Exposure to World War II and Its Labor Market Consequences over the Life Cycle*

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Abstract

With 70 million dead, World War II remains the most devastating conflict in history. Among the survivors, millions were displaced, returned maimed from the battlefield, or endured years of captivity. We examine the effects of such war exposures on labor market careers, showing that they often become apparent only at certain life stages. While war injuries reduced employment in old age, former prisoners of war prolonged their time in the workforce before retiring. Many displaced workers, especially women, never returned to employment. These responses align with standard life-cycle theory and thus likely hold relevance for other conflicts.

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1 Introduction

World War II (WWII) remains the deadliest conflict in history. In Europe alone, some 39 million people died, and many more were wounded. Millions became prisoners of war (POWs). Nazi Germany captured 5.7 million Soviet soldiers, more than half of whom died in captivity. At the same time, about 11 million German soldiers, or more than one in two, became POWs (Ratza, 1974), and 5.2 million were injured in the war (Müller, 2016). Many civilians were killed or forcibly uprooted. After the war, at least twelve million Germans were displaced from Eastern Europe in one of the largest population transfers in history. What are the long-term consequences of such traumatic events for the labor market careers of the survivors?

Using individual-level data from West Germany, we study three of the most common consequences of war: battlefield injuries, imprisonment, and displacement. We show that a life-cycle perspective is crucial, as the labor market effects of individual war experiences become visible only at certain life stages and tend to be concentrated at older ages. Moreover, the same shock can have very different effects depending on the survivors' age-at-exposure. Standard life-cycle theory can rationalize these patterns, as we show in a Ben-Porath model with endogenous retirement decisions (Hazan, 2009). Consequently, policies aimed at mitigating the economic effects of war shocks should be designed with a life-cycle framework in mind.

Our study relies mainly on nationally representative life course data for the birth cohort 1919-21 from the German Life History Study (GHS), which offers two key advantages. First, the GHS captures complete educational, employment, and family histories. This feature allows us to construct life-cycle profiles of respondents. Second, the survey asked individuals directly about their wartime experiences, such as their time as a POW or their medical history during the war. Thus, unlike most other studies, we focus on *individual* war experiences rather than regional exposure to combat or bombing.

We use this data to compare the life-cycle profiles of male survivors born 1919-21 who were wounded (30% of the respondents in our sample) or imprisoned for more than six months (47%) to other WWII veterans. We also compare the life-cycle profiles of those who were displaced (21%) with those who were not. In support of our empirical strategy, we show that neither family nor own characteristics predict individual exposure, in line with historical studies showing that young soldiers of all backgrounds suffered similarly from battlefield injuries or captivity.

We find that individual experiences during WWII have long-lasting effects on labor market prospects, but some of the most drastic consequences become visible only decades after the war ended. These effects would therefore go undetected in studies that do not follow veterans into old age. For example, battlefield injuries reduced the lifetime employment of veterans by about one year, but did not affect employment at middle age; instead, the effect is fully explained by early retirement, as war injuries reduced the employment rate at age 60 by 14.7 percentage points (pp). In contrast, former POWs postponed retirement, and their employment rate at age 60 was 8 pp higher than that of non-incarcerated soldiers. Former POWs also experienced lower occupational success throughout their careers, as did men displaced from Eastern Europe.

We complement the GHS with microdata from the 1970 population census to show that displacement had very different effects depending on the age of those affected. The loss of human capital was greatest for those born around 1930, who suffered from the turbulence of displacement during the transition from school to vocational training. In contrast, children displaced before entering school acquired *more* schooling than those who were not displaced. The labor market effects also vary greatly by age and gender. For older workers, displacement often led to an immediate exit from the labor force. The total employment loss was greatest for those displaced around age 50, who still had a longer career ahead of them. The loss was particularly severe for women: in some age groups, less than half of the women employed before the war returned to work after displacement.

Finally, we show that these findings are broadly in line with a Ben-Porath model with endogenous retirement decisions (Hazan, 2009). For example, imprisonment implies a reduction in an individual's productive work span, which reduces the incentives to invest in education (as the benefits accrue over a shorter period) and delays retirement (as former POWs seek to make up for lost lifetime earnings). And displacement triggers both substitution and income effects, the relative size of which depends critically on the age at displacement. Given that they explain our findings well, we conclude that life-cycle models might also help to understand labor market trajectories after other wars.

Related Literature. Recent studies on the long-term individual economic impact of WWII show that exposure to warfare negatively affected education, health, and labor market outcomes (Ichino and Winter-Ebmer, 2004; Akbulut-Yuksel, 2014; Kesternich et al., 2014; Akbulut-Yuksel et al., 2022).[1] For identification, the extant literature often exploits between-country variation in combat exposure or regional within-country variation in destruction. Hunger early in life is one key channel through which WWII had adverse long-term effects on survivors' well-being (e.g. Jürges, 2013; Kesternich et al., 2015; Mink et al., 2020). Moreover, evidence from Germany (Bauer et al., 2013) and Finland (Sarvimäki et al., 2022) shows that displacement resulted in long-term income loss, except for those who originated from agricultural areas. However, the loss of land or property might encourage investment in education, and the descendants of Polish WWII migrants are better educated today (Becker et al., 2020a). WWII military service increased the

[1] A related literature examines the impact of male mobilization for WWII and military deaths on female labor force participation. (e.g., Goldin, 1991; Acemoglu et al., 2004; Goldin and Olivetti, 2013; Jaworski, 2014; Rose, 2018).

educational attainment of veterans (Bound and Turner, 2002; Cousley et al., 2017) but had little effect on earnings (Angrist and Krueger, 1994) and occupational attainment later in life (Maas and Settersten, 1999).

The core innovation of our study is the life-cycle perspective. We show that the labor market consequences of individual war shocks often become visible only at certain stages of life, making a life-cycle perspective essential. This result is consistent with previous work on the impact of military service, which emphasizes the importance of a long-term perspective (Bedard and Deschênes, 2006; Angrist et al., 2011).[2] A second innovation of our study is that we examine the response to *individual* shocks, including war captivity and injury. Previous work has focused chiefly on the effects of war on entire cohorts or regions, or on the impact of wartime service in general. To our knowledge, the only evidence of the economic impact of war captivity and injuries comes from the American Civil War of 1861-65 (Lee, 2005; Costa, 2012; Costa et al., 2020).[3] In addition, we highlight that the consequences of displacement for education and labor market careers interact critically with the age at displacement, adding to a growing literature documenting heterogeneity in the impact of displacement (Bauer et al., 2013, 2019; Sarvimäki et al., 2022).

Our study also relates to the literature on human capital and labor supply decisions (Ben-Porath, 1967; Heckman, 1976). Interest has focused on whether standard models can explain important empirical regularities, such as the shape of age-experience profiles in earnings (Mincer, 1997), or long-run trends in schooling and labor supply (Hazan, 2009; Cervellati and Sunde, 2013). In contrast, there exists less evidence on whether such models can explain the response to exogenous *shocks*. A notable exception is the literature on the effect of diseases on human capital investments and development (Bleakley, 2010; Fortson, 2011; Manuelli and Yurdagul, 2021). In comparison, rather than shifts in life expectancy across time and place, we study the response to realized shocks on the individual level.

2 Data and Background

German Life History Study. Our main data source is the GHS, a survey of eight West German birth cohorts born 1919-1971 (Mayer, 2007). We draw on retrospective life-cycle information from the first two waves (Mayer, 1995, 2018a,b). Both waves constructed nationally representative samples of German citizens living in West Germany at the time of the survey (foreigners were excluded). The first wave (GHS-1, conducted in 1981-83) surveyed respondents born in 1929-31, 1939-41, and 1949-51. We instead focus on the second wave (GHS-2, conducted in 1985-88), which surveyed individuals born in 1919-21,

[2]Similarly, Kesternich et al. (2020) show that the impact of war-related sex ratio imbalances on fertility depends crucially on when fertility is assessed.

[3]More evidence exists on the impact of war captivity on health and mortality, although many studies show only statistical associations; see Myrskylä and Santavirta (2023) for recent causal evidence from the Finnish Civil War.

who were 18-20 years old when the war started. We observe 1,412 respondents in this wave, 559 of which are men. Although modest, this main sample is sufficiently large to capture the effects of the life-changing shocks we are studying. Moreover, parts of our analysis can be also implemented in the much larger 1970 census, as discussed below.

Importantly for our purpose, the GHS-2 focused on events related to WWII. It recorded occupational absences and gaps in employment due to military service, captivity, and displacement. Respondents were also asked about illness, accidents, or ailments. We classify bullet and shrapnel wounds, frostbite, amputations, and "general war injuries" sustained between 1939-45 as war-related injuries.

The GHS also contains rich demographic and labor market information. Respondents reported their education, employment, and family history, including their entire occupational history. To examine occupational success, we use the Standard International Occupational Scale (Treiman, 1977), in which the values for occupational prestige range from 18 (unskilled workers) to 78 (doctors, professors) and are coded as missing for periods of non-employment. The GHS recorded time spent in school, vocational training, and further education, and we measure educational attainment by total years of education (see Appendix A.1 for details). We also observe education and employment outcomes for the respondents' parents. In addition, the GHS-2 recorded pension income, distinguishing between different sources, including pensions from own work and war victims' pensions (we discuss war compensations below). When analyzing pension incomes, we restrict attention to GHS-2 respondents surveyed in 1987/88 and thus at age 66 or older.[4]

The GHS recorded the complete residential history of respondents, which we use to define displacement status. As in official population statistics, we define displaced persons as Germans who lived in the eastern territories of the German Reich, Czechoslovakia, or Eastern Europe on 1 September 1939.[5] We classify all other individuals as non-displaced, except for Germans living in the future Soviet occupation zone in 1939, whom we exclude from this part of the analysis as they were positively selected in education (Becker et al., 2020b). Overall, 7.9 million displaced persons (so-called expellees) lived in West Germany in 1950 (Statistisches Bundesamt, 1955). Most arrived in 1945-46, primarily from the eastern territories of the German Reich, which Germany ceded in 1919 and 1945 (see Appendix Figure C1 for an overview of Germany's territorial losses).

1970 census. Two limitations of the GHS are its small sample size and the focus on specific birth cohorts, limiting its usefulness in examining how individual war experiences vary across cohorts. For this type of analysis, we therefore use a second data set, the West

[4]The GHS-2 was conducted in two parts. The first part surveyed 407 respondents in 1985/86 using face-to-face interviews; the second surveyed 1005 respondents in 1987/88 using telephone interviews.

[5]If respondents report changing or war-related places of residence, we use their latest residence before September 1939. For individuals born in 1939-41 but after September 1939, we use their residence at birth.

Table 1: Exposure to individual war shocks

	War injuries (men) 1919-21		War captivity (men) 1919-21			Displacement (men and women)		
						1919-21	1929-31	1939-41
	Share	Bullet wounds	Share	>6 months	Length (months)	Share	Share	Share
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean	0.299	0.206	0.755	0.474	16.547	0.227	0.182	0.187
Std. deviation	(0.458)	(0.405)	(0.431)	(0.500)	(20.256)	(0.419)	(0.386)	(0.390)
Observations	559	559	559	559	559	1,278	661	673

Notes: Statistics for battlefield injuries and war captivity are based on men born 1919-21. War injuries include amputation, frostbite, bullet wound, others. Statistics for displacement are based on men and women, excluding GDR refugees. The displaced are defined as individuals who on 1 September 1939 lived in the Eastern territories of the German Reich, Czechoslovakia, or Eastern Europe.

German population and occupation census of 1970. The data comprise a 10% random sample of the population, almost 6.2 million individuals (FDZ, 2008). The census contains information on an individual's residence on September 1, 1939 (or the father's residence for individuals born after that date). As in the GHS, we drop migrants from the Soviet occupation zone and define displaced persons as Germans who lived in Germany's former eastern territories, Czechoslovakia, or Eastern Europe in 1939. Unfortunately, we cannot identify war wounded or POWs in the census.

The census provides information only on socioeconomic attainment in 1970. Two outcome variables are nevertheless of interest for our analysis: educational attainment and the year of exit from employment. We measure years of education by adding the years spent in vocational training and university to the time required to attain the highest school degree. The census also asked respondents who were not employed in 1970 when they left their last job. For older individuals over the statutory retirement age of 65, we can be reasonably confident that the year indicates the end of their labor market career.

Exposure to wartime shocks. The shocks we consider–war injuries, captivity, and displacement–were common (see Table 1). In the GHS sample of men born in 1919-21, 29.9% suffered from war injuries, most commonly bullet wounds. Our empirical analysis compares injured and non-injured soldiers over their life cycles. Among men born in 1919-21, three-fourths were POWs, but the length of imprisonment varied considerably, with a mean of 16.5 and a standard deviation of 20.3 months. Our analysis compares the life-cycle profiles of soldiers who were POWs for more than six months to those who were not imprisoned (our results remain similar when including POWs imprisoned for fewer than six months). The treated make up 47.4% of respondents. Finally, more than one in five individuals in our sample were displaced. We compare them to their non-displaced peers (after excluding GDR refugees). We discuss potential concerns related to selection and multiple treatments in the next section.

Compensation programs. Not least because of the large number of people affected, the fate of the war-damaged was a pressing social problem in the postwar period. To compensate them and facilitate their integration into the labor market, policymakers developed two critical programs (Wiegand, 1995), the war victims' provision (*Kriegsopferversorgung*) and the equalization of burden (*Lastenausgleich*). The financially most significant part of the war victims' provision was the war victim's pension (*Kriegsopferrente*). The pension was paid to persons who suffered serious health damage as a result of military or military-like service in connection with the war (e.g. damage due to direct warfare, captivity, or internment abroad). The war victims' provision also paid for measures suitable for improving the earning capacity of war-disabled persons, such as advanced training and vocational (re)training, and for curative treatments to restore their health.

The war victim's pension had three key components. Basic assistance (*Grundrente*) was paid to all war-damaged persons whose civilian earning capacity was reduced by at least 25%. Its exact amount depended on the severity of the war-related health damage. An additional equalization pension (*Ausgleichsrente*) was paid to severely disabled persons whose earning capacity was reduced by 50%, if they were no longer able to work (or only to a limited extent). Finally, an additional compensation (*Schadensausgleich*) was paid to severely disabled persons whose income was below of what they would likely have earned without the war damage. Both the equalization and compensation were means-tested. Importantly, the war victim's pension was not tied to any age thresholds.

The second program, equalization of burdens, partially compensated for the loss of wartime property, thereby distributing the burdens of war more evenly throughout society. Those whose property had been spared by the war were to compensate those who had suffered war damage. Displaced persons could also apply for grants to start businesses and for public assistance in finding housing. However, the equalization of burdens had only limited success in restoring the occupational status of the displaced and the prewar distribution of wealth (Falck et al., 2012; Wiegand, 1995).

Cohort effects. Figure 1 plots the life-cycle profile for males born in 1919-21, distinguishing four states: non-participation, unemployment, employment, and education. The cohort was 18-20 years old when the war started, and all males were conscripted.[6] War service thus hit the cohort when it would normally have entered the labor market, severely interrupting the transition from education to work (Brückner and Mayer, 1987). The figure shows that the cohort's labor force participation rate plummeted abruptly around age 20 and gradually recovered in the late 20s. War captivity reduced the cohort's labor force participation long after the war ended.

Appendix Figure C2 compares the life-cycle profile of the 1919-21 cohort with later-

[6] The 1919 cohort was conscripted on 26 August 1939, the 1920 cohort on 1 October 1940, and the 1921 cohort on 1 February 1941 (Kroener et al., 1988, 1999).

born cohorts covered by the GHS-1, illustrating that their transition from education to work was dramatically different.[7] Men born in 1919-21 spent, on average, just 156 months in the labor market by age 37, more than 60 months less than males born in 1929-31 or 1939-41. For women we see the inverse pattern: Compulsory work services, unusually high labor demand during war time, and the absence of men accelerated labor market entry of the 1919-21 cohort and led to comparably high participation rates. In their first 37 years of life, females born 1919-21 participated in the labor market twelve and 18 months longer than those born 1929-31 and 1939-41, respectively. Our analysis abstracts from such cohort effects, instead identifying within-cohort differences by war experience.

Figure 1: Life-cycle profile for the male cohort born in 1919-21

Notes: The figure shows the share of individuals in four mutually exclusive states: non-participation, unemployment, employment, and education (including school, vocational training, and further education).

Macroeconomic conditions. Macroeconomic conditions were favorable for the integration of former soldiers into the labor market. West Germany recovered swiftly from WWII (Eichengreen and Ritschl, 2009), and real GDP per capita nearly tripled between 1950 and 1970. The mass inflow of displaced persons increased unemployment initially (Braun and Omar Mahmoud, 2014), but provided a valuable pool of labor for the booming economy in the late 1950s and 1960s. Unemployment fell steadily, from 10.4% in 1950 to 1.3% in 1960, and remained very low until the mid-1970s. These favorable conditions likely explain why, despite their late entry into the labor force, men in the 1919-21 cohort were rarely unemployed after age 35. As discussed, policy measures also improved

[7]See also Mayer (1988) for a cohort perspective o the impact of WWII on German survivors.

the earning capacity of the war-disabled, by covering the costs of vocational training and curative treatments.

3 Life-Cycle Effects of Individual War-Time Shocks

This section considers the impact of battlefield injuries, war captivity, and displacement on labor market outcomes of men born 1919-21. For each shock, we present three sets of results. First, we report cross-sectional summary measures of labor market success, based on regressions such as

$$y_i = \alpha + \beta shock_i + \gamma x_i + \varepsilon_i, \tag{1}$$

where y_i is an outcome of interest for individual i, $shock_i$ is one of the three shocks listed in Table 1, and x_i is a set of control variables as defined below. We restrict the sample to WWII veterans when examining war injuries and imprisonment. In robustness tests, we also include all three shocks jointly to account for the fact that individuals might be exposed to more than one shock. This has little effect on our estimates, as the shocks are hardly correlated with each other (as discussed below).

Second, we show full life-cycle plots for employment and occupational prestige, based on pooled regressions that interact the shock with age:

$$y_{it} = \sum_t \alpha_t I(Age = t) + \sum_t \beta_t I(Age = t) shock_i + \sum_t \gamma_t I(Age = t) x_i + \varepsilon_{it}, \tag{2}$$

where y_{it} is the employment status or occupational prestige of individual i at age t (age in years). Third, we ask whether individuals' responses are consistent with the predictions from standard life-cycle theory of human capital and labor supply decisions. For readability, most of this theoretical discussion is relegated to the appendix, with only the main results summarized in the main text.

Identification. A concern for identification is that war shocks may correlate with individual characteristics affecting labor market supply or prospects after the war ended. To address this concern, we show that battlefield injuries and imprisonment were unrelated to own and family characteristics, in line with historical studies.

Enlistment was near-universal for the 1919-21 cohort (Overmans, 1999), with 95% of men in our sample fighting in the war. Neither the duration nor the intensity of their exposure to the war varied much with family or own characteristics. While qualified workers in the arms industry were initially spared from military service (Müller, 2016), the 1919-21 cohort was still too young to fill such positions when WWII began. Indeed, their year of war entry differs little in our sample, as the 1919 and 1920 cohorts formed the backbone of Hitler's Wehrmacht at the beginning of the war. Highly educated individuals were as likely to be placed in combat roles as their less educated peers, and social background had little to do with the assignment of individuals to subunits–and thus their risk of injury or imprisonment.[8]

The 1919-21 cohort was also too young to reach the middle and higher officer ranks, who had been less likely to die in past wars than regular soldiers. In our data, only 5% have reached lieutenant rank. Even the lower officer ranks of captains and majors tended to be significantly older than the 1919-21 cohort, averaging 33.5 and 26.5 years of age in 1942, respectively (Förster, 2009). Moreover, unlike in previous wars, there was a high casualty rate among officers in WWII (Müller, 2016). For example, the proportion of officers among all missing during the most deadly defeat in German military history, the collapse of the *Heeresgruppe Mitte* on the Eastern Front in 1944, corresponded exactly to their proportion in two combat divisions studied by Hartmann (2010).[9]

Instead, the likelihood of injury and duration of imprisonment depended primarily on which part of the front the soldiers were fighting,[10] over which they had little control. Notably, the soldiers' region of deployment did not depend on their regions of origin (Overmans, 1999). And while the very young and old were more likely to be released early from captivity (Overmans, 2000), our analysis focus on a narrow birth cohort and conditions on age.

As for the displacement effect, Bauer et al. (2013) show that the differences between displaced and non-displaced Germans were small before the war, not least in education. The only major differences were in the proportions employed in agriculture and industry, which can be attributed to the more agrarian structure of the eastern territories. However, the 1919-21 cohort had little labor market experience when the war began, so these structural differences had little impact on their work experience. Importantly, virtually all Germans living east of the postwar German-Polish border were displaced, minimizing problems of selection.

We provide evidence in support of these arguments in panel (a) of Table 2, regressing indicators for war service and each shock on prewar characteristics of the respondents (birth year, siblings, years of schooling, and an indicator for ill health in childhood) and

[8]For example, (Fritz, 1996, p. 686) notes that "*Unlike the American army, which until 1944 shunted its most educated men into specialized roles, the Wehrmacht from the start deployed a remarkably high percentage of its manpower as combat troops*". This was especially true of the young, on whom our analysis focuses. Similarly, Rass (2003) finds no association between social origin and allocation across subunits in his study of a German infantry division. The exception was the intelligence unit, which recruited predominantly from higher socio-economic classes, but accounted for only 3% of the division's personnel.

[9]"*This suggests that the 1944 catastrophe must have affected the [divisions] across the board. All became their victims, regardless of rank, function, or place of operation*" (Hartmann, 2010, p. 220, own translation).

[10]While all POWs in Western Allied custody were released by the end of 1948, the last POW from Soviet captivity did not return until 1956. In our sample, those serving (also) at the Eastern front were more than twice as likely to suffer from bullet wounds than those serving only at other fronts.

their parents (years of education and the father's occupational score). Individuals who were sick in childhood were less likely to serve in the war, but war service is uncorrelated with socio-economic characteristics. Conditional on serving, prewar characteristics do not predict war injuries, captivity, or displacement, explaining less than 2% of their variation.[11] Our baseline analysis nevertheless controls for birth year indicators, parental education, number of siblings (which correlates with socio-economic background), and time of war entry. The model fit increases as controls are added while our coefficients of interest remain stable, making it unlikely that omitted variables drive our results.

For a subset of our data, we also observe the individuals' military rank, training, and branch, and whether they volunteered to serve. Rank or specialized military training (beyond basic combat training) are uncorrelated with any of our war shocks (Table 2, panel (b)). As expected, army soldiers were much more likely to sustain war injuries than those serving in the navy or the air force, and sailors were imprisoned more often than soldiers of the other two branches. However, individual or parental characteristics do not predict military branch or voluntary service, and do therefore not predict war injuries or captivity either (Table 2, panel (a)).

Multiple shocks. One other concern is that soldiers can be subject to multiple war-related shocks. We therefore risk capturing the consequences of multiple war experiences rather than a clearly defined shock if the different shocks were correlated. Displacement is not correlated with either imprisonment or wartime injuries (Appendix Table C2). Imprisonment and wartime injuries show a slight negative correlation ($\rho = -0.11$), presumably because wartime injuries reduced subsequent combat time and thus the risk of imprisonment. However, we show in additional checks that our estimates change little when adding the other respective shocks as controls (i.e., when considering all shocks jointly).

Selective mortality. One might worry that veterans with serious injuries were more likely to die before the 1980s and thus underrepresented in the retrospectively collected GHS. Two observations suggest that such selective mortality is not an issue for our analysis. First, official mortality tables for the postwar period do not show an unusually high risk for males born around 1920 (Statistisches Bundesamt, 2006). For example, the 1920 male cohort had a remaining (post-war) life expectancy of 43.6 years at age 30, only about one year less than the non-serving cohort of 1930. This increase in life expectancy between cohorts is not unusually large (life expectancy at age 30 increased by more than two years from the 1930 to the 1940 cohort). Second, the share of injured veterans in our

[11] Since about one-third of POWs in Soviet custody died, one might expect survivors to be positively selected on health. However, the mortality rate of German POWs varied greatly with the place and time of internment, limiting selectivity with respect to individual characteristics and possibly explaining the lack of correlation with pre-war socio-economic status or health (Table 2). Returning POWs reported similar or slightly *worse* health at later ages (Appendix Figure C3).

Table 2: Exogeneity of war service and war shocks

	mean (std. dev.)	War service (0/1) men only (1)	War injury (0/1) men only (2)	War captivity (0/1) men only (3)	Displaced (0/1) men & women (4)
(a) Pre-war characteristics					
Father's years of schooling	8.68	0.003	-0.002	0.004	-0.005
	(2.07)	(0.004)	(0.016)	(0.014)	(0.009)
Mother's years of schooling	8.24	-0.021	-0.02	0.011	0.008
	(0.95)	(0.021)	(0.034)	(0.025)	(0.017)
Father's occupational score	41.0	-0.002*	0.003	-0.004	0.000
	(10.9)	(0.001)	(0.002)	(0.002)	(0.001)
Birth year	1920.1	0.017	-0.026	0.018	0.005
	(0.79)	(0.013)	(0.029)	(0.025)	(0.016)
# siblings	2.86	-0.003	0.005	0.011	0.004
	(2.44)	(0.004)	(0.010)	(0.008)	(0.005)
Years of schooling	8.77	0.009	-0.028	0.020	0.018
	(1.42)	(0.007)	(0.017)	(0.015)	(0.012)
Poor health at age≤18	0.02	-0.454***	-0.184	-0.016	-0.110
	(0.12)	(0.168)	(0.142)	(0.214)	(0.086)
Female	0.60	–	–	–	0.001
	(0.49)				(0.026)
Observations	1,412	492	465	465	1,054
R2		0.077	0.015	0.012	0.005
(b) Position in the military					
Branch: Navy (cf: Army)	0.08	–	-0.464***	0.244***	0.040
	(0.27)		(0.131)	(0.052)	(0.148)
Branch: Air force	0.30	–	-0.410***	0.022	-0.082
	(0.46)		(0.081)	(0.072)	(0.077)
Rank (≥ *Unteroffizier*)	0.49	–	0.052	-0.016	0.028
	(0.50)		(0.077)	(0.062)	(0.066)
Volunteer (cf: drafted)	0.33	–	0.031	-0.102	0.132*
	(0.47)		(0.078)	(0.077)	(0.078)
Specialized training	0.67	–	0.041	0.012	-0.076
	(0.47)		(0.088)	(0.071)	(0.079)
Observations	178	–	175	177	167
R2			0.156	0.035	0.035

Notes: The table reports coefficient estimates from the indicated war-related shock on a set of pre-war individual and parental characteristics (panel (a)) or indicators of their position within the military during the war (panel (b)) for birth cohorts 1919-21. Estimates for war injuries and captivity are conditional on war service. Robust standard errors in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

data is broadly in line with existing estimates. Müller (2016) states that about 5.2 million German soldiers were injured in the war (out of 18.2 million serving, corresponding to a share of 28.5% compared to 29.9% in our sample). Even with selective mortality we would still estimate a lower bound on the true (negative) effect of war injuries on labor market outcomes.[12]

Battlefield injuries. Panel (a) of Table 3 summarizes how battlefield injuries affected the labor market careers of soldiers born 1919-21. The estimates are based on equation (1), estimated separately for each outcome and shock (the estimates change little when including all shocks jointly, as shown below). Two main findings emerge. First, injured soldiers were less likely to be employed at older ages than their non-injured peers, although they achieved similar employment rates at earlier ages (see columns (2) and (3)). War injuries reduced employment by nearly one year between ages 56-65, by accelerating the transition from work to retirement. Second, war injuries reduced monthly work pensions by DM 234 or almost 10% compared to the control mean (column (5)). However, the higher pension payments as war victims almost compensated for this loss (column (6)). Battlefield injuries have no sizeable effects on educational investments (column (1)) or on nonpension income in old age (column (7)).

The life-cycle graph in panel (a) of Figure 2 confirms that the adverse employment effect of war injuries arose only late in life. Employment probabilities of men with and without injuries were surprisingly similar at young and middle age but started diverging in the early 50s. The gap then widened steadily until age 61, reaching 17 pp, before shrinking again as injured and non-injured veterans retired. On average, the employment probability of injured veterans was 8.5 pp lower between ages 56 and 65 than that of non-injured peers (relative to a baseline probability of 60.9%).[13] Perhaps surprisingly, we do not find a sustained effect of wartime injuries on occupational success (see panel (b) of Figure 2).

As detailed in Appendix D, these life-cycle patterns in injured veterans' employment are in line with a standard Ben-Porath type of model with endogenous retirement decisions (Hazan, 2009). We assume that war injuries increase the disutility of work, which tends to decrease employment. But since the disutility of work also increases with age, an upward shift in this disutility does not tend to affect early or mid-career employment; instead, it accelerates entry into retirement (see Appendix D.2 and Figure D6b).[14] Standard theory therefore helps to understand why the labor market consequences of a sudden health shock at young age manifest themselves only at older age, decades after the war ended.

[12] The GHS allows us to distinguish severely from less severely injured veterans, and the labor market consequences are more pronounced for the former. If the severely injured faced a higher mortality risk, we would, therefore, underestimate the true effect of war injuries. Note also that selective mortality could not affect the direction of our results unless mortality were substantially higher *and* at-risk veterans showed the opposite labor market effects than less severely injured veterans; our data support neither of these assumptions.

[13] When focusing only on severe injuries, such as amputations, we still find no effect on employment at mid age. Yet, severely injured veterans retired even earlier.

[14] As shown in Appendix D.2, war injuries and the implied reduction in the retirement age also reduce incentives to invest into education. However, the cohort born 1919-21 entered the military around age 20, so many had already completed their educational investments before enlistment.

Table 3: The effect of war experiences on labor market outcomes, men born 1919-21

	Educational attainment (years)	Years in employment age 20-55	Years in employment age 56-65	Occup. prestige (maximum)	Old age income from work pension	Old age income from war victim pension	Old age income from nonpension sources
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(a) War injury (0/1)							
	-0.263	0.060	-0.908***	-0.086	-233.91*	180.63***	-14.98
	(0.199)	(0.320)	(0.290)	(0.987)	(122.80)	(48.76)	(131.74)
	[11.06]	[28.68]	[6.03]	[46.90]	[2390.73]	[20.31]	[375.97]
Observations	465	465	465	465	282	282	297
(b) War captivity (> 6 months)							
	-0.262	-2.266***	0.446	-2.879**	-11.71	-121.35***	-62.98
	(0.224)	(0.332)	(0.332)	(1.201)	(129.94)	(42.21)	(137.43)
	[10.98]	[29.75]	[5.29]	[48.36]	[2301.65]	[146.09]	[377.35]
Observations	331	331	331	296	203	203	216
(c) Displacement (0/1)							
	-0.150	-0.638*	0.121	-2.424**	-80.08	19.74	-310.05***
	(0.233)	(0.367)	(0.314)	(1.015)	(144.09)	(41.30)	(94.47)
	[10.93]	[28.82]	[5.69]	[47.04]	[2376.11]	[59.57]	[459.16]
Observations	427	427	427	427	254	254	269

Notes: Regression estimates of the effect of battlefield and other war-related injuries (panel (a)), war captivity (panel (b)), and displacement (panel (c)) on various outcome variables (shown in the table header). Each estimate is from a separate regression. The sample consists of males born 1919-21. Columns (5) to (7) restrict the sample to the second part of GHS-2 conducted in 1987/88 where we observe individuals up to age 65-69 (see Footnote 4). All regressions control for the birth year (indicators), years of schooling of father and mother, number of siblings, and time of entry into the war. Robust standard errors are shown in parentheses, unconditional means for the unaffected control group are in square brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Two factors might amplify this decline in employment at older ages. First, by mitigating the implied income loss, compensations and pensions for war victims (Section 2) increase the incentives for early retirement further (Section D.2).[15] Second, health might deteriorate more rapidly over age for wounded than non-wounded veterans (e.g., Stewart et al. 2015); Appendix Figure C3 shows that this is the case in our sample. The disutility of work may thus not only shift upwards, but also become steeper over age.[16]

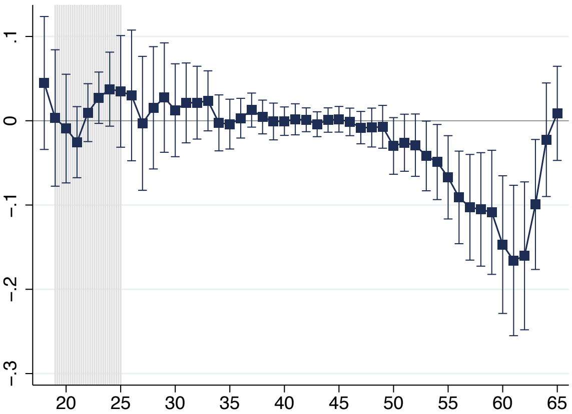
In sum, our findings underscore the importance of a life-cycle perspective in designing policies to alleviate the economic hardship of injured veterans. War injuries can have surprisingly little consequences on labor market careers in the first decades after the war, but then greatly decrease employment rates when veterans reach older ages. As these findings can be rationalized by standard life-cycle theory, we might expect similar patterns following recent or current violent conflicts and wars.

[15] See also Autor et al. (2016) who show that a disability compensation program targeting veterans of the Vietnam war greatly reduced their labor supply. The authors note that the response may have been particularly large as the program affected a near-elderly population in diminished health.

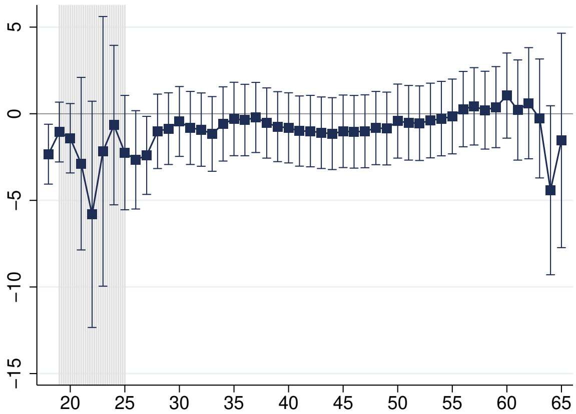
[16] However, the life-cycle model predicts the labor market consequences of war injuries to be concentrated at older age irregardless of such dynamic health effects. Indeed, controlling for health trajectories, we still find that the war-injured have lower employment in old age than the control group; the estimated effect diminishes only slightly in magnitude and remains statistically significant ($p = 0.014$).

Figure 2: Life-cycle effects of war experiences, men born 1919-21

War injury

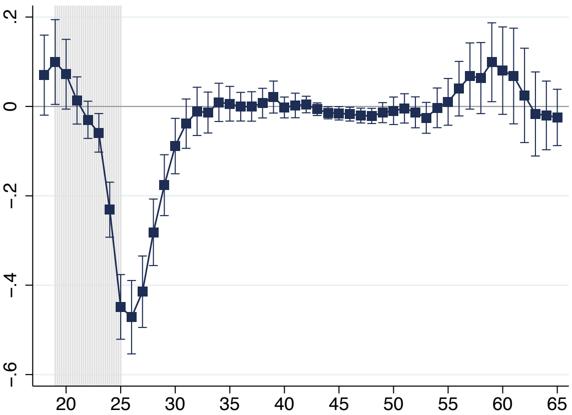


(a) Employment

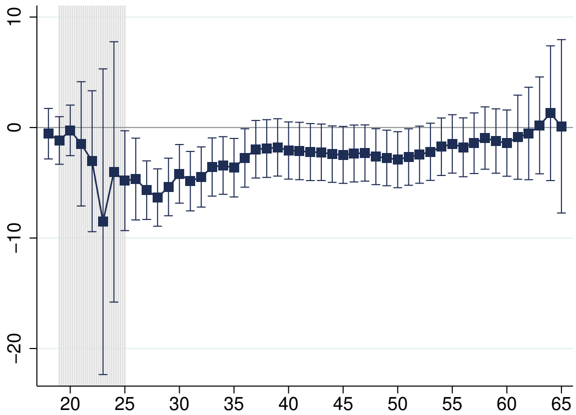


(b) Occupational Prestige

War captivity

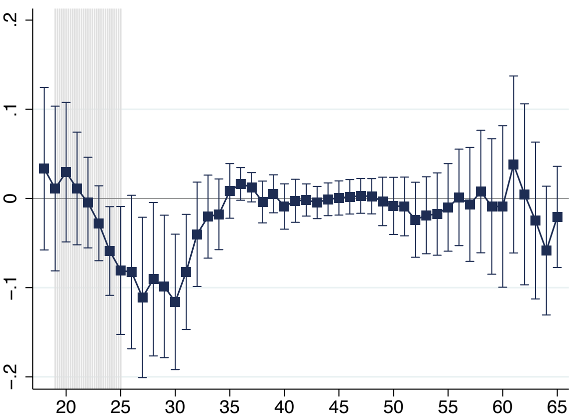


(c) Employment

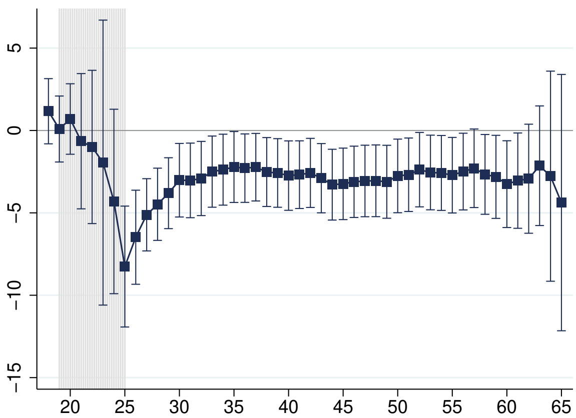


(d) Occupational prestige

Displacement



(e) Employment



(f) Occupational prestige

Notes: Effect of battlefield and other war-related injuries (panels (a) and (b)), war captivity (panels (c) and (d)), and displacement (panels (e) and (f)) on employment (left panels) and occupational prestige (conditional on employment, right panels) over the life cycle. Estimates are from a pooled OLS regression, interacting the regressor of interest and birth year (indicators) with a full set of age indicators. The sample consists of males born 1919-21. Point estimates are marked by a dot. The vertical bands indicate the 95% confidence interval of each estimate. The shaded area indicates the duration of WWII.

Prisoners of war. Next, we consider the effect of being taken POW. For comparability with the other war shocks, we consider a binary indicator, comparing those who were imprisoned for more than six months (a fate shared by nearly half of the men in our data) with those who escaped imprisonment. Since we drop individuals with short durations of captivity of no more than six months, the number of observations in panel (b) of Table 3 is lower than in previous tables. However, our estimates remain similar if we consider all POWs regardless of their length of captivity, and/or if we use the continuous length of captivity rather than a binary indicator for our analysis.

POWs born in 1919-21 were in captivity at a time when–in peacetime–they would have completed their education or entered the labor market. Panel (b) of Table 3 shows that as a result, they received slightly less education (column (1))[17] and were employed for about 2.3 fewer years before age 55 (column (2)). They also had less occupational success than veterans who escaped war captivity (column (4)). Nevertheless, POWs did not receive much lower work pensions (column (5)), as Germany's pension system "replaces" employment gaps caused by war captivity (see Appendix B for an overview of the pension system).[18]

Panel (c) of Figure 2 illustrates how war captivity delayed labor market entrance. POWs were significantly less likely to be employed in their 20s, with the gap peaking at nearly 50 pp in their mid-20s. This gap is unsurprising, reflecting the POWs' forced withdrawal from the labor market due to their imprisonment. But remarkably, POWs managed to close the employment gap in their 30s and were *more* likely to work in later life: POWs' probability of employment overtook that of non-POWs at age 55. The gap widens until age 59, when POWs were 9.9 pp more likely to be employed than non-POWs, before closing again as increasingly many veterans retire. POWs experienced lower occupational success than non-POWs at earlier ages, reflecting their delayed career start, but the gap closes gradually over time (panel (d)).

These effects of imprisonment on educational attainment and retirement decisions are again in line with the predictions from standard life-cycle theory, as we show in Appendix D.3. By reducing the potential duration of an individual's productive working span, imprisonment discourages educational investments. Moreover, by reducing labor earnings, war captivity increases the marginal utility of consumption and, therefore, participation–POWs postpone their retirement entry to compensate for the lost working time during captivity. This is akin to an income effect in static or dynamic models of labor supply, the

[17]As shown in Appendix Table C3, the small and insignificant net effect on completed education reflects a significant reduction in educational investments at age 18-25 (i.e., during captivity) and increased educational investments at age 26-30 (i.e., after returning from captivity).

[18]POWs also received significantly lower war victim's pensions (column (6)). This seemingly counter-intuitive result partly reflects that severely wounded soldiers, eligible for victim's pension, sometimes avoided captivity because they returned home earlier. Accordingly, controlling for war injuries attenuates the effect on war pensions (Table 4, see "Extended" specification in panel (b)).

importance of which has been well established in other contexts (e.g. Imbens et al., 2001). Note that our arguments here are unrelated to the potential health effects of imprisonment, which have received much attention in the related literature (see Myrskylä and Santavirta 2023). In any case, the health trajectories of POWs and non-POWs are not very different in our setting (see Appendix Figure C4b).

Displacement. More than one in five men in our sample were forcibly displaced from Eastern Europe. As one of the largest population movements in history, the mass arrival of displaced persons in West Germany had important aggregate effects (e.g. Braun and Kvasnicka, 2014; Braun and Weber, 2021; Ciccone and Nimczik, 2022; Peters, 2022). However, our interest here is in the (relative) individual economic performance of the displaced, which was of central policy interest in postwar Germany (Bauer et al., 2013).

We again focus on the 1919-21 birth cohort observed in the GHS. This cohort was in their mid-20s at the time of displacement (we study the role of age-at-displacement below). Panel (c) of Table 3 shows that between the ages of 20 and 55, displaced persons were employed for about 0.6 years less than their non-displaced peers (column (2)), but their employment at older ages was similar (column (3)). Consistent with its negative impact on employment, displacement reduced the maximum occupational prestige attained over a lifetime by 2.4 points (or 5% relative to the mean of the control group).

Displaced persons also had significantly lower incomes in old age than non-displaced persons, even though West German pension law equated periods of employment before displacement from Eastern Europe with periods in West Germany (Bauer et al., 2019). This is primarily due to lower nonpension income from rental income, interest, or dividends, lowering income from such sources by DM 310 per month, or almost 68%, relative to the control mean (Column (7)). This result is consistent with previous findings that the displaced never fully caught up in terms of wealth (Bauer et al., 2013).

Panels (e) and (f) of Figure 2 show that displacement left clear traces in labor market careers. Immediately after the war, displaced persons were up to 10 pp less likely to be employed than non-displaced men (panel (e)). The gap in employment decreased in the early 30s and disappeared by the mid-30s. However, the occupational prestige of displaced persons remained significantly lower throughout their labor market careers. Panel (f) illustrates that this gap was greatest around age 25, shortly after displacement. While this penalty declined in the late 20s, it remained largely unchanged thereafter. At age 56-65, displacement still lowered occupational prestige by around 3.4 points (or 7.8% relative to the control mean).

In Appendix D, we interpret displacement as a decline in the wage rate (e.g., due to a loss of social and job networks) or a loss of wealth (e.g., due to lost property). A wage decline generates opposing income and substitution effects and, therefore, ambiguous implications for the retirement decision. In a simple model with log-linear utility, the income and substitution effects on labor market entrants cancel out exactly. On the other hand, a pure wealth effect would generate an income but no substitution effect and therefore delay retirement. These implications align with the observation that in the 1919-21 cohort, expellees do not retire (significantly) later. However, as we show in Section 4, the effects of displacement depend critically on the age at which a person was displaced, with strong effects on education for younger birth cohorts (whose educational investments were directly interrupted) and large effects on employment for older cohorts (who experience weaker income effects).

Robustness checks and additional evidence. Table 4 shows that our baseline results from Table 3 are robust to alternative control variables and to the joint inclusion of all shocks. We present three sets of regressions for each shock. The "raw" specification controls only for year of birth. The "baseline" specification adds our standard controls, i.e., years of schooling of father and mother, number of siblings, and time of war entry. Finally, the "extended" specification controls for own years of secondary schooling and the respective other shocks (this extended specification is therefore the same across shocks). Our main estimates of the effect of war shocks on years of employment, occupational prestige, and pension income are robust across specifications. Only the effects on education vary somewhat with the set of controls included in the regression, and are estimated with little precision. We return to the educational effect of displacement in the next section, where we take advantage of the large sample size of the 1970 census to present precise estimates of displacement effects by cohort.

Finally, Appendix Table C3 reports additional evidence on the effects of wartime shocks on education, marital status, and number of children over the life cycle. The results are from separate regressions for different age groups (18-25, 26-30, 31-40, 41-55, 56-65), controlling for our standard set of control variables.[19] Two findings stand out. First, the different war experiences had large short-term but virtually no long-term effects on marital status or the number of children. War-injured veterans were more likely to be married in their late twenties (up 8.8 pp from a baseline of 49.5%), presumably because they returned from the battlefield earlier or were more dependent on a partner for help. On the other hand, POWs were significantly less likely to be married in their late 20s (by 23.2 pp). However, neither war injury nor captivity significantly affected the marital status of veterans in their 30s. The war led to an acute shortage of men and thus strengthened men's bargaining power (see, e.g., Bethmann and Kvasnicka, 2013; Kesternich et al., 2020; Battistin et al., 2022), even if they returned from the war disabled or after long captivity. Second, the table also shows that some POWs sought further education after returning

[19] The tables also report age-specific effects on employment and occupational prestige, complementing the detailed life-cycle graphs in Figure 2 (which only control for year of birth). As can be seen, the life-cycle patterns reported earlier are robust to controlling for parental education, number of siblings, and time of entry into the war.

Table 4: Robustness tests on the effect of different war-related shocks, men born 1919-21

	Educational attainment (years)	Years in employment		Occup. prestige (maximum)	Old age income from		
		age 20-55	age 56-65		work pension	war victim pension	nonpension sources
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(a) War injury (0/1)							
Raw	-0.434**	-0.031	-1.008***	-0.458	-263.98**	195.57***	23.89
	(0.204)	(0.307)	(0.272)	(0.957)	(122.75)	(51.58)	(134.43)
Baseline	-0.263	0.060	-0.908***	-0.086	-233.91*	180.63***	-14.98
	(0.199)	(0.320)	(0.290)	(0.987)	(122.80)	(48.76)	(131.74)
Extended	-0.078	-0.173	-0.807***	0.616	-174.58	186.66***	38.12
	(0.152)	(0.313)	(0.304)	(0.930)	(126.47)	(47.08)	(148.52)
(b) War captivity (> 6 months)							
Raw	-0.413*	-2.286***	0.386	-3.396***	35.07	-131.28***	-88.68
	(0.237)	(0.318)	(0.324)	(1.170)	(125.36)	(44.91)	(133.53)
Baseline	-0.262	-2.266***	0.446	-2.879**	-11.71	-121.35***	-62.98
	(0.224)	(0.332)	(0.332)	(1.201)	(129.94)	(42.21)	(137.43)
Extended	-0.260	-2.140***	0.534	-2.192*	19.02	-114.82***	-17.72
	(0.171)	(0.355)	(0.345)	(1.171)	(133.07)	(38.58)	(150.00)
(c) Displacement (0/1)							
Raw	-0.087	-0.854**	-0.074	-2.351**	-99.85	39.58	-303.93***
	(0.233)	(0.356)	(0.286)	(0.990)	(131.29)	(44.81)	(78.99)
Baseline	-0.150	-0.638*	0.121	-2.424**	-80.08	19.74	-310.05***
	(0.233)	(0.367)	(0.314)	(1.015)	(144.09)	(41.30)	(94.47)
Extended	-0.264	-0.484	0.107	-2.692***	-91.44	14.83	-325.91***
	(0.163)	(0.356)	(0.307)	(0.927)	(136.52)	(36.80)	(95.95)

Notes: Regression estimates of the effect of war-related shocks on various outcome variables (shown in the table header). Each estimate is from a separate regression. The sample consists of males born 1919-21. Columns (5) to (7) restrict the sample to the second part of GHS-2 conducted in 1987/88 where we observe individuals up to age 65-69 (see Footnote 4). The "raw" specification controls only for birth year indicators. The "baseline" specification additionally controls for years of schooling of father and mother, number of siblings, and time of entry into the war. The "extended" specification additionally controls for own years of secondary schooling and all other war shocks. Robust standard errors are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

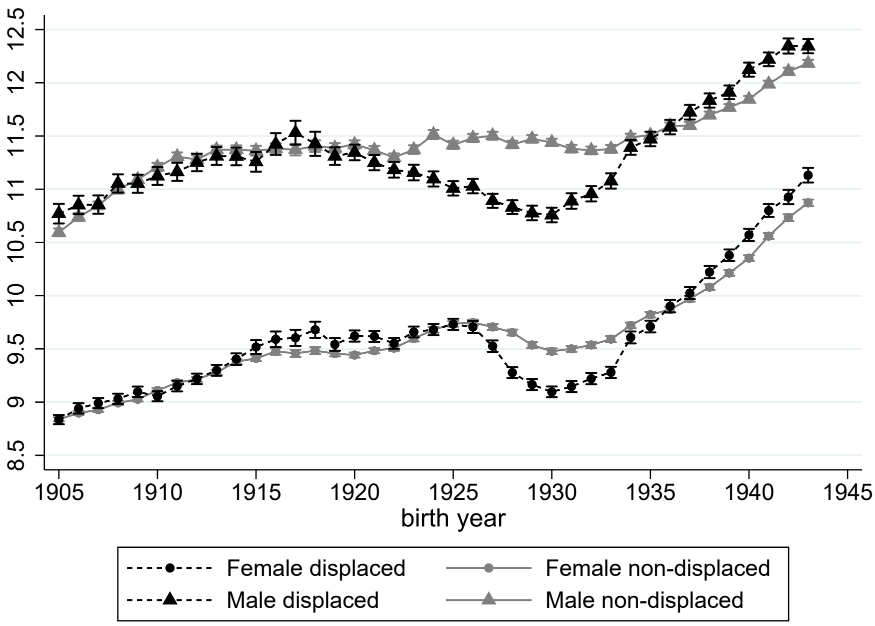
from captivity. Thus, POWs in their thirties were more likely than non-POWs to be in education. However, this was not enough to close the negative educational gap created by their captivity in their early 20s.

4 The Effect of Displacement across Cohorts

This section studies how the impact of displacement on education and employment varies across cohorts. Our analysis relies mainly on the 1970 census, whose large sample size allows us to precisely identify displacement effects by cohort.

Education. Figure 3 compares, separately for men and women, the average educational attainment of displaced and non-displaced persons for cohorts born 1905-1943. We exclude more recent cohorts as they may not have completed their education by 1970.

Figure 3: The impact of displacement on education



Notes: The figure illustrates the impact of displacement on education across cohorts. It shows unconditional means in years of education by cohort and displacement status.

Among men, we observe nearly identical trends in education for displaced and non-displaced persons born before 1920. Beginning with cohorts born in the early 1920s, the average educational attainment of the displaced declined, while it stagnated for the non-displaced. Displacement, therefore, slightly reduced the education of men who were in their early 20s at the time of expulsion. This educational penalty gradually increased in subsequent cohorts, reaching a maximum of about 0.7 years for men born around 1930. These cohorts suffered from the turmoil of flight and expulsion during the transition from school to vocational training.[20]

The gap between displaced and non-displaced males shrinks for even younger cohorts and in fact turns positive for cohorts who entered school after displacement. Such positive effects could result from the loss of land, which led the children of displaced persons to seek work outside of agriculture, thereby increasing the importance of educational investment (Bauer et al., 2013). Moreover, the experience of losing property might have encouraged displaced people to invest in "portable assets" such as education (Brenner and Kiefer, 1981; Becker et al., 2020a).

Similar patterns emerge for women: Displaced women born around 1930 suffered educational losses of about 0.4 years, while women displaced at young age had higher educa-

[20]Unreported regressions confirm that there was a sharp decline in the duration of apprenticeship among displaced persons born around 1930. For the 1930 cohort, e.g., the average duration of apprenticeship was 0.43 years less for displaced persons than for their non-displaced peers. This gap explains almost 2/3 of the total education gap of -0.68 years.

tional attainment than their non-displaced counterparts. The gap between the displaced and the non-displaced opened later for women than men, around the 1926/27 cohort, perhaps because most women in earlier cohorts had completed their education when the war began (as they had, on average, lower education than men). Moreover, women's educational careers were less directly interrupted by the war, while military service forced men to postpone further educational investments.

One drawback of the 1970 census data is that we cannot control for parental background. However, we observe similar patterns in the GHS in regressions that condition on parental education (see Appendix Table C4). We also verify in the GHS that the educational gap between displaced and non-displaced in the 1929-31 cohort opens only with displacement (see Appendix Figure C4).

Beyond the displaced, Figure 3 also illustrates that the secular expansion of education was halted and reversed for cohorts born around 1930. These cohorts suffered from school closures and a lack of apprenticeships in the postwar years (Müller and Pollak, 2004). Our results thus also testify to the cohort-wide educational costs of WWII, documented in Ichino and Winter-Ebmer (2004).

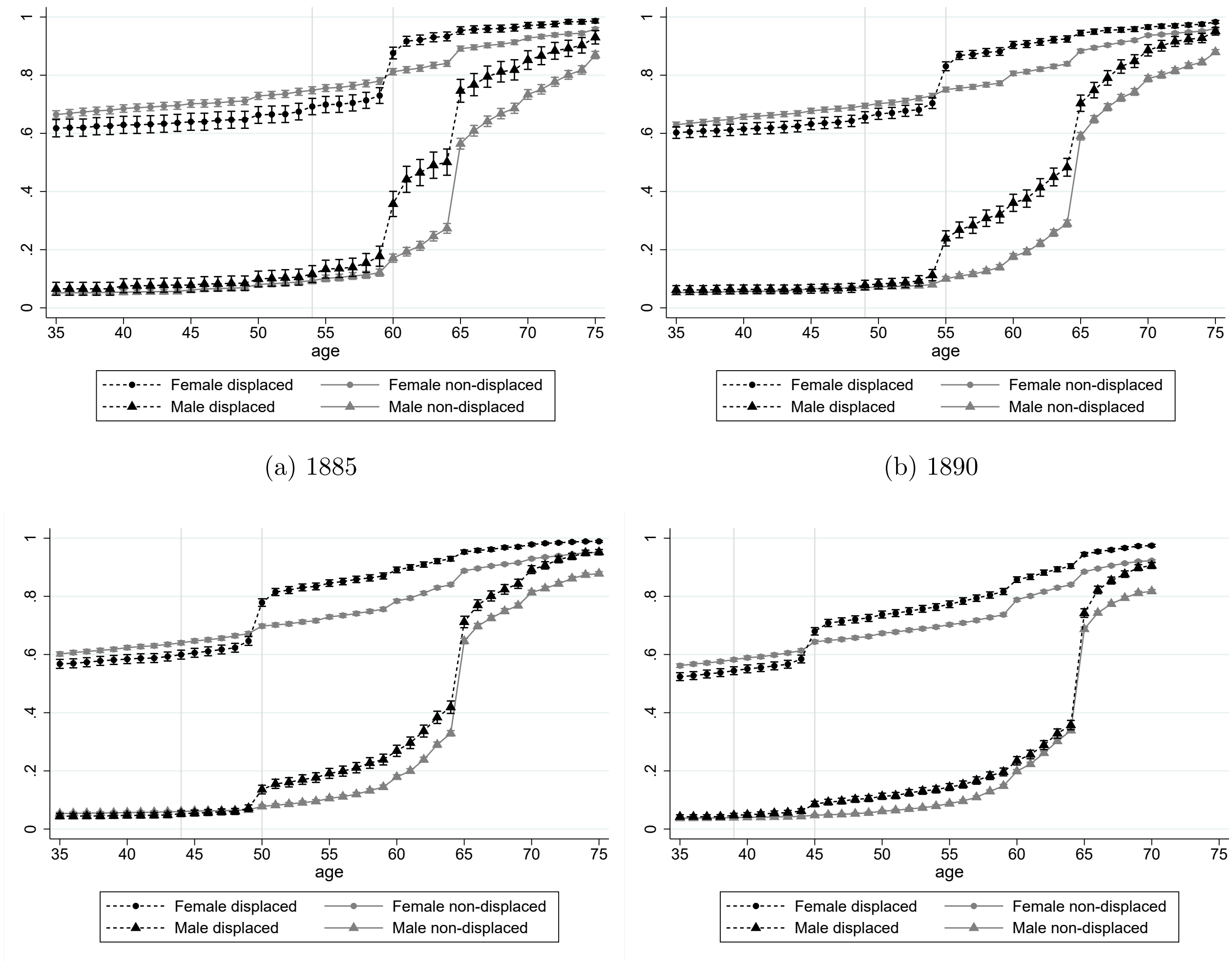
Employment. Displacement had little impact on the retirement behavior of men who experienced WWII as young adults (Section 3), but how did it affect women or older cohorts? We use an individual's last employment to define an indicator that takes the value of one for years in which an individual has left gainful employment ("employment exit").

Figure 4 illustrates how the probability of exiting employment evolves over the life cycle, distinguishing between displaced and non-displaced persons. We consider four cohorts born in 1885, 1890, 1895, and 1900. For all four cohorts, and both genders, employment exits of displaced persons spiked in 1945 when most displacements occurred (the second gray vertical line in the figures indicate the corresponding ages of 60, 55, 50, and 45). In contrast, there is no spike for the non-displaced, for whom the exit probability evolves smoothly around 1945.[21] The employment gap between the groups, therefore, widened sharply at displacement. Many expellees never returned to the labor market after losing their jobs during the displacement.

Importantly, this effect of displacement on employment varies greatly by birth cohort and gender. Panel (a) of Figure 5 illustrates this pattern in detail, reporting the immediate employment effect of displacement for each cohort born between 1880 and 1905. Estimates are from simple Difference-in-Differences (DiD) regressions, which measure the difference between displaced and non-displaced individuals in the change in the labor market exit probability between 1938 (pre-) and 1946 (post-treatment period). Specifically,

[21] For men, the plot also shows a second jump–for expellees and non-expellees–at the statutory retirement age of 65.

Figure 4: Employment exit probability over the life cycle, by cohort



(a) 1885

(b) 1890

(c) 1895

(d) 1900

Notes: The figures depict, by cohort, the probability of having exited employment for displaced and non-displaced persons over the life cycle. Gray vertical lines indicate the beginning and end of WWII. Vertical bands indicate 95% confidence interval.

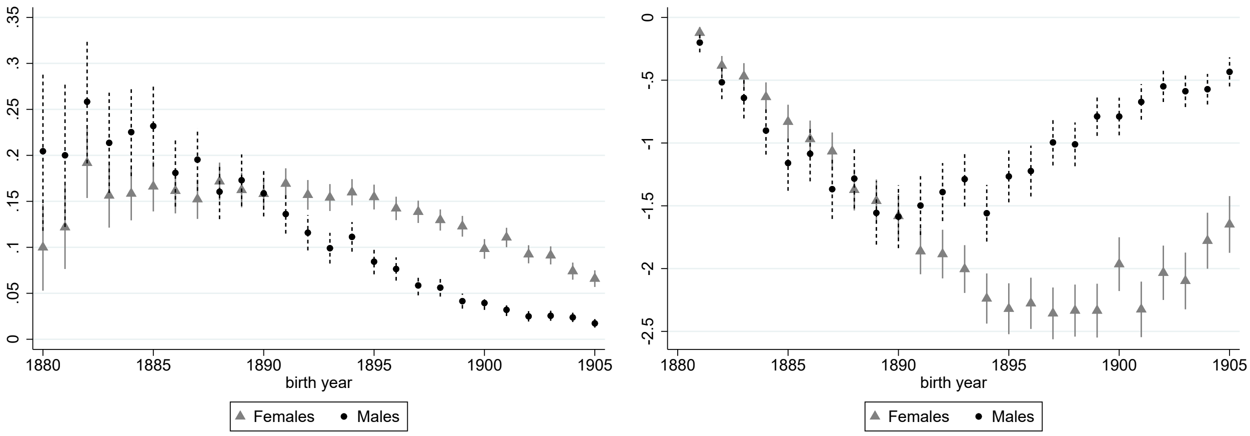
we estimate, separately for each cohort, the following regression equation

$$exit_{it} = \alpha + \beta displaced_i + \gamma d_t + \delta(displaced_i \times d_t) + \varepsilon_{it}, \quad (3)$$

where $exit_{it}$ indicates whether individual i has left the labor market by year t, $displaced_i$ is a dummy variable for (to be) displaced persons, and d_t is an indicator for the post-displacement year 1946. The parameter of interest is δ.

For men born in 1885, displacement increased the probability of employment exit in 1946 by 23.2 pp (relative to a post-treatment control mean of 19.3). The effect gradually declines for more recent cohorts who were displaced at younger age, to less than 1.7 pp for men born in 1905. The immediate effects of displacement on employment are more stable with age for women. For older women born in 1885, displacement increased the probability

Figure 5: The impact of displacement on education and employment



(a) Immediate effect on employment exit

(b) Total employment effect (years)

Notes: The figure illustrates the impact of displacement on employment across cohorts. Panel (a) estimates the immediate effects of displacement on the probability to exit from employment for cohorts born between 1880 and 1905. Effect estimates are from DiD regressions, with displaced persons as the treatment group and 1938 as the pre- and 1946 as the post-treatment period. Panel (b) estimates the overall impact of displacement on years of employment up to age 65. The effect estimates are from DiD regressions, with displaced workers as the treatment group and 1938 as the pre-treatment period. The post-treatment period extends from 1946 to the year a cohort turns 65. We measure total impacts as the product of the DiD coefficient and the potential years of employment from 1946 to the year a cohort turns 65. Point estimates are indicated by a dot, vertical bands indicate 95% confidence intervals (based on standard errors clustered at the individual level).

of exiting the labor market by 16.6 pp in 1946. The effect size is substantial, given that only a third had not yet left the labor market by 1938. Thus, half of the women still "at risk" of exiting did so due to displacement. Displacement also had a much greater effect on younger women than on men: Among women born in 1905, 6.9 pp left employment permanently by 1946 as a result of displacement. Presumably, the displacement effect is larger for women than men because the former were on average less attached to the labor market at the time.

While the immediate impact is smaller for younger cohorts, the young have a longer labor market career ahead of them. An earlier employment exit is, therefore, more consequential for them. Panel (b) of Figure 5 depicts the total effect of displacement on years of employment up to age 65, the statutory retirement age. We quantify the total employment effect as the cumulative difference in employment from 1946 to the year a cohort turns 65.[22] For men, the total effect of displacement follows a hump shape: Older cohorts lost little time in employment because they were close to retirement anyway. The employment

[22]Specifically, we first estimate the average effect of displacement on employment in the post-treatment period in a DiD design, with displaced workers as the treatment group, 1938 as the pre-treatment period, and the post-treatment period extending from 1946 to the year in which a cohort turns 65. We then multiply this average effect by the length of the post-treatment period (i.e., the potential years of employment before a worker turns 65).

loss then gradually increases with birth year, peaking at about 1.5 years for men born in 1890-95. Younger male cohorts again lost very little employment time, as only a few exited employment after displacement. For women, on the other hand, the overall employment loss is largest for the relatively young cohorts born in 1895-1905. They lost more than two years of employment due to displacement.

In Appendix D, we show that the observed variation in the employment effect is consistent with simple theoretical arguments. A reduction in the wage rate due to displacement generates a negative substitution effect (as work is being less rewarded) and a positive income effect (as life-cycle earnings and consumption decrease). However, this income effect depends on the age at which an individual is being displaced. Individuals close to their expected retirement age experience only a minor income effect, as most of their life-cycle earnings have already been realized–their employment response is dominated by the substitution effect, and hence negative. In contrast, younger individuals experience a more sizable income effect due to displacement, muting the response in employment.

5 Conclusion

The dramatic return of war and displacement to Europe following Russia's attack on Ukraine has reignited interest in the labor market consequences of violent conflict. Our study examines the impact of battlefield injuries, war captivity, and displacement in the context of WWII, the most devastating conflict in history. We show that the economic consequences of these shocks often became visible long after the war. For example, the effect of war injuries on the employment of WWII veterans was most pronounced not in the immediate postwar period, but decades later, as these veterans approached retirement. Displacement also had very different effects depending on the age and gender of the displaced. The impact on education was worst for adolescents facing the critical transition from school to vocational training. On the other hand, the loss in employment was particularly severe for women and older male cohorts. Overall, our findings suggest that policies to alleviate the hardships of war should take into account that its consequences depend critically on age-at-exposure and vary greatly over the life cycle.

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Online Appendix

A Data Appendix

A.1 Educational attainment

The GHS indicates the highest school-leaving and vocational training qualifications that a person has obtained (if any). Using this information, we calculate years of schooling as the minimum duration required to earn a particular degree. To determine the total number of years of education, we add to the years of schooling the minimum length of time required to earn a particular vocational education degree. Table A1 shows the minimum length of time we use to calculate our measures of education (taken primarily from Müller, 1979).

Table A1: Minimum lengths of time required to earn a given degree

Degree	Minimum time length
School Degree	
No completed school degree	8 years
Sonderschulabschluss (special needs school)	8 years
Volks-/Hauptschulabschluss (low school track)	8 years
Mittlere Reife (medium school track)	10 years
Fachhochschulreife (high school track)	12 years
Abitur (high school track)	13 years
Vocational Training Degree	
No vocational degree	0 years
Agricultural or household apprenticeship	2 years
Industrial apprenticeship	2 years
Vocational school degree	2 years
Commercial apprenticeship	3 years
Master craftsman	4 years
University of applied sciences degree	4 years
University degree	5 years
Other vocational training degree	2 years

B Pension Benefits and World War II

Statutory pensions in Germany depend on the labor income earned over the life course.[23] The longer people work and the more they earn, the higher their pensions. The German pension system thus "insures" living standards achieved during working life and extends prosperity into retirement. Since the pension reform of 1957, the system has been organized as a pay-as-you-go-scheme. This means that current contributions (from employees and employers) pay for current pension obligations. The 1957 reform also made pensions

[23] We describe the provisions of the pension system as they were relevant to the 1919-21 birth cohort (see Allmendinger, 1994, for further details, especially on the gendered impact of the pension system on this generation's life courses). Mierzejewski (2016) provides a comprehensive history of the German pension system.

dynamic by linking them to wage trends. Entitlement to a pension arises when individuals have paid contributions for at least five years.

Before 1992, the statutory retirement age for old-age pensions was 65 for men and 60 for women.[24] Early retirement at age 60 was possible under certain conditions for the disabled and long-term unemployed. The actual average entry age for old-age pensions was significantly lower than the standard retirement age in the early 1980s (when most individuals in our sample retired). It fell sharply after the pension reform of 1972 introduced "flexible retirement" from age 63 for workers with a long service history (Börsch-Supan and Schnabel, 1998). The entry age reached a low point in 1982 at 62.3 years for men and 61.5 years for women. The actual retirement age spiked at age 60, 63, and 65 (Börsch-Supan and Schnabel, 1998). These spikes correspond to the earliest age at which early retirement, flexible retirement, and regular retirement for workers with short work histories were possible.

Importantly, the pension system smooths out gaps in the employment biography caused by compulsory state measures such as military service, war captivity, expulsion, and resettlement. These "substitute periods" (*Ersatzzeiten*) are fully taken into account when calculating the pension. In addition, "periods of absence" (*Ausfallzeiten*)[25] are taken into account in the pension calculation. Periods of absence are periods during which employment is interrupted for personal reasons, including unemployment, incapacity to work, pregnancy, and further education.

In addition to old-age pensions, the pension system provides disability benefits for workers below age 60 (which are later converted to old-age pensions). These disability benefits used to be an important pathway to retirement, especially in the early 1980s (Börsch-Supan and Schnabel, 1998). The pension system also covers the financial loss caused by the death of a spouse. The survivor's pension (*Witwenrente*) is intended to replace the support previously provided by the deceased. Until 1986, women received survivor's pension unconditionally and regardless of their own work history. Widowers, on the other hand, were entitled to a survivor's pension only if the deceased's wife had provided most of the family's support. This differential treatment did not end until 1986.

War victims receive additional pension benefits under the Bundesversorgungsgesetz (BVG). The BVG aimed at the physical and vocational rehabilitation of victims and their families, and paid social assistance to those for whom rehabilitation was not, or only partially, possible. The war victim's pension (*Kriegsopferrente*) is paid to persons who have suffered serious health damage as a result of military or military-like service in connection with the war (e.g. damages due to direct warfare, captivity, or internment abroad). The basic income support (*Grundrente*), which is paid as part of the war victim's pension, is not means-tested. Instead, its amount depends only on the severity of the health damage caused by the war. Severely disabled persons who can no longer work receive an additional means-tested compensatory pension (*Ausgleichsrente*). If an injured person dies as a result of his injury, his widow receives survivor's pension. The war victim's pension for former soldiers are not bound to certain age thresholds.

[24]The pension reform of 1992 abolished gender differences in the retirement age, which was gradually increased to 65 for women.

[25]The pension reform of 1992 changed the term to *Anrechnungszeiten*.

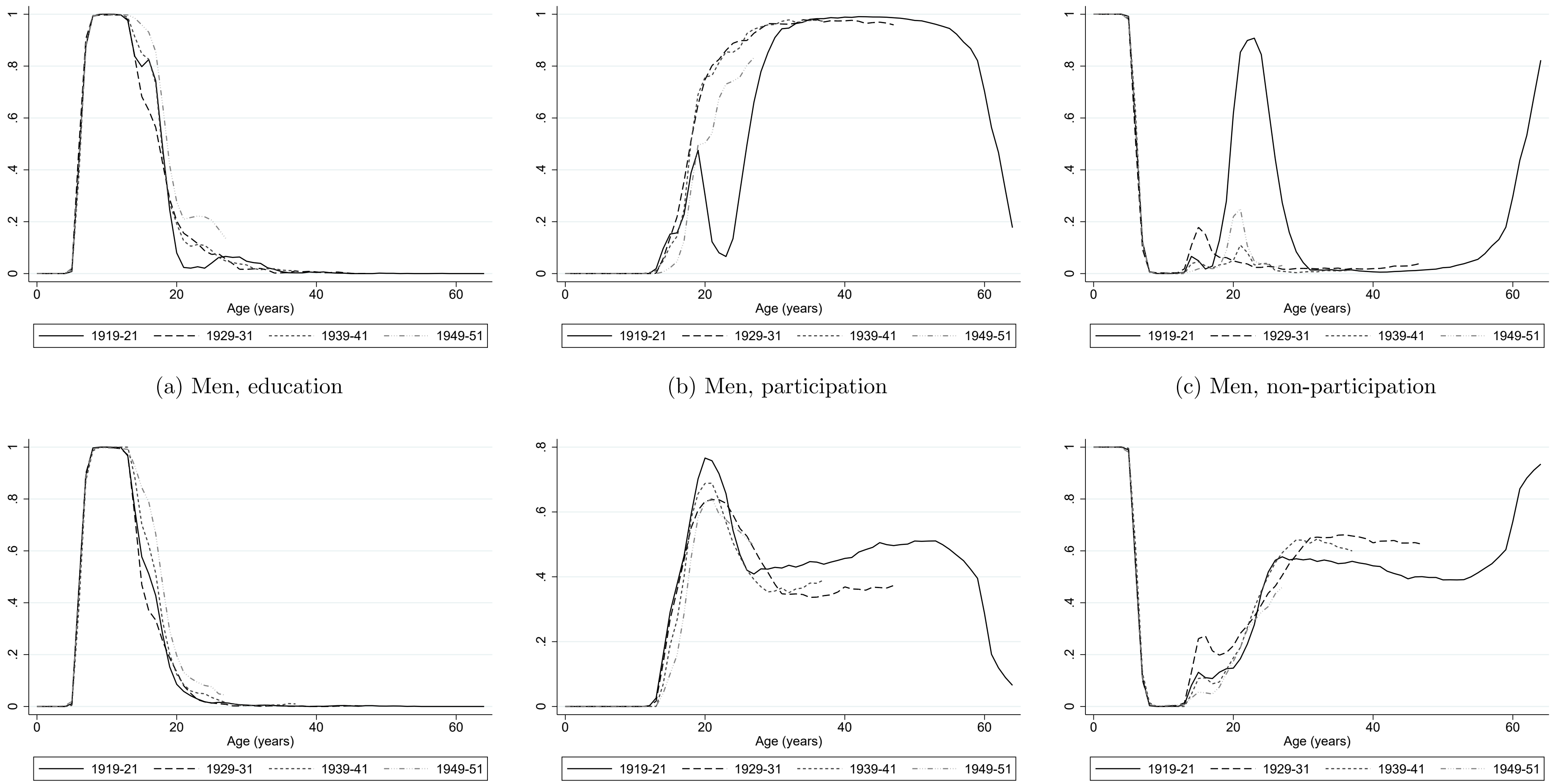
C Additional Figures and Tables

C.1 Figures

Figure C1: German territorial losses in World War I and II

Base maps: MPIDR and CGG (2011).

Figure C2: Education, participation, and non-participation over the life cycle, by gender and cohort



(a) Men, education

(b) Men, participation

(c) Men, non-participation

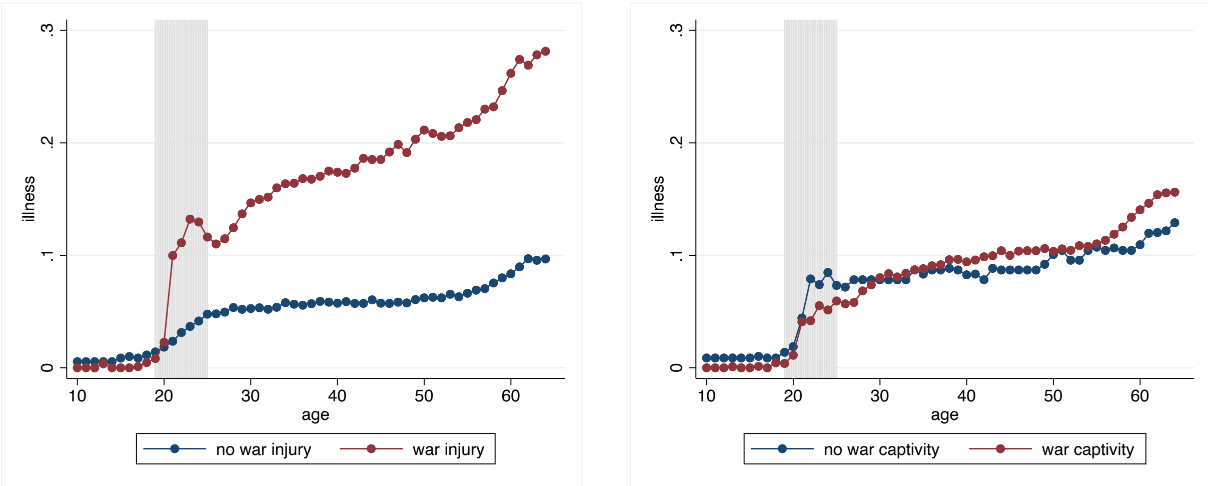
(d) Women, education

(e) Women, participation

(f) Women, non-participation

Notes: The graph depicts, separately by gender, the share of individuals in education (Panels (a) and (d)), in the labor force (Panels (b) and (e)) and non-participating (Panels (c) and (e)). We distinguish between cohorts born in 1929-21, 1929-31, 1939-41 and 1949-51. Education includes schooling, vocational training, and further education. Individuals are in non-participation if they are not in education, do not work, and are not unemployed.

Figure C3: The effect of war injury or captivity on health status over the life cycle, cohort born 1919-21

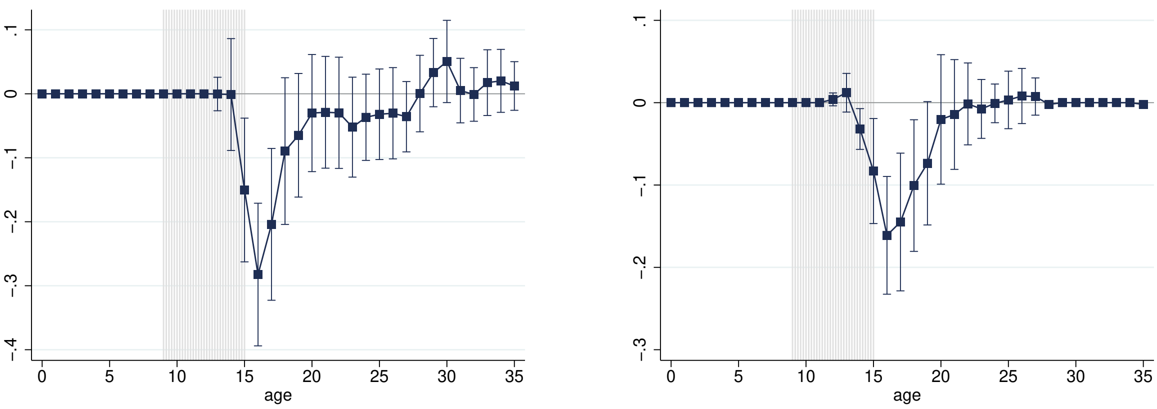


(a) War injury

(b) War captivity

Notes: The figure plots the share of respondents reporting ill health over the life cycle, comparing those who sustained a war-related injury (left panel) or those who experienced war captivity (right panel) with those who did not. The sample consists of males born 1919-21 who served in the war. The shaded area indicates the duration of WWII.

Figure C4: The effect of displacement on education over the life cycle, cohort born 1929-31



(a) Males

(b) Females

Notes: The graph depicts estimated differences in educational participation between displaced and non-displaced individuals over the life cycle, drawing on GHS data. Estimates come from conditional OLS regressions, controlling for the father's and mother's years of schooling and number of siblings. Point estimates are marked by a dot. The vertical bands indicate the 95% confidence interval of each estimate. The shaded area indicates the duration of WWII.

C.2 Tables

Table C2: Correlation between war-related shocks

	War injuries (1)	War captivity (2)	Displacement (3)
War injuries	1.000	–	–
War captivity	-0.107	1.000	–
Displacement	0.041	0.014	1.000

Notes: Men born in 1919-21 (N=529).

Table C3: Life-cycle effects of war-related shocks, men born 1919-21

	Age brackets				
	18–25	26–30	31–40	41–55	56–65
	(1)	(2)	(3)	(4)	(5)
(a) War injury (0/1)					
In education	–0.017	–0.023	–0.008	-	-
	(0.011)	(0.017)	(0.012)		
Employed	0.028**	0.022	0.004	–0.015	–0.085***
	(0.014)	(0.030)	(0.011)	(0.011)	(0.029)
Occupational Score	–1.760**	–1.629*	–0.263	–0.337	0.770
	(0.890)	(0.975)	(0.964)	(1.067)	(1.209)
Married	0.006	0.088**	–0.022	–0.004	0.008
	(0.016)	(0.042)	(0.024)	(0.010)	(0.018)
Children	0.007	0.106	–0.004	–0.135	–0.135
	(0.022)	(0.073)	(0.101)	(0.131)	(0.137)
(b) War captivity (> 6 months)					
In education	–0.033**	–0.000	0.023**	-	-
	(0.015)	(0.018)	(0.011)		
Employed	–0.082***	–0.282***	–0.003	–0.008	0.043
	(0.018)	(0.029)	(0.015)	(0.010)	(0.033)
Occupational Score	–2.344**	–4.280***	–2.458**	–2.366*	–1.658
	(0.955)	(1.251)	(1.237)	(1.276)	(1.539)
Married	–0.021	–0.232***	–0.013	0.015	0.015
	(0.020)	(0.047)	(0.030)	(0.015)	(0.024)
Children	–0.024	–0.203**	–0.110	0.112	0.133
	(0.034)	(0.085)	(0.115)	(0.148)	(0.155)
(c) Displacement (0/1)					
In education	–0.006	0.007	0.010	-	-
	(0.013)	(0.020)	(0.013)		
Employed	0.007	–0.080**	–0.012	–0.008	0.011
	(0.014)	(0.036)	(0.011)	(0.014)	(0.031)
Occupational Score	–1.228	–4.801***	–3.081***	–3.497***	–3.315***
	(0.996)	(0.996)	(1.025)	(1.051)	(1.237)
Married	–0.001	–0.076	–0.032	–0.015	–0.017
	(0.019)	(0.048)	(0.031)	(0.014)	(0.024)
Children	0.022	0.006	–0.064	–0.218	–0.212
	(0.032)	(0.084)	(0.119)	(0.152)	(0.161)

Notes: Regression estimates of the effect of war-related shocks on various outcome variables (shown on the left) at different points in the life cycle (shown in the table header). The sample consists of males born 1919-21. All regressions control for birth year (indicators), years of schooling of father and mother, number of siblings and time of entry into the war (all interacted with age). The regressions for occupational prestige are estimated conditional on being employed. Robust standard errors are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table C4: The effect of displacement on education, by sex and cohort

	Males			Females		
	1919-21	1929-31	1939-41	1919-21	1929-31	1939-41
	(1)	(2)	(3)	(4)	(5)	(6)
Displacement (0/1)	-0.150	-0.652***	0.074	0.360*	-0.825***	0.207
	(0.233)	(0.274)	(0.343)	(0.202)	(0.242)	(0.403)
	[10.934]	[10.693]	[10.782]	[9.732]	[9.447]	[9.988]
Observations	427	303	310	605	303	298

Notes: The table shows, by sex and cohort, estimates of the effect of displacement on years of education, drawing on data from the GHS. Estimates come from conditional OLS regressions. Years of education include time spent in vocational training and at university. All regressions control for birth year (indicators), years of schooling of father and mother, number of siblings and (for males) time of entry into the war. Robust standard errors are shown in parentheses, unconditional means for the non-displaced control group in square brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

D Theoretical Predictions

How do war-related shocks affect an individuals' education and labor market outcomes over the life course, and can standard theory capture those effects? In this section we derive theoretical predictions from a standard life-cycle model of human capital and retirement decisions.

D.1 A Ben-Porath model with endogenous retirement

Summarizing a version of the Ben-Porath model with endogenous retirement decisions (Hazan, 2009), assume that an individual's lifetime utility V equals

$$V = \int_0^T e^{-\rho t} u(c(t))dt - \int_0^R e^{-\rho t} f(t)dt, \tag{D-1}$$

where $c(t)$ is consumption at age t, $f(t)$ is the disutility of work (assumed to satisfy $f'(t) > 0$ and $f(T) = \infty$), ρ is the subjective discount rate, R is the retirement age, and T is the length of the individual's lifetime.

Human capital $h(s)$ and therefore the wage w depend on the individual's choice of the length of schooling prior to entering the labor market s and "learning speed" $\theta(s)$, such that $w = h(s) = e^{\theta(s)}$. The sole costs of schooling is foregone earnings, so the budget constraint

$$\int_s^R e^{-rt} e^{\theta(s)} dt = \int_0^T e^{-rt} c(t)dt \tag{D-2}$$

equates consumption over the lifetime (between 0 and T) with earnings over the working life (between s and R), where r is the interest rate. Following Hazan (2009), we assume $r = \rho$, implying that consumption is constant over the life cycle,

$$c(s, R) = \frac{e^{\theta(s)} \left(e^{-rs} - e^{-rR}\right)}{1 - e^{-rT}}. \tag{D-3}$$

Solving the Lagrangian associated with maximizing lifetime utility V leads to the two equilibrium conditions equating the marginal costs of schooling with its marginal benefits,

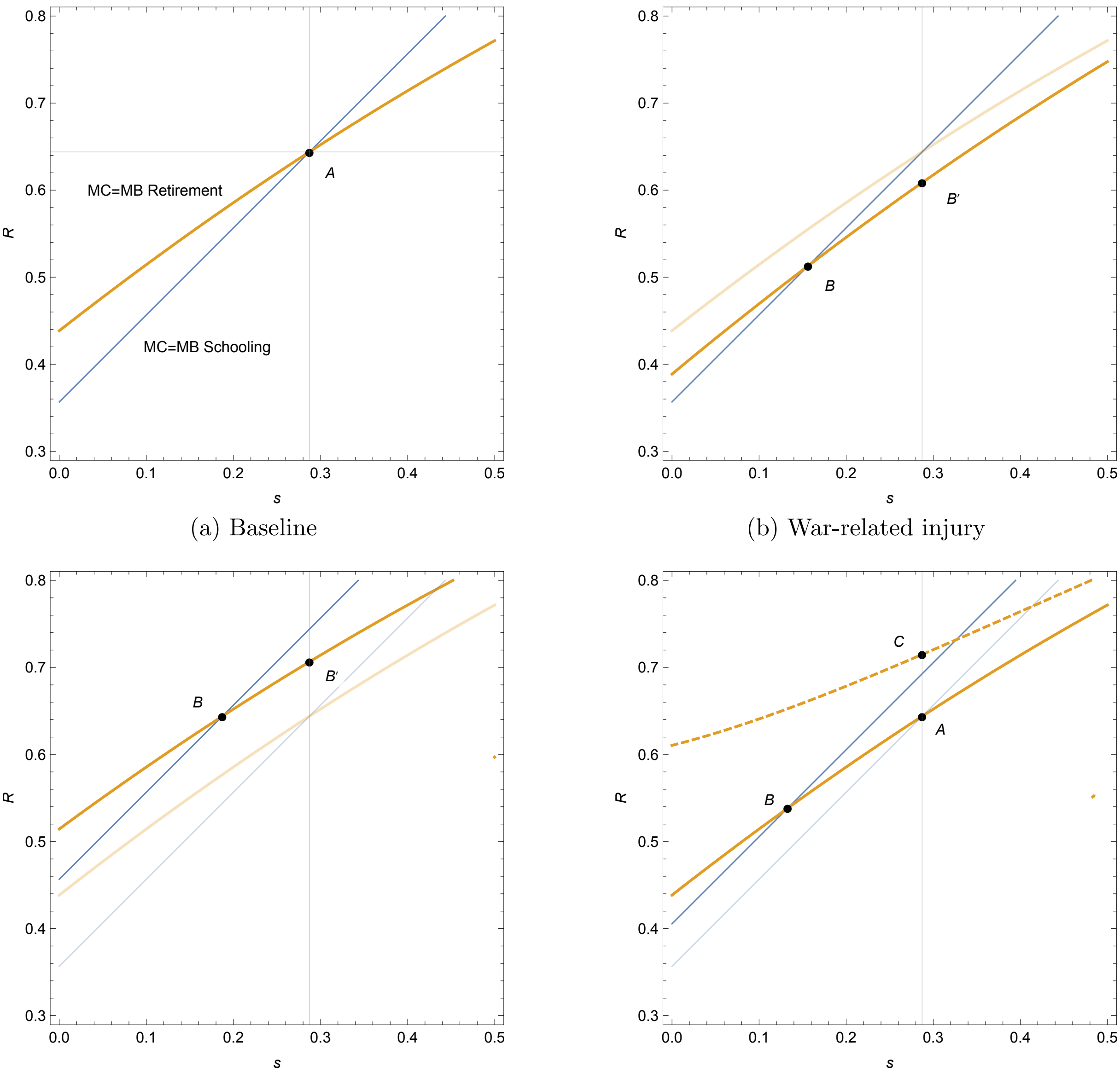
$$\frac{1}{\theta'(s)} = \frac{1 - e^{-r(R-s)}}{r} \tag{D-4}$$

and the disutility of work at age R with the marginal utility of working (in terms of consumption)

$$f(R) = u'(c(s, R))e^{\theta(s)}. \tag{D-5}$$

Figure D5a provides a numerical example, assuming $u(\cdot) = log(\cdot)$, $f(R) = 1/(1 - R)$, $T = r = 1$ and $\theta(s) = s/0.3$. The (thin) blue line corresponds to the indifference curve associated with the optimal schooling condition in equation (D-4) while the (thick) orange line corresponds to the optimal retirement decision represented by equation (D-5). The optimal schooling and retirement age are determined by the intersection of these two

Figure D5: Theoretical predictions



(a) Baseline

(b) War-related injury

(c) War captivity

(d) Displacement

Notes: Numerical illustrations of a Ben-Porath model with retirement decision (Hazan, 2009) for retirement age R and length of schooling s. Figure (a) is our baseline calibration with $u(\cdot) = log(\cdot)$, $f(R) = 1/(1-R)$, $T = r = 1$ and $\theta(s) = s/0.3$. Figure (b) corresponds to a war-related injury with an increase in disutility of work such that $f_{injury}(R) = 1.2f(R)$. Figure (c) corresponds to war captivity with time $x = 0.1$ spent in captivity. Figure (d) corresponds to displacement with a reduction in the wage rate to $\theta_d(s) = 0.9\theta(s)$ (solid blue and orange lines) or a reduction in wealth such that $c_d(s, R) = c(s, R) - 1/3$ (dashed orange line).

curves (point A).

Using this model, we next derive the implications of different types of war-related shocks–war injuries, captivity, and displacement–for the choice of schooling s and retirement age R.

D.2 War injuries

Among men born 1919-21, nearly one third suffered injuries such as bullet and shrapnel wounds, frostbite or amputations (see Table 1). What are the likely implications? Interpreted through the lens of the model, war injuries increase the disutility of work $f(R)$. Moreover, their effect on schooling s will be non-positive, as explained below. The equilibrium condition (D-5) determining the retirement decision then implies that the marginal utility of consumption u' must increase, corresponding to a reduction in consumption (and income), and therefore a reduction in the retirement age R.[26]

But, war injuries may not only affect the disutility of work, but also generate different types of income effects. First, the war-injured were eligible to a war pension (see Section B), corresponding to an *increase* in income. Second, war-related injuries may reduce productivity, at least in some jobs or for some individuals, corresponding to a decrease in the wage $w = e^{\theta(s)}$ and a *decline* in income and pensions. The overall effect of war injuries on income is therefore ambiguous. We show in Section 3 that in our setting, the net effect on (labor + war) pensions is negligible. The main channel via which war injuries affect (life-cycle) income is therefore the retirement decision.

The effect of war injuries on schooling s is non-positive. First, note that most of those born in 1919-21 entered the military around age 20, *after* leaving school. Moreover, military service shortened the remaining lifespan available for work, thereby lowering the incentives for war returnees to invest into education (a positive relation between the length of the economic lifespan and educational investments is a standard implication of the Ben-Porath model; see Ben-Porath 1967). Indeed, fewer than 10% of returnees entered an apprenticeship after the war.[27] A further shortening of the active working life due to early retirement decreases these incentives further, implying that the effect of war injuries on educational investments are negative.[28]

Figure D5(b) provides a numerical example. The increase in the disutility of work corresponds to a downward shift of the indifference curve associated with condition (D-5). If the war-injured could freely optimize (ex-ante optimization) they would reduce both retirement entry R and their schooling s (point B). However, most have completed their schooling investments before enlistment to the military (vertical line). As they cannot reduce those educational investments ex-post, their incentives to reduce the retirement age are mitigated (point B'). Standard theory therefore predicts that war injuries decrease the retirement age and reduce educational investments in the right tail of the distribution (i.e., among those who had not yet completed their investments before enlistment).

[26] War injuries might also reduce the length of the individual's lifetime T, reducing the retirement age R further. The reason is that according to condition (D-3), a decrease in T increases the consumption level (for a given R and s). Consequently, the marginal utility of consumption decreases, and so does retirement age R (according to the condition (D-5)). However, this mechanism is less relevant in our context, as our empirical analysis conditions on survival until the statutory retirement age.

[27] While the war may have increased skill returns overall, such general equilibrium effect would affect both the treated (the war-injured) and control group.

[28] As a possible exception, educational investments might allow the war-injured to access white-collar jobs, in which war injuries might be less detrimental to productivity than in blue collar jobs. However, we do not find such occupational reallocation in our setting.

D.3 War captivity

More than three quarters of men born 1919-21 were in captivity, often for years (see Table 1). This captivity disincentives educational investments. While some war returnees entered apprenticeships or studied at a university, those spending time in captivity returned later and would have made such investments later. But a key implication of the Ben-Porath and similar models is that educational investments are less profitable at later ages, when the remaining productive work span is shorter. Formally, the optimal educational investment of war prisoners is determined by

$$\frac{1}{\theta'(s)} = \frac{1 - e^{-r(R-x-s)}}{r} \tag{D-6}$$

where x is the time spent in captivity. An increase in x decreases the right hand of this equation, so for the condition to hold we require a reduction of schooling s or an increase in the retirement age R (or both).

Individuals choose their optimal retirement age according to condition (D-5). Plausibly, the disutility of work on the left-hand side is not much affected by war captivity. But for a given retirement age R and schooling s, the right side of (D-5) increases because life-cycle income–and therefore consumption according to equation (D-3)–declines due to war captivity.[29] Specifically, the optimal consumption is now given by

$$c(s,R) = \frac{e^{\theta(s)}\left(e^{-r(s+x)} - e^{-rR}\right)}{1 - e^{-rT}}. \tag{D-7}$$

Therefore, consumption decreases and the marginal utility of consumption increases in x, ceteris paribus. To satisfy condition (D-5) we therefore need that the retirement age R increases and/or that s declines in response to time spent in captivity x.[30] The reduction in lifetime income associated with captivity therefore raises incentives to work; this is akin to income effects from shifts in non-labor income or wages in standard models of labor supply.

Figure D5(c) provides a numerical example. Both the indifference curves associated with condition (D-4) and condition (D-5) shift upward, reflecting a decrease in the marginal benefits of schooling for a given level of R and an increase in the marginal utility of working for a given level of s. If individuals could freely optimize they would reduce schooling but do not change their retirement age much (point B). However, many individuals will have already completed their schooling investments before enlistment (vertical line). With education above its ex-post optimum, individuals have an incentive to retire later (point B'). Standard theory therefore predicts that war captivity increases the retirement age but reduces educational investments and, therefore, wages.

[29] As an individual's work-span is shorter than his lifespan, years spent in war captivity will decrease life-cycle income by a greater proportion than the period over which consumption needs to be financed. The effect on pensions will be more modest, as the pension system compensated for gaps in the employment biography due to war captivity (see Section B).

[30] While an increase in retirement age increases both sides of equation (D-5), it will ultimately increase the left side more (as $f(T) = \infty$).

D.4 Displacement

More than one fifth of our survey respondents are displaced Germans, mostly from the German Reich's Eastern territories (see Table 1). The extent to which displacement affects educational and labor market careers will depend on the timing of the expulsion. As most displacements occurred towards the end of WWII, they will have only limited effects on the educational investments of older cohorts, including the 1919-21 cohort. In contrast, younger cohorts experienced direct interruptions of their educational careers. For example, the 1929-31 cohort were only 14-16 years olds when the war ended in 1945. As we show in Section 4, displacement therefore led to a large decline in education among younger cohorts.

Here we focus instead on the labor market effects of displacement. Motivated by the evidence shown in Section 4, we assume that displacement reduces an individual's wage from $\theta(s)$ to $\theta_d(s)$, such that $\theta_d(s) < \theta(s)\ \forall s$. The precise reason for this wage decline is not central for our argument, but it might reflect the loss of social networks, specific human capital or "search capital" as the displaced could not return to their previous jobs.[31] This wage decline affects the marginal utility of working $u'(c(s,R))e^{\theta(s)}$ on the right-hand side of equilibrium condition (D-5) via two channels. On the one hand, a reduction in the wage $w = e^{\theta(s)}$ directly reduces the incentives to work (*substitution effect*). On the other hand, a reduction in earnings also reduces consumption $c(s,R)$, thereby increasing the marginal benefits of consumption $u'(c(s,R))$ and incentives to work (*income effect*). As these income and substitution effects have opposing signs, the overall effect on the optimal retirement age R is ambiguous and depends on the curvature of the utility function. A pure wealth effect on the other hand would generate an income but no substitution effect, and therefore lead to an unequivocal postponement of retirement entry.

Figure D5(d) provides a simple illustration for the case of displacement *before* labor market entry (such as for the 1919-21 cohort). A proportional decrease in the wage rate $w = e^{\theta(s)}$ due to expulsion would shift the indifference curve associated with condition (D-4) upwards (thin blue line). The curve associated with condition (D-5) however remains unchanged in this particular example: as utility is log linear in consumption we have $u'(c(s,R)) = 1/c(s,R)$, and income and substitution effects of a reduction in the wage rate in early life cancel each other out exactly. Ex-ante, expellees would therefore choose lower schooling and an earlier retirement age (point B). However, if educational investments were made before expulsion (as for the 1919-21 cohort) the optimal retirement age remains unchanged (point A). If expulsions affect wealth rather than wages then the curve associated with condition (D-5) would shift, corresponding to a pure income effect (orange dashed line). Assuming schooling is fixed at s, individuals would choose a higher retirement age (point C).

But how would the employment effects of displacement vary with age at displacement d? The key insight is that the size of the income effect from a reduction in the wage rate depends on the age at which an individual experiences this change. Individuals who are already close to their expected retirement age experience only a minor income effect, as most of their life-cycle earnings have already been realized. The effect of displacement on the employment of older individuals is therefore dominated by the substitution effect,

[31] See also Bauer et al. (2013), who show that in 1971, first-generation displaced men had 5.1% lower incomes than native men and displaced women 3.8% lower incomes than native women. Moreover, the displaced were markedly over-represented among blue-collar workers and under-represented among the self-employed.

and hence negative. We can show this explicitly by solving for the consumption profile of displaced individuals. Recall that for given life-cycle earnings, the optimal consumption profile is flat. However, as displacement was unexpected, it shifts an individual's consumption from c to post-displacement consumption c_d. Focusing on displacement events that occur before retirement ($d < R$) but after the completion of schooling ($d > s$), the budget constraint of a displaced individual is therefore given by

$$\int_s^d e^{-rt} e^{\theta(s)} dt + \int_d^{R_d} e^{-rt} e^{\theta_d(s)} dt = \int_0^d e^{-rt} c dt + \int_d^T e^{-rt} c_d dt \tag{D-8}$$

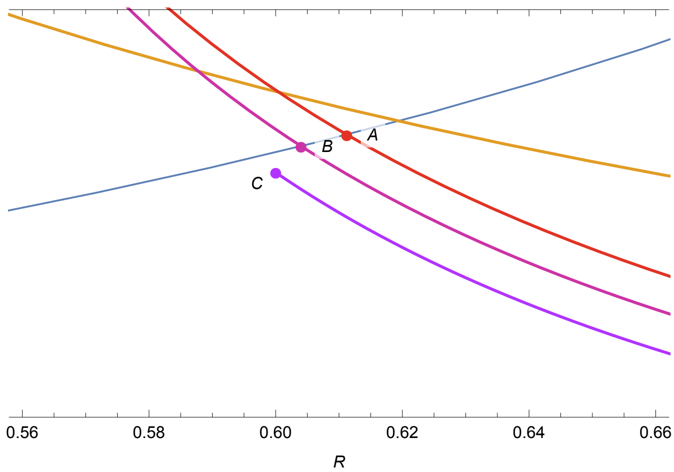
where the left-hand side is the sum of present discounted value of earnings at wage $e^{\theta(s)}$ before displacement (between end of schooling s and displacement d) and at wage $e^{\theta_d(s)}$ after displacement (between d and new retirement age R_d), and the right side is the PDV of consumption c in the pre- and consumption c_d in the post-period. Solving the budget constraint for c_d and simplifying, we have

$$\begin{aligned} c_d &= \frac{e^{\theta(s)}\left(e^{-rd} - e^{-rs}\right) + e^{\theta_d(s)}\left(e^{-rR_d} - e^{-rd}\right) - c\left(e^{-rd} - 1\right)}{e^{-rT} - e^{-rd}} \\ &= c + \left(e^{\theta_d(s)} - e^{\theta(s)}\right)\frac{e^{-rd} - e^{-rR}}{e^{-rd} - e^{-rT}} + \left(e^{-rR} - e^{-rR_d}\right)\frac{e^{\theta(s)}}{e^{-rd} - e^{-rT}}. \end{aligned} \tag{D-9}$$

The difference between consumption after displacement c_d and consumption c in the pre-period (which itself is a function of schooling s and the planned retirement age R) depends on the difference between the old and new wage rate, weighted by the relative lengths of the post-displacement working ($R - d$) and consumption spells ($T - d$). For example, if displacement occurs at the end of the working life ($d = R$), then the weight equals zero and consumption remains unaffected; the individual experiences only a substitution effect. In contrast, if displacement occurs earlier in the career ($R - d \gg 0$) then the weight will be closer to one, and the decline in consumption can be substantial; the individual experiences an income effect. This reduction in consumption maps into a corresponding increase in the marginal utility, counteracting the substitution effect from a decline in wages. Consumption post-displacement also depends on the gap between the initially planned and new post-displacement retirement ages, R and R_d; an unplanned early retirement due to displacement might necessitate a sudden and large reduction in consumption.

Figure D6 illustrates these arguments by plotting the two sides of the equilibrium condition (D-5) for the optimal retirement decision, over retirement age R. The marginal disutility of work $f(R)$ increases (thin blue line) while the marginal benefits $u'(c(s,R))e^{\theta(s)}$ decreases over R (orange line). The optimal retirement age corresponds to the intersection of the two curves. The effects of displacement depend on the age at displacement d. We compare displacement around mid-age ($d = 0.5$) or closer to retirement age ($d = 0.6$). For the mid-age worker, the marginal benefits of working change (red line), but they remain greater than the marginal disutility of work at the time of displacement. This individual would therefore not retire immediately, but retire earlier than originally planned (at point A). Intuitively, mid-aged expellees cannot "afford" to leave the labor force immediately, as their cumulative life-cycle earnings are still low. They retire earlier, but not much earlier than planned. For a worker displaced at older age ($d = 0.6$), this income effect is less pronounced, and their response to displacement is instead dominated by the substitution effect. Indeed, in our example the marginal benefit of working (purple line) falls below

Figure D6: Theoretical predictions: Displacement by age



Notes: Numerical illustrations of a Ben-Porath model with retirement decisions (Hazan, 2009) with $u(\cdot) = log(\cdot)$, $f(R) = 1/(1-R)$, $T = r = 1$, $\theta(s) = 4s$ and $\theta_d(s) = 3s$. The thin blue line corresponds to the the disutility of work $f(R)$. The orange line corresponds to the marginal utility of working $u'(c(s,R))e^{\theta(s)}$. The red, red-purple and purple lines correspond to the marginal utility of working if an individual is displaced at age $d = 0.5, d = 0.55$ or $d = 0.6$.

the marginal disutility of work; the individual would therefore retire immediately after displacement (point C). Point B represents an intermediate case, in which displacement occurs at $d = 0.55$. Overall, a simple life-cycle model implies that the immediate effect of displacement on employment exit increases with age-at-displacement, in line with the empirical pattern shown in Figure 5 (panel (c)).

A similar mechanism could explain why the displacement effect increases less steeply with age-at-displacement for women than men. At the time of our study, most women were married and rarely the main breadwinner in the household. The marginal benefits of working will therefore tend to be lower but also flatter over retirement age R for women (as consumption is less dependent on own than on the spouse's employment). This has two implications. First, young women may leave the labor force in response to displacement, while this is unlikely to be the case for young men. Second, the employment effects of displacement are reduced for older women, as many will have left the labor force already.

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