549	-0.0196
	(0.0115)	(0.0102)	(0.0116)	(0.0103)
Early Pension Benefits Eligibility		0.382		0.381
		(0.0100)		(0.0100)
Full Pension Benefits Eligibility		0.225		0.245
		(0.0120)		(0.0121)
Cumulative Income Age 50			0.0000643	0.000145
(in 1000s)			(0.0000188)	(0.0000167)
Mean Non-displaced	0.522	0.522	0.522	0.522
% of Non-displaced	-11.46	-5.974	-10.52	-3.759
N	46310	46310	46310	46310

Notes: This table displays the effect of job loss on the retirement probability (from age 60-64) using the VSKT, estimated using specification (5). Standard errors (in parentheses) are clustered at the worker level. Column 1 shows the baseline result. Column 2 adds pension benefit eligibility (early and full) as controls. Column 3 adds cumulative income at age 50 as control. Column 4 adds all variables as controls.

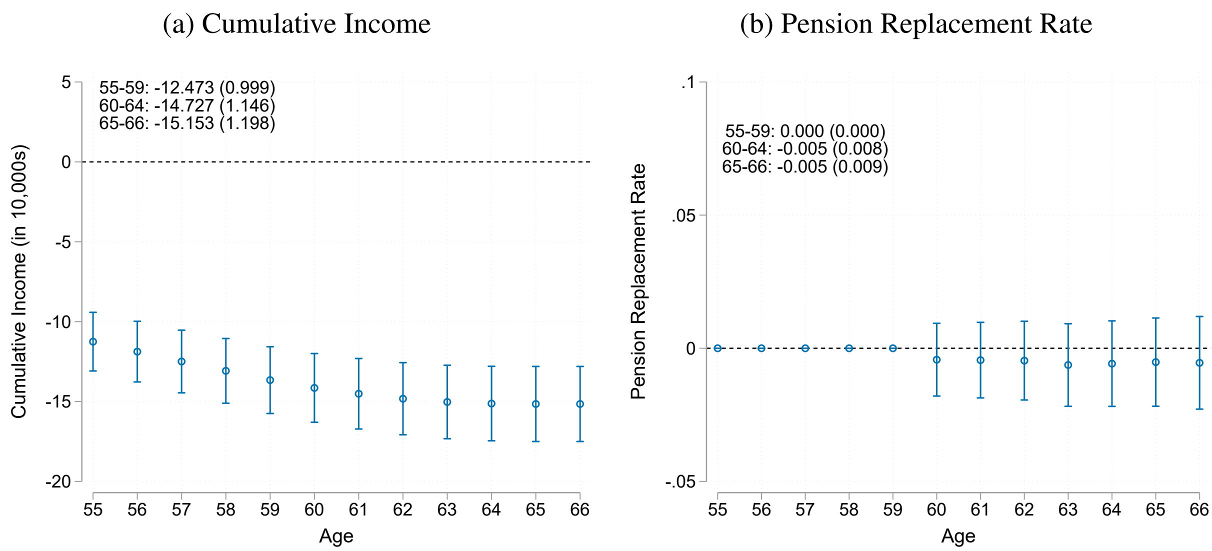
Conversely, a reduction in wage income near retirement is expected to increase retirement incentives, as it decreases the relative attractiveness of working versus retiring. In particular, a (relatively) lower wage income near retirement implies (relatively) low opportunity costs of retirement due to both few foregone wage income and few losses in additional pension contribution points. If displaced workers had a much higher wage income relative to their potential pension benefits (a lower pension replacement rate), this could lead to later retirement.

To investigate the role of financial incentives, I use the VSKT and begin by showing the effect of job loss on cumulative income and the pension replacement rate. For each individual, I define the pension replacement rate as the potential pension benefits received if retiring at a given age, divided by workers' pre-retirement earnings.[37] Figure 6 shows that displaced workers experience significant losses in cumulative income, but there is no effect on the pension replacement rate.

[37] For example, the pension replacement rate at age 61 is calculated as the pension benefits received if retiring at age 61, divided by pre-retirement earnings. I measure pre-retirement earnings at age 55. For workers who are not employed for the full year at age 55, the last year they are employed for the full year is used.

To further explore the role of financial incentives, I correlate cumulative income (at age 50) with the change in the retirement probability and estimate specification (5). I choose age 50 to ensure that workers are still at least ten years away from their earliest possible retirement age. Measuring cumulative income at a later age could confound cumulative income with retirement decisions, as workers may already adjust their labor supply in anticipation of retirement. As discussed earlier, this analysis should be interpreted with caution, as omitted variables could affect both cumulative income and retirement decisions. Column 3 of table 3 shows that accounting for financial incentives decreases the treatment effect by only about 1%. This provides suggestive evidence that the main factor driving the delay in retirement among displaced workers is the lack of pension benefit eligibility rather than financial incentives.

Figure 6: Job Loss and Financial Incentives for Retirement



Notes: This figure shows the effect of job loss on cumulative income (panel a) and the pension replacement rate (panel b) for displaced workers relative to matched control workers using the VSKT. Coefficients are estimated using specification (2). 95% confidence intervals are derived from standard errors clustered at the worker level. The coefficients and standard errors (in parentheses) in the upper left corner are averages of the point estimates from age 55-59, 60-64, and 65-66.

Alternative Explanations Finally, there may be some further explanations for the delay in retirement of displaced workers. First, displaced and non-displaced workers may end up in different types of jobs after job loss. If displaced workers are more likely to be employed in jobs that allow them to work longer, this could be an alternative explanation for their delay in retirement. However, appendix figure A-11 indicates that displaced workers are more likely to be employed in physically demanding jobs, which does not support this hypothesis.[38]

Second, job loss has been shown to affect family formation, leading to fewer children (Del Bono et al. 2012; Lindo 2010) and an increased probability of divorce (Foerster et al. 2022). These post-displacement changes may also influence retirement behavior. Several studies document that spouses often coordinate their retirement decisions (e.g., Johnsen et al. 2022; García-Miralles and Leganza 2024; Gustman and Steinmeier 2000). If displaced workers are more likely to be single, they may face fewer constraints related to joint retirement, which could offer an alternative explanation for their delayed retirement. Unfortunately, both datasets lack information on marital status, preventing me from testing this hypothesis.

5.4 Impact of Job Loss on Pension Benefits

Although displaced workers delay retirement, they still experience losses in pension benefits. Table 4 presents the results for the impact of job loss on pension benefits using the VSKT and estimating specification (3). Column 1 shows that displaced workers experience significant losses in pension benefits, amounting to about €1500 (12%) in annual pension benefits. Put differently, this is equivalent to roughly 1.5 months of pension benefits.

This difference in pension benefits can result from three factors: cumulative pension contribution years, average yearly pension contribution points, and/or the pension adjustment factor. Table 4 shows that losses in pension benefits are primarily driven by significant reductions in average yearly pension contribution points. By this, I refer to the average pension contribution points earned per year. Column 3 shows that displaced workers experience a decrease of approximately 9% in contribution points per year. This reduction can be attributed to lower post-displacement earnings and periods of non-employment, both of which lead to fewer pension contribution points.

[38] I use the classification by Kroll (2015) to categorize jobs into physically demanding and non-demanding jobs. Physically demanding jobs are those that score at least 9 out of 10 on the overall physical exposure index.

In contrast to yearly pension contribution points, the impact of job loss on cumulative pension contribution years is much smaller. This can be explained by the fact that, in Germany, pension contribution years can be accumulated not only during periods of employment but also during other insurance periods such as unemployment, sickness, or child care.

Column 4 shows the effect on the pension adjustment factor, which accounts for earlier or later retirement. Retiring before the normal retirement age results in pension deductions, while retiring after the normal retirement age leads to pension rewards. Column 4 indicates a positive effect on the pension adjustment factor, as displaced workers delay retirement, and later retirement leads to a more favorable pension adjustment factor.

Table 4: Impact of Job Loss on Determinants of Pension Benefits

	(1) Yearly Pension Benefits	(2) Cumulative Contribution Points	(3) Average Yearly Contribution Years	(4) Pension Adjustment Factor
Displaced - Non-displaced	-1495.8 (129.1)	-1.306 (0.252)	-0.0884 (0.00894)	0.00850 (0.00216)
Non-displaced Mean	12191.7	37.14	0.988	0.934
% of Non-displaced Mean	-12.27	-3.516	-8.951	0.911
N	9262	9262	9262	9262

Notes: This table displays point estimates and robust standard errors (in parentheses) for the impact of job loss on pension benefits and its determinants using the VSKT and estimating specification (3).

Appendix table A-2 shows how the overall effect varies across subgroups. Columns 1 and 2 indicate that women experience larger proportional losses in pension benefits. Columns 3 and 4 show that proportional losses are smaller for early birth cohorts, which is consistent with the fact that they drive the overall delay in retirement.[39]

Appendix table A-4 shows that late-career job loss leads to smaller reductions in pension benefits compared to the baseline estimate. Job loss between ages 50 and 59 results in about half the decline in annual pension benefits relative to the baseline. This is primarily because losses occur over a shorter time horizon, with fewer years remaining until retirement.

[39]Early birth cohorts are defined as those born before 1948, and late cohorts as those born in 1948 or later. This split ensures comparable group sizes.

5.5 Robustness

Alternative Estimation Strategy Matching displaced and non-displaced workers using coarsened exact matching avoids imposing any functional form relationship between the covariates and the outcomes. However, it comes at the cost of reducing the sample size. To address this, I estimate the impact of job loss using the full sample, controlling for pre-displacement characteristics. I use the following specification to estimate the effect on retirement timing:

$$y_{i,k} = \sum_{k=55}^{66} \gamma_k \times \mathbb{1}[\text{Age} = k] + \sum_{k=55}^{66} \beta_k \times \mathbb{1}[\text{Age} = k] \times \text{Disp}_i + \delta \times X_{i,t-1} + \varepsilon_{i,k}, \tag{6}$$

where $y_{i,k}$ is the probability that worker i is retired at age k (an indicator equal to one if worker i is retired at age k and zero otherwise), $\mathbb{1}$ is an indicator equal to one at age k and zero otherwise, Disp_i is an indicator equal to one if worker i has been displaced, and $X_{i,t-1}$ are pre-displacement worker characteristics. Standard errors are clustered at the level of the displacing plant.

To estimate the effect of job loss on pension benefits, I use the following specification:

$$y_i = \beta_0 + \beta_1 \times \text{Disp}_i + \delta \times X_{i,t-1} + \varepsilon_i, \tag{7}$$

where y_i are pension benefits of worker i, and Disp_i is an indicator equal to 1 if worker i has been displaced, and $X_{i,t-1}$ are pre-displacement worker characteristics.

In both specifications, I use the same set of covariates ($X_{i,t-1}$) as in the matching procedure, and measure the covariates in $t-1$. The results of this alternative strategy, shown in panel (a) of appendix figure A-12 and table A-3 are largely unchanged compared to the baseline findings.

Controlling for Plant Characteristics In addition to worker-level characteristics, the SIAB provides information on plant characteristics. Plant characteristics, such as firm size and industry, could influence workers' post-displacement career prospects, potentially influencing their retirement decisions. To account for pre-displacement differences in plant characteristics between displaced and non-displaced workers, I add controls for 1-digit industry and plant size to specification (6). The results, shown in panel (b) of appendix figure A-12, are very similar to the baseline findings.

Matching on Occupation Codes In addition to the covariates used in the main matching procedure, I also match displaced workers to non-displaced workers with the exact same two-digit occupation code.[40] Occupation captures aspects of worker skills and job characteristics, such as physical job demands, that can affect post-displacement outcomes and retirement behavior. This more restrictive matching procedure reduces the share of displaced workers that can be successfully matched to non-displaced workers to 33%. However, the results, shown in panel (d) of appendix figure A-12, remain very similar to the baseline findings. If anything, the decrease in the retirement probability of displaced workers relative to their matched controls becomes slightly larger.

Alternative SIAB Sample A caveat of the SIAB is that it does not include information on pension claims. The year of retirement entry is defined as the last year that a worker is observed in the data as employed or unemployed. However, there are other reasons why workers may leave the dataset, such as becoming self-employed, entering the civil service, or emigrating. For these individuals, the year of retirement entry may not be correctly identified.

To assess the sensitivity of my results to this potential misclassification, I construct an alternative sample that includes only workers whose exit from employment or unemployment is explicitly recorded as retirement.[41][42][43] While this approach conditions on observed retirement, it allows me to examine the timing of retirement among those who are classified as retired. This check helps to rule out the possibility that the baseline results are driven by exits unrelated to retirement, such as transitions to self-employment or emigration. The results, shown in panel (c) of appendix figure A-12, are largely unchanged compared to the baseline findings.

[40] Occupation codes are only available in the SIAB.

[41] Note that most employers do not specify the reason for the end of the employment relationship, typically reporting it as "Deregistration due to end of employment." As many employers do not report the retirement entry of their employees, the sample size for this robustness check is smaller than that of the main sample.

[42] Appendix table A-1 shows summary statistics for this sample.

[43] I use the following codes to identify retirement: (i) Withdrawal from working life, (ii) Retirement pension, (iii) Pension for reduced earning capacity (<15 hours), (iv) Pension for reduced earning capacity (15-30 hours), (v) Notification of the difference in amount in the case of earnings-replacement benefits during partial retirement.

5.6 The Lifetime Costs of Job Loss

The previous results showed that displaced workers not only experience substantial income losses during their working lives, but also face reductions in pension benefits that extend beyond their working years. In this section, I provide summary measures of the lifetime costs of job loss. To do so, I use the VSKT sample and estimate the difference in the present discounted value (PDV) of income for displaced workers relative to matched control workers using specification (4). For each worker, the PDV is computed from the year of job loss through age 80 (in the baseline).

The analysis of the lifetime consequences of job loss, as shown in table 5, reveals large costs for affected workers. Column 1 shows that job loss leads to large income losses, with displaced workers losing about €130,000 (25%) in the PDV of income on average. These income losses are driven by substantial earnings losses (31%). Although displaced workers experience reductions in pension benefits, these are more than offset by larger increases in UI benefit receipts.[44][45]

While previous research has documented effects up to 20 years after job loss, this paper extends the analysis by tracking workers throughout their entire life cycle. It captures not only earnings losses, but also delayed retirement and reductions in pension benefits. To put my estimates into perspective, Jarosch (2023) reports that the losses in the PDV of log earnings amount to about 21% over a 20-year follow-up period using German data, while Davis and von Wachter (2011) estimate lower PDV earnings losses of 12% for men in the US over a similar follow-up period.[46]

[44] Appendix tables A-6 and A-7 show that the results remain largely unchanged under alternative assumptions regarding the discount rate and the age to which workers receive pension benefits.

[45] Research has shown that job loss may also affect longevity (Sullivan and Von Wachter 2009; Browning and Heinesen 2012; Eliason and Storrie 2006). For example, using US data, Sullivan and Von Wachter (2009) estimate that job displacement between ages 35 and 45 reduces life expectancy by approximately 1.5 years. European studies tend to find smaller effects on mortality (Eliason and Storrie 2006; Browning and Heinesen 2012). Assuming that displaced workers receive pension benefits for one year less than non-displaced workers, e.g., due to earlier mortality, results in slightly larger losses in the PDV of income (see appendix table A-8).

[46] As in Jarosch (2023), I define job loss based on transitions from employment to unemployment (using the VSKT), capturing both involuntary and voluntary job separations. To assess how results differ by the nature of the job separation, I use the SIAB data to estimate PDV earnings losses for workers experiencing involuntary job separations due to plant closures. Consistent with Jarosch (2023), I find that involuntary separations are associated with less persistent long-term earnings losses. Appendix table A-5 shows that the PDV earnings losses from involuntary job separations are approximately half as large as those from any job separation (including both voluntary and involuntary separations) and are close to the estimate reported by Davis and von Wachter (2011), who use mass layoff separators. An explanation for the lower long-term losses of involuntary job losses may be that workers laid off during plant closures are less negatively selected compared to the average job loser, which may reduce post-displacement earnings losses.

Table 5: Lifetime Costs of Job Loss

	(1) PDV Total Income	(2) PDV Labor Earnings	(3) PDV Pension Benefits	(4) PDV UI Benefits Benefits
Displaced - Non-displaced	-130334.9	-134390.4	-11695.8	15751.4
	(7445.1)	(6855.5)	(911.6)	(834.8)
Non-displaced Mean	528674.4	429490.6	86175.5	13008.3
% of Non-displaced Mean	-24.65	-31.29	-13.57	121.1
N	9262	9262	9262	9262

Notes: This table displays point estimates and robust standard errors (in parentheses) for the impact of job loss on the PDV of income, labor earnings, pension benefits, and UI benefits using the VSKT and estimating specification (4).

Appendix table A-9 presents the lifetime costs of job loss by gender. Both displaced men and women experience significant reductions in the PDV of income and labor earnings, with men facing a 22% decline in the PDV of income and a 28% decline in the PDV of labor earnings. Women experience even greater losses, with a 27% decrease in the PDV of income and a 36% decline in the PDV of labor earnings.

The Role of the UI System in Buffering the Lifetime Costs of Job Loss UI systems are designed to support displaced workers by providing income during unemployment spells, which can help mitigate long-term costs. Appendix table A-10 examines the role of the UI system in buffering the lifetime costs of job loss. In a hypothetical scenario without the UI system, the loss in the PDV of income increases from about 25% to 29%, and the loss in the PDV of pension benefits increases from 14% to 16%. This reflects not only the absence of UI benefit payments but also the loss of pension contributions during unemployment, since workers continue to accrue pension entitlements while receiving UI benefits. These findings suggest that the UI system helps partially buffer the long-term costs of job loss.

Gains in Lifetime Income from Adjusting Retirement Behavior Despite their adjustment in retirement timing, displaced workers still experience large losses in lifetime income. One may therefore ask: what would income losses amount to if displaced workers had not adjusted their retirement timing? Answering this question is challenging, as one needs to know the counterfactual (unobserved) retirement behavior of displaced workers had they not lost their jobs. To overcome this challenge, I take advantage of having matched each displaced worker with similar non-displaced workers.

For this analysis, I pair each displaced worker with exactly one non-displaced worker who is in the same matching cell (i.e., has identical coarsened characteristics). If there are multiple control workers in a cell, I select the control worker with the most similar pre-displacement earnings.[47] I then assign each displaced worker the retirement age of their matched "twin" and calculate the corresponding pension benefits and income in this hypothetical scenario, accounting for changes in pension benefits eligibility and penalties for early pension claiming. I estimate specification (4) using the hypothetical income as outcome variable.

Table 6 shows that lifetime income losses would be slightly larger if displaced workers had not adjusted their retirement timing. Displaced workers would have experienced losses in the PDV of income of about €145,000 (26%), compared to about €136,000 (24%) in the baseline scenario. This shows that changes in retirement timing cannot compensate the large costs of job loss. Overall, the results highlight that the costs of job loss are substantial and extend beyond what short- or medium-term estimates of earnings losses can show.

[47]Each control worker is used only once (i.e., matching is performed without replacement). I use only one match, as this simplifies the calculation of hypothetical pension benefits, but the total income losses are very similar to using all potential controls (see column 1 in table 6). Using the mean retirement age of all potential controls in a cell could result in a non-integer value for the hypothetical retirement age, which complicates the calculation of pension benefits, especially since I account for changes in pension benefits eligibility and penalties for early pension claiming.

Table 6: Gains in Lifetime Income from Adjusting Retirement Behavior

	(1) Total Income	(2) Hypothetical Total Income
Displaced - Non-displaced	-135720.8 (8747.1)	-145246.3 (8611.0)
Non-displaced Mean	534766.5	534766.5
% of Non-displaced Mean	-24.03	-25.71
N	3642	3642

Notes: This table displays point estimates and robust standard errors (in parentheses) for the impact of job loss on the PDV of income and the PDV of hypothetical income using the VSKT and estimating specification (4). Hypothetical income is calculated by assigning each displaced worker the retirement age of their matched non-displaced "twin" and then calculating the corresponding income.

6 Conclusion

Economists have long been interested in studying the effects of job loss. Job loss has been shown to lead to large and persistent income losses (e.g., Jacobson et al. 1993; Couch and Placzek 2010; Davis and von Wachter 2011; Jarosch 2023; Lachowska et al. 2020; Schmieder et al. 2023) and impacts workers in various dimensions, such as family formation, health, and crime (e.g., Del Bono et al. 2012; Carneiro et al. 2023; Foerster et al. 2022; Sullivan and Von Wachter 2009; Black et al. 2015; Khanna et al. 2021). However, there is limited evidence on the impact of job loss on retirement and how it affects lifetime income. Some studies have examined how late-career job loss affects workers' retirement behavior (Chan and Huff Stevens 2001; Chan and Stevens 2004; Merkurieva 2019), but there is no evidence on how job loss in young and middle age impacts age at retirement, pension benefits, and lifetime income.

In this study, I provide the first evidence on the long-term effects of job loss on retirement and lifetime income. I document several new findings. First, I show that displaced workers react to the shock by delaying retirement. Between the ages of 60 and 64, displaced workers are about 10% less likely to be retired compared to similar non-displaced workers. Ineligibility for early pension claiming appears to be the main driver of this response. Second, although displaced workers delay retirement, they still experience losses in pension benefits. On average, job loss results in a 12%

reduction in annual pension benefits, which is equivalent to about 1.5 months of pension payments. Finally, I show that displaced workers experience substantial income losses. Taking into account changes in retirement timing and pension benefits, displaced workers experience losses of about 25% in the PDV of income.

References

Black, Sandra E, Paul J Devereux, and Kjell G Salvanes, "Losing heart? The effect of job displacement on health," *ILR Review*, 2015, *68* (4), 833–861.

Bono, Emilia Del, Andrea Weber, and Rudolf Winter-Ebmer, "Clash of career and family: Fertility decisions after job displacement," *Journal of the European Economic Association*, 2012, *10* (4), 659–683.

Börsch-Supan, Axel H and Christina B Wilke, "The German public pension system: how it was, how it will be," 2004.

Browning, Martin and Eskil Heinesen, "Effect of job loss due to plant closure on mortality and hospitalization," *Journal of health economics*, 2012, *31* (4), 599–616.

Carneiro, Pedro, Kjell G Salvanes, Barton Willage, and Alexander Willén, "Childhood shocks across ages and human capital formation," Technical Report 2023.

Chan, Sewin and Ann H Stevens, "How Does Job Loss Affect the Timing of Retirement?," *Contributions in Economic Analysis Policy*, 2004, *3* (1), 1–24.

_ **and Ann Huff Stevens**, "Job loss and employment patterns of older workers," *Journal of Labor Economics*, 2001, *19* (2), 484–521.

Coile, Courtney C and Phillip B Levine, "Labor market shocks and retirement: Do government programs matter?," *Journal of Public Economics*, 2007, *91* (10), 1902–1919.

_ **, Kevin Milligan, and David A Wise**, *Social Security Programs and Retirement around the World: Working Longer*, University of Chicago Press, 2020.

Couch, Kenneth A and Dana W Placzek, "Earnings losses of displaced workers revisited," *American Economic Review*, 2010, *100* (1), 572–89.

Dauth, Wolfgang and Johann Eppelsheimer, "Preparing the sample of integrated labour market biographies (SIAB) for scientific analysis: a guide," *Journal for Labour Market Research*, 08 2020, *54* (10).

Davis, Steven J and Till von Wachter, "Recessions and the costs of job loss," *Brookings Papers on Economic Activity*, 2011, pp. 1–73.

Eliason, Marcus and Donald Storrie, "Lasting or Latent Scars? Swedish Evidence on the Long-Term Effects of Job Displacement," *Journal of Labor Economics*, 2006, *24* (4), 831–856.

Foerster, Hanno, Tim Obermeier, Alexander Paul, and Bastian Schulz, "Job displacement, remarriage, and marital sorting," *Unpublished manuscript*, 2022.

Forschungsdatenzentrum der Rentenversicherung (FDZ-RV), "Insurance Accounts Sample 2004-2020 (Versichertenkontenstichprobe) (Version 1.0) [Dataset]," 2008-2024.

García-Miralles, Esteban and Jonathan M Leganza, "Joint retirement of couples: Evidence from discontinuities in Denmark," *Journal of Public Economics*, 2024, *230*, 105036.

Gelber, Alexander M, Adam Isen, and Jae Song, "The effect of pension income on elderly earnings: Evidence from social security and full population data," *NBER Working paper*, 2016.

Giesecke, Matthias and Michael Kind, "Bridge unemployment in Germany: Response in labour supply to an increased early retirement age," *Ruhr Economic Paper*, 2013, (410).

Goodman-Bacon, Andrew, "Difference-in-differences with variation in treatment timing," *Journal of Econometrics*, 2021, *225* (2), 254–277.

Graf, Tobias, Stephan Grießemer, Markus Köhler, Claudia Lehnert, Andreas Moczall, Martina Oertel, Alexandra Schmucker, Andreas Schneider, Stefan Seth, Ulrich Thomsen, and Philipp vom Berge, "Weakly anonymous Version of the Sample of Integrated Labour Market Biographies (SIAB) – Version 7521 v1," 2023.

Gudgeon, Matthew, Pablo Guzman, Johannes F Schmieder, Simon Trenkle, and Han Ye, "When Institutions Interact: How the Effects of Unemployment Insurance are Shaped by Retirement Policies," Working Paper 31807, National Bureau of Economic Research October 2023.

Gustman, Alan L. and Thomas L. Steinmeier, "Retirement in Dual-Career Families: A Structural Model," *Journal of Labor Economics*, 2000, *18* (3), 503–545.

Hairault, Jean-Olivier, Thepthida Sopraseuth, and François Langot, "Distance to Retirement and Older Workers' Employment: The Case for Delaying the Retirement Age," *Journal of the European Economic Association*, 09 2010, *8* (5), 1034–1076.

Hethey-Maier, Tanja and Johannes F. Schmieder, "Does the Use of Worker Flows Improve the Analysis of Establishment Turnover? Evidence from German Administrative Data," *Schmollers Jahrbuch : Journal of Applied Social Science Studies / Zeitschrift für Wirtschafts- und Sozialwissenschaften*, 2013, *133* (4), 477–510.

Iacus, Stefano M., Gary King, and Giuseppe Porro, "Multivariate Matching Methods That Are Monotonic Imbalance Bounding," *Journal of the American Statistical Association*, 2011, *106* (493), 345–361.

Iacus, Stefano M, Gary King, and Giuseppe Porro, "Causal inference without balance checking: Coarsened exact matching," *Political analysis*, 2012, *20* (1), 1–24.

Ichino, Andrea, Guido Schwerdt, Rudolf Winter-Ebmer, and Josef Zweimüller, "Too old to work, too young to retire?," *The Journal of the Economics of Ageing*, 2017, *9*, 14–29.

Inderbitzin, Lukas, Stefan Staubli, and Josef Zweimüller, "Extended unemployment benefits and early retirement: Program complementarity and program substitution," *American Economic Journal: Economic Policy*, 2016, *8* (1), 253–88.

Jacobs, Lindsay, "Occupations, retirement, and the value of disability insurance," *Journal of Public Economics*, 2023, *225*, 104976.

Jacobson, Louis S, Robert J LaLonde, and Daniel G Sullivan, "Earnings losses of displaced workers," *The American economic review*, 1993, pp. 685–709.

Jarosch, Gregor, "Searching for Job Security and the Consequences of Job Loss," *Econometrica*, 2023, *91* (3), 903–942.

Johnsen, Julian Vedeler, Kjell Vaage, and Alexander Willén, "Interactions in public policies: Spousal responses and program spillovers of welfare reforms," *The Economic Journal*, 2022, *132* (642), 834–864.

Khanna, Gaurav, Carlos Medina, Anant Nyshadham, Christian Posso, and Jorge Tamayo, "Job Loss, Credit, and Crime in Colombia," *American Economic Review: Insights*, March 2021, *3* (1), 97–114.

Kroll, Lars Eric, "Job Exposure Matrices (JEM) for ISCO and KldB (Version 2.0)," 2015.

Lachowska, Marta, Alexandre Mas, and Stephen A Woodbury, "Sources of displaced workers' long-term earnings losses," *American Economic Review*, 2020, *110* (10), 3231–66.

Lalive, Rafael, Arvind Magesan, and Stefan Staubli, "How social security reform affects retirement and pension claiming," *American Economic Journal: Economic Policy*, 2023, *15* (3), 115–150.

Lindo, Jason M, "Are Children Really Inferior Goods?: Evidence from Displacement-Driven Income Shocks," *Journal of Human Resources*, 2010, *45* (2), 301–327.

Merkurieva, Irina, "Late career job loss and the decision to retire," *International Economic Review*, 2019, *60* (1), 259–282.

Rabaté, Simon, Egbert Jongen, and Tilbe Atav, "Increasing the retirement age: policy effects and underlying mechanisms," *American Economic Journal: Economic Policy*, 2024, *16* (1), 259–291.

Rege, Mari, Kjetil Telle, and Mark Votruba, "The effect of plant downsizing on disability pension utilization," *Journal of the European Economic Association*, 2009, *7* (4), 754–785.

Rentenversicherung, Deutsche, "Die richtige Altersrente für Sie," 2021.

_ , "Zahlen und Tabellen der gesetzlichen Rentenversicherung – Werte West (ohne Knappschaft) - 1.1. – 30.6.2021," Technical Report 2021.

Salvanes, Kjell G, Barton Willage, and Alexander Willén, "The effect of labor market shocks across the life cycle," *Journal of Labor Economics*, 2024, *42* (1), 121–160.

Sauré, Philip, Arthur Seibold, Elizaveta Smorodenkova, and Hosny Zoabi, "Occupations and retirement across countries," *The Journal of the Economics of Ageing*, 2025, *31*, 100561.

Schmieder, Johannes F, Till Von Wachter, and Jörg Heining, "The costs of job displacement over the business cycle and its sources: evidence from Germany," *American Economic Review*, 2023, *113* (5), 1208–1254.

Seibold, Arthur, "Reference points for retirement behavior: Evidence from german pension discontinuities," *American Economic Review*, 2021, *111* (4), 1126–65.

Staubli, Stefan and Josef Zweimüller, "Does raising the early retirement age increase employment of older workers?," *Journal of public economics*, 2013, *108*, 17–32.

Stevens, Ann Huff, "Persistent Effects of Job Displacement: The Importance of Multiple Job Losses," *Journal of Labor Economics*, 1997, *15* (1), 165–188.

_ , "Changes in Earnings Instability and Job Loss," *ILR Review*, 2001, *55* (1), 60–78.

Sullivan, Daniel and Till Von Wachter, "Job displacement and mortality: an analysis using administrative data," *The Quarterly Journal of Economics*, 2009, *124* (3), 1265–1306.

US Bureau of Labor Statistics, "Worker Displacement: 2019-2021," 2022.

Ye, Han, "The effect of pension subsidies on the retirement timing of older women," *Journal of the European Economic Association*, 2022, *20* (3), 1048–1094.

A Online Appendix: Additional Tables and Figures

Table A-1: Summary Statistics SIAB Alternative Sample

	Before Matching			After Matching		
	Displaced	Controls	p-value	Displaced	Controls	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Matched Variables:						
Age	40.82	40.67	0.17	40.77	40.77	1.00
	(3.24)	(3.24)		(3.32)	(3.32)	
Birth year	1950.18	1949.97	0.04	1950.17	1950.17	1.00
	(3.07)	(3.03)		(3.11)	(3.11)	
Female	0.36	0.38	0.23	0.33	0.33	1.00
	(0.48)	(0.49)		(0.47)	(0.47)	
Education						
Compulsory Schooling	0.16	0.14	0.10	0.12	0.12	1.00
	(0.36)	(0.35)		(0.32)	(0.32)	
High school/vocational training	0.79	0.76	0.08	0.85	0.85	1.00
	(0.41)	(0.43)		(0.36)	(0.36)	
College	0.05	0.10	0.00	0.04	0.04	1.00
	(0.23)	(0.30)		(0.18)	(0.18)	
Yearly labor earnings (in 1000s)	37.54	43.79		37.04	37.10	0.95
	(22.05)	(27.68)		(22.62)	(20.54)	
Job tenure*	9.32	9.09	0.16	9.45	9.30	0.49
	(5.26)	(4.89)		(5.29)	(5.12)	
Cumulative contribution points*	12.28	13.18	0.00	12.19	12.22	0.92
	(7.59)	(7.43)		(7.91)	(7.83)	
Unmatched Variables:						
Experience in unemployment*	0.19	0.23	0.07	0.17	0.19	0.23
	(0.54)	(0.64)		(0.50)	(0.53)	
Non-Native	0.09	0.08	0.73	0.07	0.08	0.55
	(0.28)	(0.28)		(0.25)	(0.26)	
Outcome Variables:						
Retirement age	63.81	63.50	0.00	63.77	63.45	0.00
	(1.87)	(1.98)		(1.88)	(2.08)	
Observations	915	25515		684	3354	

Notes: This table displays means and standard deviations (in parentheses) for different variables in the year before the job loss ($t-1$) for the alternative SIAB sample. For the variable retirement age, right-censored observations contribute one observation at age 66 to the sample. Variables marked with * are left-censored in 1975. Columns (1) - (3) show the unmatched sample and columns (4) - (6) the matched sample. Columns (4) - (6) are weighted. Columns (3) and (6) test for differences in means between displaced and control workers. Earnings are measured in 2015 Euros. The sample includes only workers whose exit from employment or unemployment is explicitly recorded as retirement (see section (5.5)).

Table A-2: Impact of Job Loss on Yearly Pension Benefits by Subgroups

	(1) Men	(2) Women	(3) Early Birth Cohort	(4) Late Birth Cohort
Displaced - Non-displaced	-1764.3	-1302.1	-1525.8	-1456.8
	(199.5)	(139.2)	(172.1)	(186.3)
Non-displaced Mean	14950.8	10200.6	12961.1	11188.2
% of Non-displaced Mean	-11.80	-12.77	-11.77	-13.02
N	4212	5050	6018	3244

Notes: This table displays point estimates and robust standard errors (in parentheses) for the impact of job loss on yearly pension benefits by subgroups using the VSKT. Coefficients are estimated using specification (3).

Table A-3: Robustness Check - Impact of Job Loss on Determinants of Pension Benefits

	(1) Yearly Pension Benefits	(2) Cumulative Contribution Points	(3) Average Yearly Contribution Years	(4) Pension Adjustment Factor
Displaced - Non-displaced	-1447.2	-1.070	-0.0864	0.00872
	(67.99)	(0.173)	(0.00492)	(0.00164)
Non-displaced Mean	13715.7	37.67	1.078	0.931
% of Non-displaced Mean	-10.55	-2.841	-8.013	0.937
N	21360	21360	21360	21360

Notes: This table displays point estimates and robust standard errors (in parentheses) for the impact of job loss on pension benefits and its determinants using the VSKT. Coefficients are estimated using specification (7).

Table A-4: Late Career Job Loss - Impact of Job Loss on Determinants of Pension Benefits

	(1) Yearly Pension Benefits	(2) Cumulative Contribution Points	(3) Average Yearly Contribution Years	(4) Pension Adjustment Factor
Displaced - Non-displaced	-817.5	0.527	-0.0630	-0.0256
	(122.8)	(0.182)	(0.00734)	(0.00170)
Non-displaced Mean	13839.0	37.65	1.062	0.938
% of Non-displaced Mean	-5.907	1.398	-5.936	-2.726
N	10914	10914	10914	10914

Notes: This table displays point estimates and robust standard errors (in parentheses) for the impact of job loss on pension benefits and its determinants using the VSKT. Late career job loss is defined as job loss occurring at ages 50-59. Coefficients are estimated using specification (3).

Table A-5: Lifetime Costs of Job Loss - SIAB

	(1) PDV Labor Earnings	(2) PDV UI Benefits
Displaced - Non-displaced	-83989.2	6246.4
	(11433.6)	(417.8)
Non-displaced Mean	570658.4	6203.4
% of Non-displaced Mean	-14.72	100.7
N	14659	14659

Notes: This table displays point estimates and robust standard errors (in parentheses) for the impact of job loss on the PDV of labor earnings and UI benefits using the SIAB and estimating specification (4).

Table A-6: Robustness Check - Lifetime Costs of Job Loss I

	(1) PDV Income	(2) PDV Labor Earnings	(3) PDV Pension Benefits	(4) PDV UI Benefits
Panel A: Baseline (Until Age 80)				
Displaced - Non-displaced	-130334.9	-134390.4	-11695.8	15751.4
	(7445.1)	(6855.5)	(911.6)	(834.8)
Non-displaced Mean	528674.4	429490.6	86175.5	13008.3
% of Non-displaced Mean	-24.65	-31.29	-13.57	121.1
N	9262	9262	9262	9262
Panel B: Until Age 70				
Displaced - Non-displaced	-125235.0	-134390.4	-6596.0	15751.4
	(7082.2)	(6855.5)	(535.9)	(834.8)
Non-displaced Mean	486635.2	429490.6	44136.3	13008.3
% of Non-displaced Mean	-25.73	-31.29	-14.94	121.1
N	9262	9262	9262	9262
Panel C: Until Age 75				
Displaced - Non-displaced	-127973.1	-134390.4	-9334.0	15751.4
	(7275.8)	(6855.5)	(726.3)	(834.8)
Non-displaced Mean	509205.3	429490.6	66706.4	13008.3
% of Non-displaced Mean	-25.13	-31.29	-13.99	121.1
N	9262	9262	9262	9262
Panel D: Until Age 85				
Displaced - Non-displaced	-132372.2	-134390.4	-13733.2	15751.4
	(7592.9)	(6855.5)	(1079.1)	(834.8)
Non-displaced Mean	545468.7	429490.6	102969.8	13008.3
% of Non-displaced Mean	-24.27	-31.29	-13.34	121.1
N	9262	9262	9262	9262
Panel E: Until Age 90				
Displaced - Non-displaced	-134129.7	-134390.4	-15490.6	15751.4
	(7721.5)	(6855.5)	(1226.9)	(834.8)
Non-displaced Mean	559955.6	429490.6	117456.7	13008.3
% of Non-displaced Mean	-23.95	-31.29	-13.19	121.1
N	9262	9262	9262	9262

Notes: This table displays point estimates and robust standard errors (in parentheses) for the impact of job loss on the PDV of income, labor earnings, pension benefits, and UI benefits using the VSKT and estimating specification (4). The panels show results for different age windows. Panel A shows the baseline scenario assuming that workers receive pension benefits until age 80. All panels assume a discount rate of 3%.

Table A-7: Robustness Check - Lifetime Costs of Job Loss II

	(1) PDV Income	(2) PDV Labor Earnings	(3) PDV Pension Benefits	(4) PDV UI Benefits Benefits
Panel A: Baseline (r = 3%)				
Displaced - Non-displaced	-130334.9	-134390.4	-11695.8	15751.4
	(7445.1)	(6855.5)	(911.6)	(834.8)
Non-displaced Mean	528674.4	429490.6	86175.5	13008.3
% of Non-displaced Mean	-24.65	-31.29	-13.57	121.1
N	9262	9262	9262	9262
Panel B: r = 2%				
Displaced - Non-displaced	-144396.9	-145174.2	-15537.7	16315.0
	(8532.8)	(7690.5)	(1206.9)	(909.8)
Non-displaced Mean	598841.0	468291.1	115512.4	15037.5
% of Non-displaced Mean	-24.11	-31.00	-13.45	108.5
N	9262	9262	9262	9262
Panel D: r = 4%				
Displaced - Non-displaced	-118490.5	-124848.2	-8858.4	15216.0
	(6564.1)	(6152.0)	(698.2)	(771.6)
Non-displaced Mean	471766.3	395748.0	64714.0	11304.4
% of Non-displaced Mean	-25.12	-31.55	-13.69	134.6
N	9262	9262	9262	9262
Panel C: r = 5%				
Displaced - Non-displaced	-108414.9	-116373.7	-6749.4	14708.2
	(5842.3)	(5555.6)	(541.7)	(717.7)
Non-displaced Mean	425044.2	366267.0	48909.9	9867.4
% of Non-displaced Mean	-25.51	-31.77	-13.80	149.1
N	9262	9262	9262	9262

Notes: This table displays point estimates and robust standard errors (in parentheses) for the impact of job loss on the PDV of income, labor earnings, pension benefits, and UI benefits using the VSKT and estimating specification (4). The panels show results for different discount rates. Panel A shows the baseline scenario with a discount rate of 3%. All panels assume that workers receive pension benefits until age 80.

Table A-8: Lifetime Costs of Job Loss - Differential Mortality

	(1) PDV Income	(2) PDV Labor Earnings	(3) PDV Pension Benefits	(4) PDV UI Benefits Benefits
Displaced - Non-displaced	-133557.1	-134390.4	-14918.1	15751.4
	(7426.1)	(6855.5)	(889.7)	(834.8)
Non-displaced Mean	528674.4	429490.6	86175.5	13008.3
% of Non-displaced Mean	-25.26	-31.29	-17.31	121.1
N	9262	9262	9262	9262

Notes: This table displays point estimates and robust standard errors (in parentheses) for the impact of job loss on the PDV of income, labor earnings, pension benefits, and UI benefits using the VSKT and estimating specification (4). The analysis assumes that displaced workers receive pension benefits for one year less than non-displaced workers (i.e., while non-displaced workers receive pension benefits until age 80, displaced workers receive pension benefits until age 79).

Table A-9: Lifetime Costs of Job Loss for Men and Women

	(1) PDV Income	(2) PDV Labor Earnings	(3) PDV Pension Benefits	(4) PDV UI Benefits Benefits
Panel A: Men				
Displaced - Non-displaced	-151895.6	-155841.0	-14024.3	17969.6
	(12383.0)	(11649.8)	(1383.1)	(1334.0)
Non-displaced Mean	680412.8	562754.9	103147.9	14510.0
% of Non-displaced Mean	-22.32	-27.69	-13.60	123.8
N	4212	4212	4212	4212
Panel B: Women				
Displaced - Non-displaced	-114774.8	-118909.9	-10015.4	14150.5
	(7605.4)	(6969.5)	(1073.7)	(1059.8)
Non-displaced Mean	419167.0	333315.6	73926.8	11924.6
% of Non-displaced Mean	-27.38	-35.67	-13.55	118.7
N	5050	5050	5050	5050

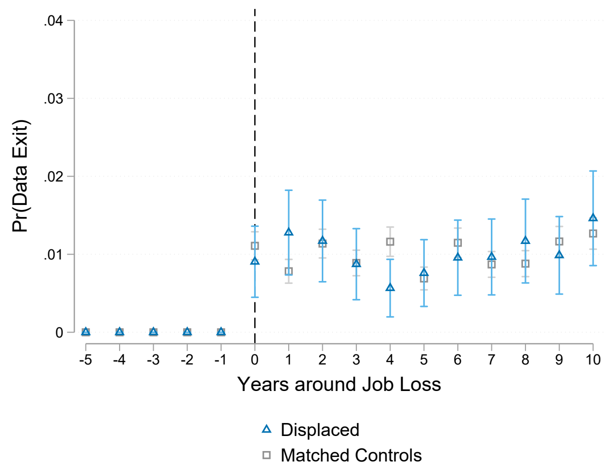
Notes: This table displays point estimates and robust standard errors (in parentheses) for the impact of job loss on the PDV of income, labor earnings, pension benefits, and UI benefits using the VSKT and estimating specification (4), separately for men and women.

Table A-10: The Role of UI System in Buffering the Lifetime Costs of Job Loss

	Baseline		Without UI System	
	(1) PDV Total Income	(2) PDV Pension Benefits	(3) PDV Total Income	(4) PDV Pension Benefits
Displaced - Non-displaced	-130334.9	-11695.8	-147630.9	-13240.5
	(7445.1)	(911.6)	(7523.3)	(899.8)
Non-displaced Mean	528674.4	86175.5	513702.7	84212.1
	(4705.1)	(558.5)	(4740.1)	(553.7)
% of Non-displaced Mean	-24.65	-13.57	-28.74	-15.72
N	9262	9262	9262	9262

Notes: This table displays point estimates and robust standard errors (in parentheses) for the impact of job loss on the PDV of income and pension benefits under the baseline scenario and a scenario without an UI system using the VSKT and estimating specification (4).

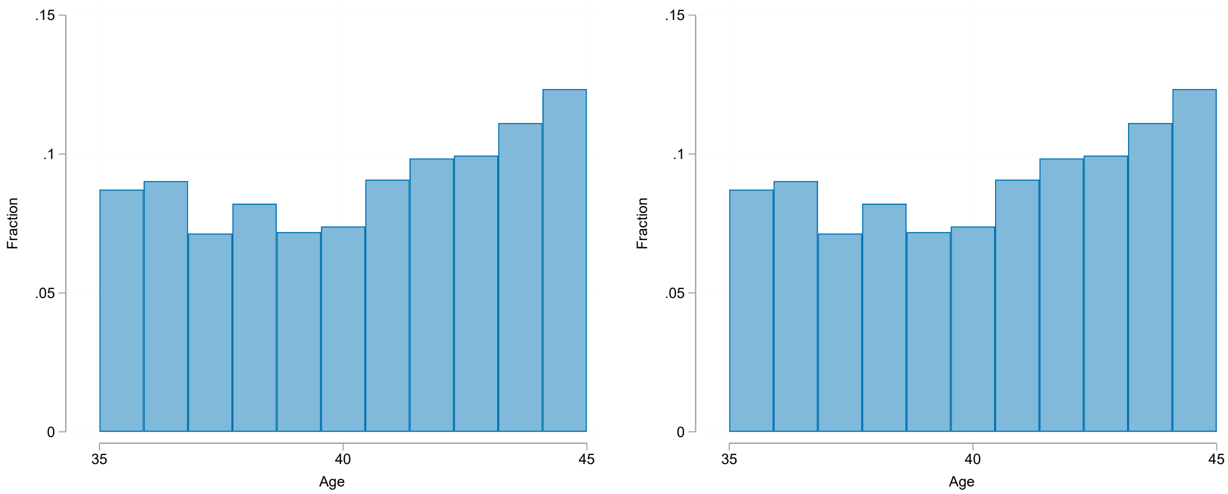
Figure A-1: Relationship between Job Loss and Data Exit



Notes: This figure displays weighted means (with 95% confidence intervals) for the probability to exit the data for displaced and matched non-displaced workers from $t-5$ to $t+10$ relative to job loss using the SIAB.

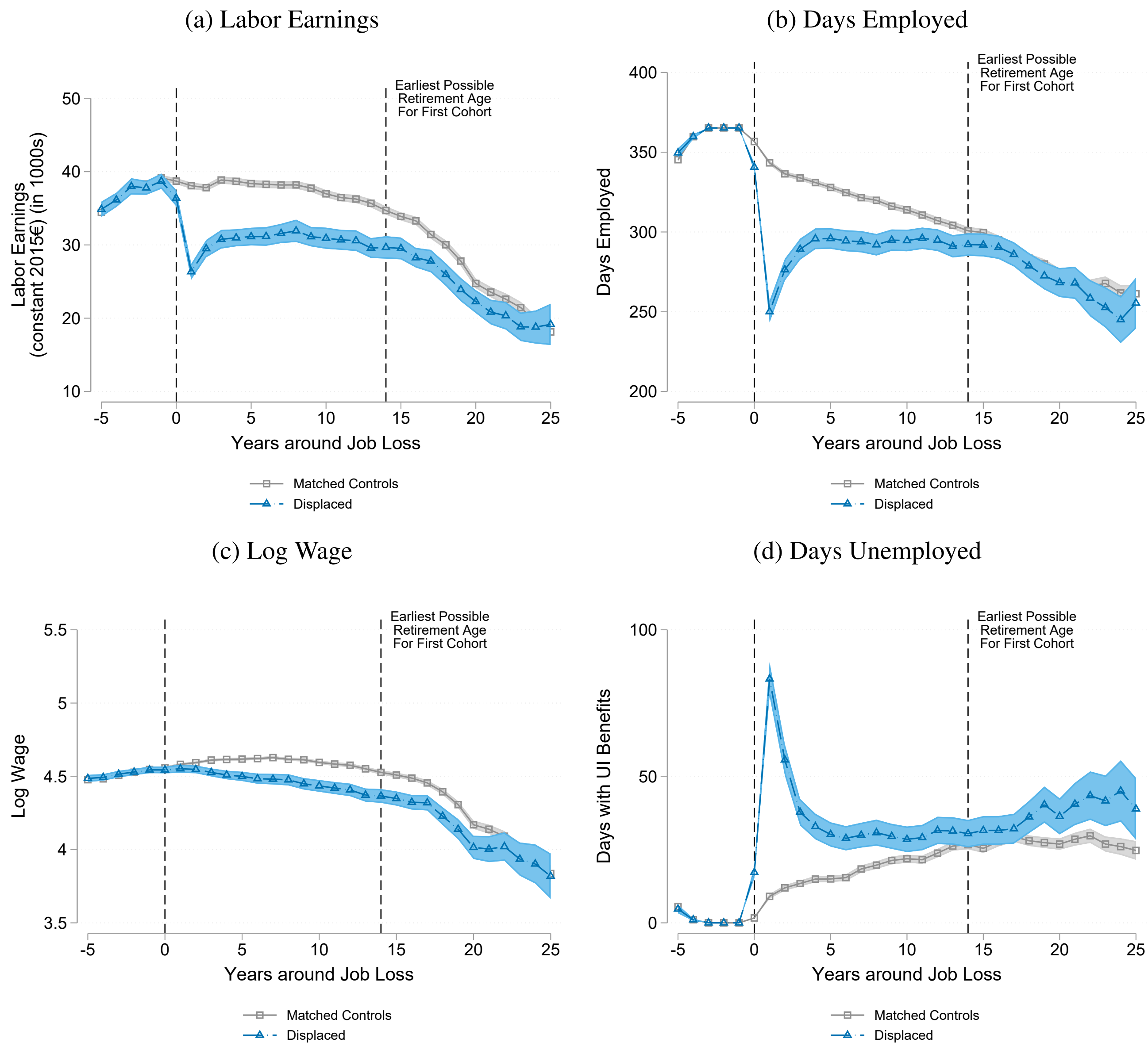
Figure A-2: Age Distributions

(a) SIAB (b) VSTK



Notes: This figure shows the age distribution for the SIAB (panel a) and the VSKT sample (panel b) in the year before the job loss ($t-1$).

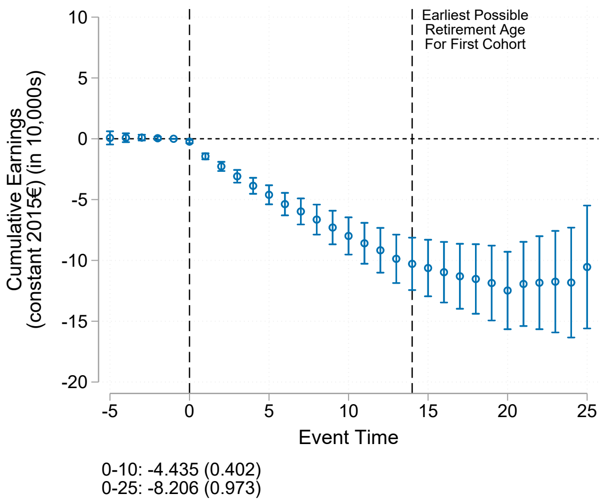
Figure A-3: Relationship between Job Loss and Labor Earnings, and Employment



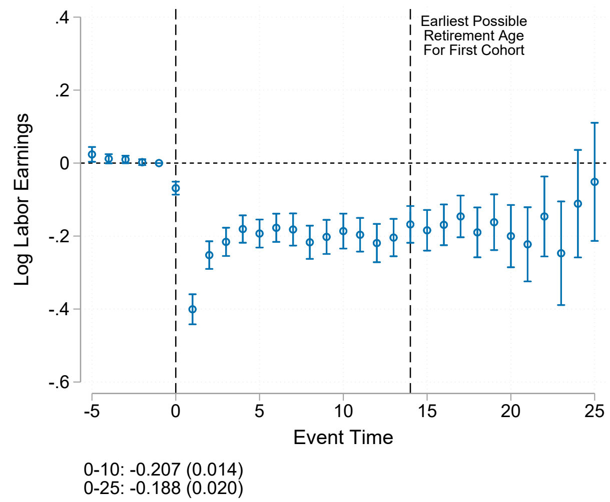
Notes: This figure displays weighted means (with 95% confidence intervals) for displaced and matched non-displaced workers for different variables from $t-5$ to $t+10$ relative to job loss using the SIAB.

Figure A-4: Impact of Job Loss - SIAB

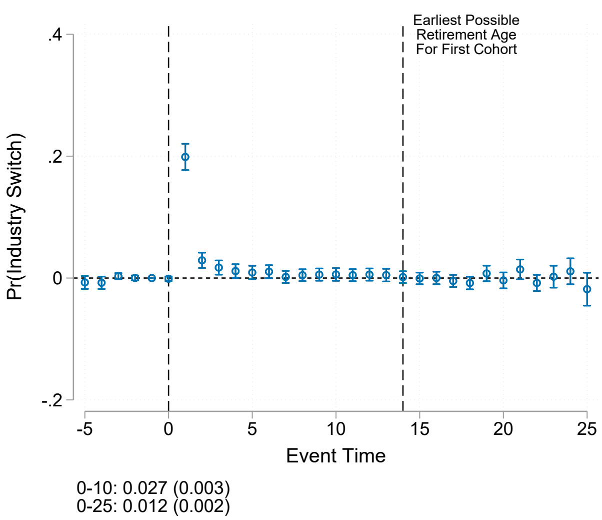
(a) Cumulative Earnings



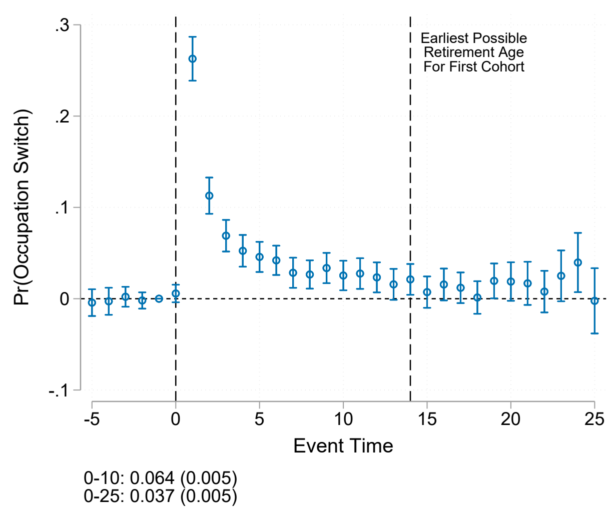
(b) Log Earnings



(c) Industry Switch



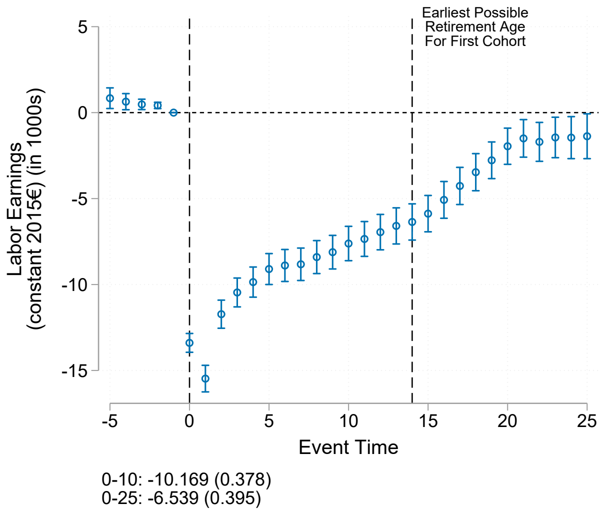
(d) Occupation Switch



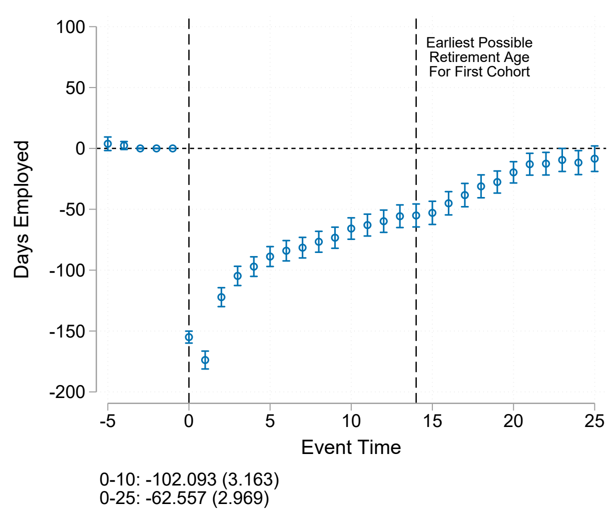
Notes: This figure shows the effect of job loss on different outcomes for displaced workers relative to matched control workers using the SIAB. Coefficients are estimated using specification (1). 95% confidence intervals are derived from standard errors clustered at the level of the displacing plant. The coefficients and standard errors (in parentheses) in the lower left corner are averages of the point estimates for years 0–10 and 0–25 after job loss.

Figure A-5: Impact of Job Loss - VSKT

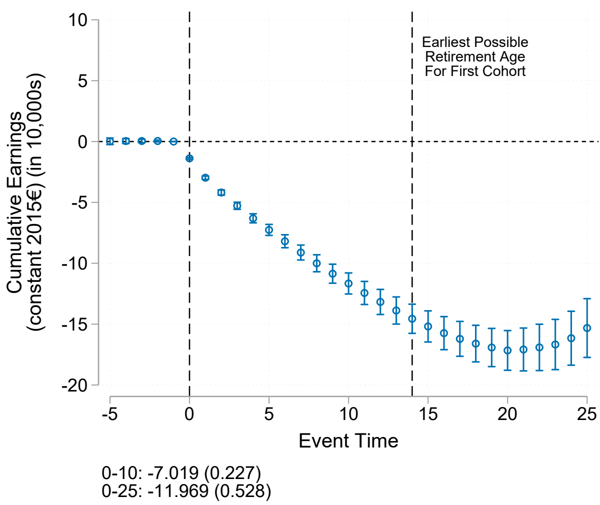
(a) Labor Earnings



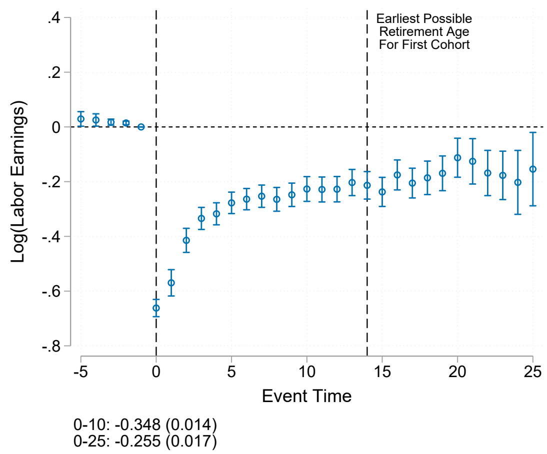
(b) Days Employed



(c) Cumulative Earnings

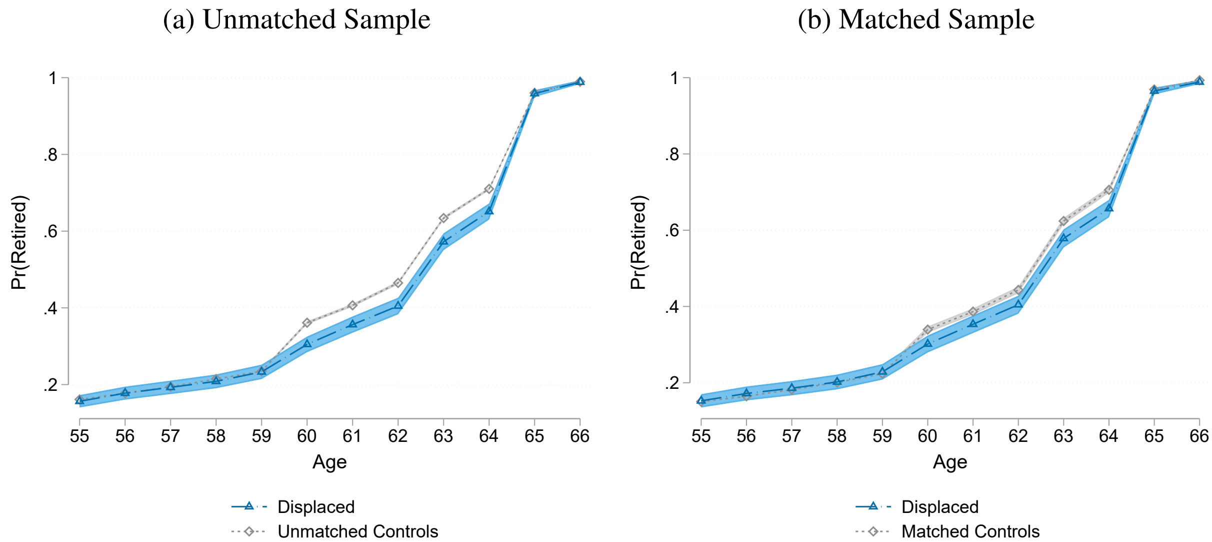


(d) Log Earnings



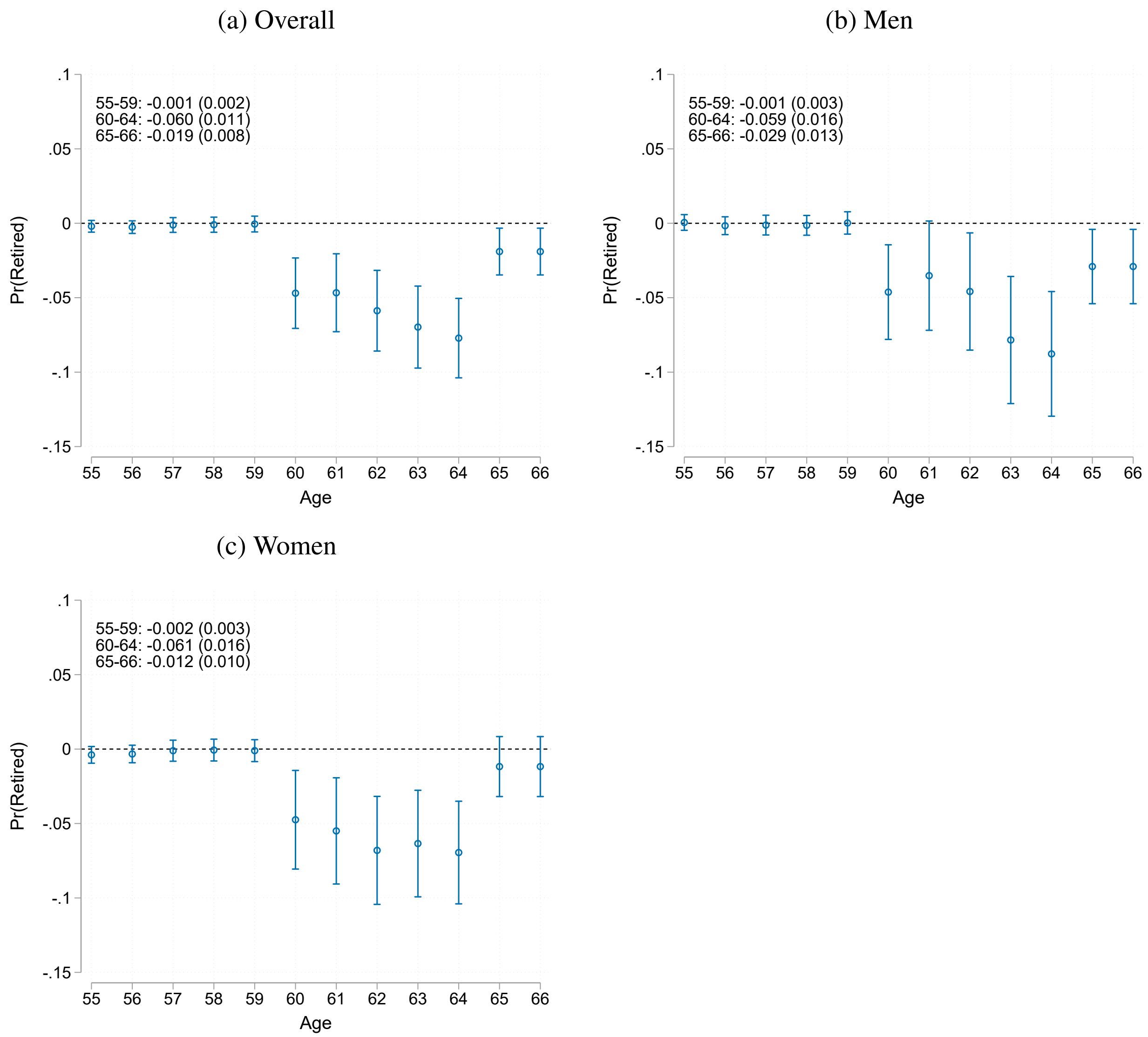
Notes: This figure shows the effect of job loss on different outcomes for displaced workers relative to matched control workers using the VSKT. Coefficients are estimated using specification (1). 95% confidence intervals are derived from standard errors clustered at the worker level. The coefficients and standard errors (in parentheses) in the lower left corner are averages of the point estimates for years 0–10 and 0–25 after job loss.

Figure A-6: Relationship between Job Loss and Retirement



Notes: This figure displays means (with 95% confidence intervals) for the retirement probability for displaced and non-displaced workers from age 55 to 66 using the SIAB. Panel (a) shows the unmatched sample and panel (b) the matched sample. Panel (a) shows unweighted means and panel (b) weighted means.

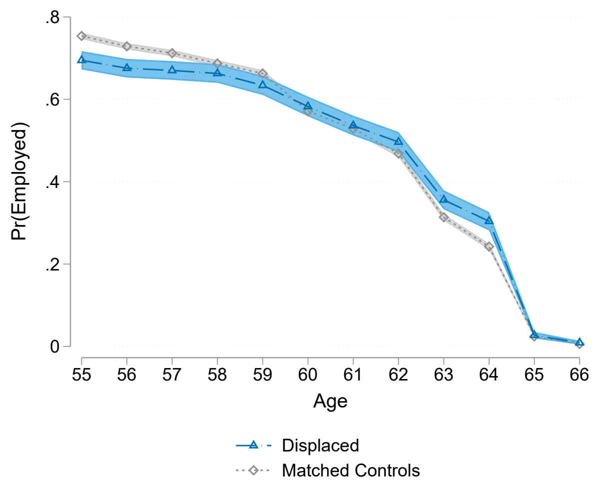
Figure A-7: Effect of Job Loss on Retirement



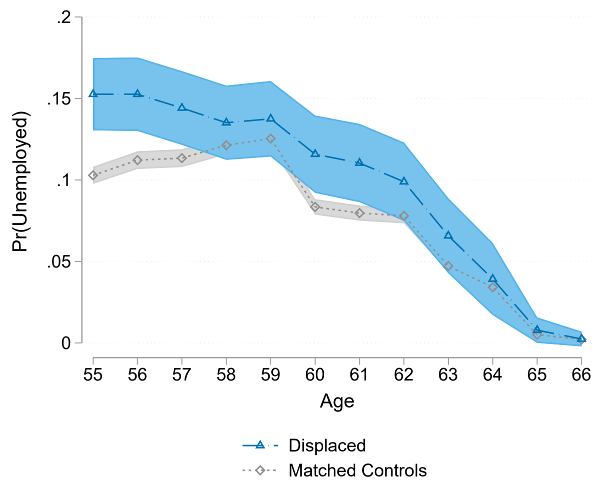
Notes: This figure shows the effect of job loss on the retirement probability of displaced workers relative to matched control workers using the VSKT. Coefficients are estimated using specification (2). 95% confidence intervals are derived from standard errors clustered at the worker level. The coefficients and standard errors (in parentheses) in the upper left corner are averages of the point estimates from age 55-59, 60-64, and 65-66.

Figure A-8: Pathways into Retirement

(a) Pr(Employed)

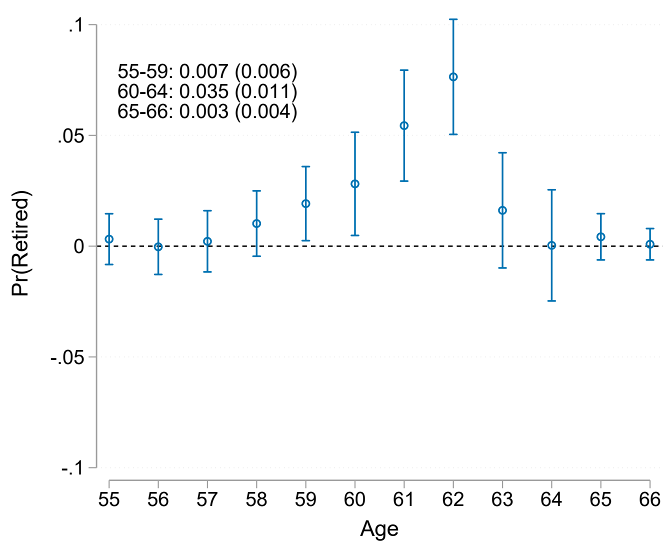


(b) Pr(Unemployed)



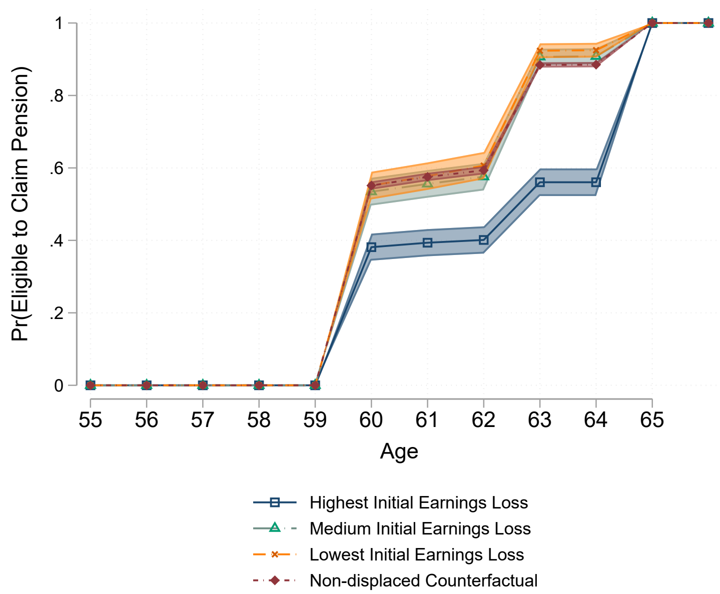
Notes: This figure displays weighted means (with 95% confidence intervals) for the probability to be employed (panel a) and the probability to be unemployed (panel b) for displaced and matched non-displaced workers using the SIAB.

Figure A-9: Effect of Late Career Job Loss on Retirement



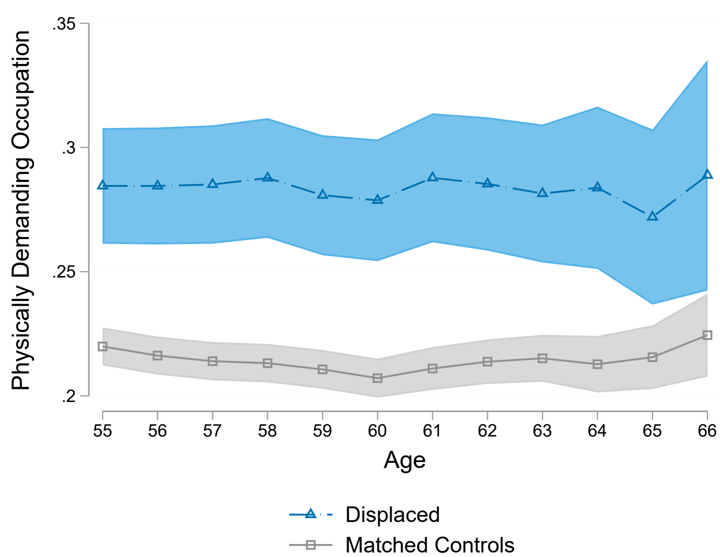
Notes: This figure shows the effect of late career job loss on the retirement probability of displaced workers relative to matched control workers using the SIAB. Late-career job loss is defined as job loss occurring between the ages 50-59. Coefficients are estimated using specification (2). 95% confidence intervals are derived from standard errors clustered at the level of the displacing plant. The coefficients and standard errors (in parentheses) in the upper left corner are averages of the point estimates from age 55-59, 60-64, and 65-66.

Figure A-10: Effect on Pension Benefits Eligibility by Initial Earnings Loss



Notes: This figure displays weighted means (with 95% confidence intervals) for the probability to be eligible for pension benefits by tertile of initial earnings loss for displaced workers using the VSKT. Initial earnings losses are calculated as the percentage change in earnings from five years before to five years after job loss.

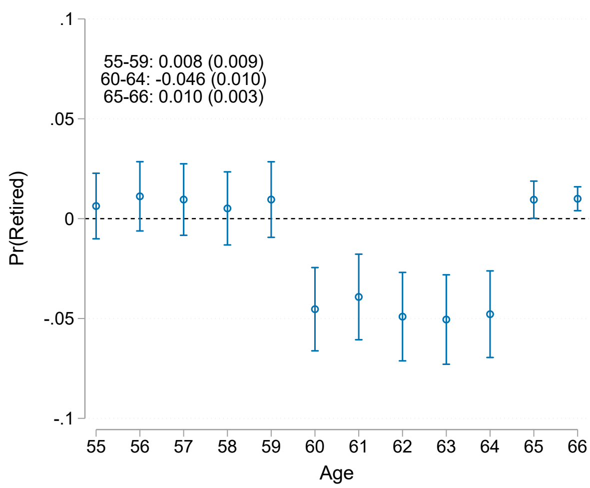
Figure A-11: Relationship between Job Loss and Job Type



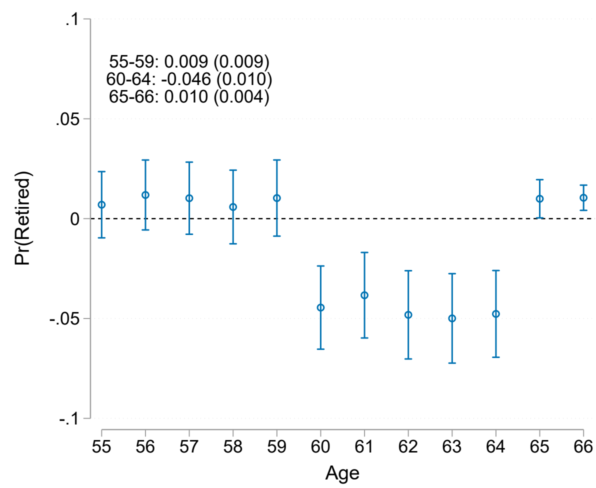
Notes: This figure displays weighted means (with 95% confidence intervals) for the probability to work in a physically demanding job for displaced and matched non-displaced workers using the SIAB. Jobs are classified as physically demanding or non-demanding following the classification of Kroll (2015).

Figure A-12: Robustness Checks

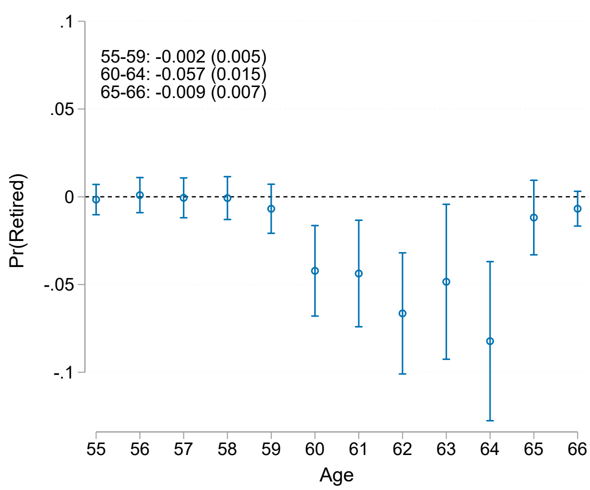
(a) Alternative Estimation Procedure



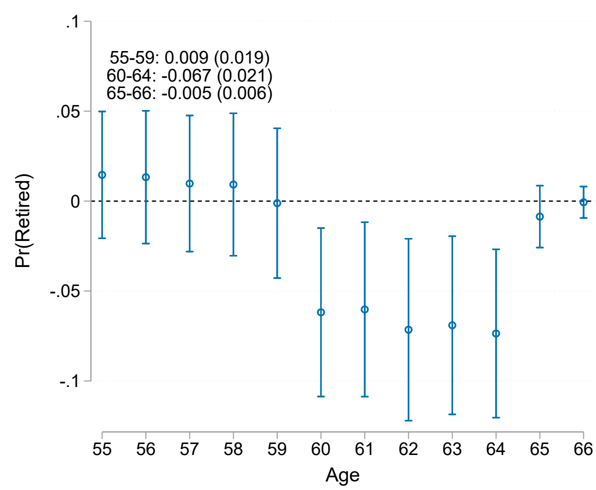
(b) Controlling for Plant Characteristics



(c) Alternative Sample



(d) Matching on 2-Digit Occupation



Notes: This figure shows the effect of job loss on the retirement probability of displaced workers relative to matched control workers using the SIAB. Coefficients are estimated using specification (6) (panel a and b) or specification (2) (panel c and d). 95% confidence intervals are derived from standard errors clustered at the level of the displacing plant. The coefficients and standard errors (in parentheses) in the upper left corner are averages of the point estimates from age 55-59, 60-64, and 65-66.

B Online Appendix: Institutional Setting

This section provides additional information on the institutional setting in Germany. For more details on the public pension system, see Börsch-Supan and Wilke (2004).

B.1 Pathways

Over the observation period, the German public pension system has different pathways through which workers can enter retirement, which vary in the statutory retirement ages and requirements. Table B1 summarizes the requirements for the different pathways. To claim a regular pension, workers only need a minimum of five contribution years, but there is no possibility of early retirement. For all other pathways, the eligibility requirements are stricter than for claiming a regular pension, but each pathway offers an opportunity for early retirement. In case of early retirement, a worker has to bear a penalty of 0.3% for each month retiring before the NRA. Table B2 shows the statutory retirement ages corresponding to the different pathways. The statutory retirement ages vary by birth cohort due to pension reforms. Some reforms changed retirement ages at the monthly level; for example, 61+1/12 indicates that the statutory retirement age increases by one month for each month of birth (January = +1 month, December = +12 months). In table B2, the NRA is shown along with the ERA in brackets (if the respective pathway offers an early retirement option).

Table B1: Requirements under Different Pathways

Pathway	Requirements	Early Retirement Possible
Regular	At least 5 contribution years	No
Especially Long-term Insured	At least 45 contribution years	No
Long-term Insured	At least 35 contribution years	Yes
Unemployment	At least 15 contribution years and at least contributions in 8 out of 10 years before claiming and born before 1952 and (i) unemployed for at least 1 year after age 58 and 6 months or (ii) worked in old-age part-time employment for at least 24 months after age 55	Yes
Women	At least 15 contribution years and at least 10 contribution years after age of 40 and born before 1952	Yes

Notes: This table shows the requirements for the different pathways. Sources: Börsch-Supan and Wilke (2004), Rentenversicherung (2021b).

Table B2: Statutory Retirement Ages under Different Pathways

Cohort	Regular Pathway	Especially Long-term Insured Pathway	Long-term Insured Pathway	Unemployed Pathway	Women Pathway
1938	65	-	63+13/24 (63)	61+1/12 (60)	60 (60)
1939	65	-	65 (63)	62+1/12 (60)	60 (60)
1940	65	-	65 (63)	63+1/12 (60)	60+1/12 (60)
1941	65	-	65 (63)	64+1/12 (60)	61+1/12 (60)
1942	65	-	65 (63)	65 (60)	62+1/12 (60)
1943	65	-	65 (63)	65 (60)	63+1/12 (60)
1944	65	-	65 (63)	65 (60)	64+1/12 (60)
1945	65	-	65 (63)	65 (60)	65 (60)
1946	65	-	65 (63)	65 (60+1/12)	65 (60)
1947	65+1	-	65 (63)	65 (61+1/12)	65 (60)
1948	65+2	-	65 (63)	65 (62+1/12)	65 (60)
1949	65+3	-	65+1/3 (63)	65 (63)	65 (60)
1950	65+4	-	65+4 (63)	65 (63)	65 (60)
1951	65+5	63	65+5 (63)	65 (63)	65 (60)
1952	65+6	63	65+6 (63)	-	-
1953	65+7	63	65+7 (63)	-	-
1954	65+8	63+2	65+8 (63)	-	-

Notes: This table shows the normal retirement age (NRA) for the different pathways, with the early retirement age (ERA) in brackets. A hyphen (-) indicates that a pathway is not applicable. Some reforms changed statutory retirement ages at the monthly level; for example, 61+1/12 means that the NRA increases by one month for each month of birth (January = +1 month, December = +12 months). Sources: Börsch-Supan and Wilke (2004), Rentenversicherung (2021a).