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

In what follows, we describe the provisions of the pension system as they were relevant to the 1919-21 birth cohort.[32] Statutory pensions in Germany depend on the labor income earned over the life course. 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

[32] 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. Riphahn (1999) studies the predictors of the transition into disability retirement of German men in the 1980s.

1957 reform also made pensions dynamic by linking them to wage trends. Entitlement to a pension arises when individuals have paid contributions for at least five years.

Old-age pensions. Before 1992, the statutory retirement age for old-age pensions was 65. Thus, *regular retirement* was open to anyone at age 65 who had contributed to the pension system for at least five years. Those with at least 35 years of contributions could retire at age 63 under the *flexible retirement* option introduced in 1972.

Retirement at age 60 was possible under certain conditions for women, the long-term unemployed, and the disabled. Women could retire at age 60 if they had been insured in the public pension system for at least 15 years and had paid contributions for more than ten years after their 40th birthday.[33] The unemployed could retire at 60 if they had paid contributions for eight of the previous ten years and had been unemployed for 12 of the previous 18 months. The severely disabled could also retire at 60 if they had at least 35 years of contributions and an officially recognized disability.

The introduction of flexible retirement in 1972 led to a significant decline in the average entry age for old-age pensions (Börsch-Supan and Schnabel, 1998), especially for men. Their average age of first claiming an old-age pension fell from 65.1 years in 1972 to a low of 62.3 years in 1982 and thus well below the standard retirement age of 65. The distribution of retirement ages peaked at ages 60, 63 and 65 (Börsch-Supan and Schnabel, 1998). These peaks correspond to the earliest ages at which early retirement for health and labor market reasons, flexible retirement for workers with long work histories, and regular retirement for workers with short work histories were possible.

Disability and survivor pensions. In addition to old-age pensions, the pension system provides *disability benefits* for workers of any age, subject to medical indication and a minimum insurance period of at least five years. Disability benefits took two forms. *General disability benefits* (*Erwerbsunfähigkeitrente*) were paid to individuals unable to perform continuous, regular employment. This form accounted for 80% of all approved disability claims in the late 1980s (Riphahn, 1999). Disability benefits (*Berufsunfähigkeitrente*) were paid to individuals whose ability to work was less than half that of a healthy worker in the same job. These benefits were one-third lower than the full old-age pension, based on the assumption that recipients could still engage in marginal gainful activity.

Disability benefits have been an important route to retirement in Germany.[34] Throughout the late-1970s and 1980s, the share of workers retiring on disability benefits was higher than the share retiring on regular old-age pensions (Börsch-Supan and Schnabel, 1998; Riphahn, 1999). Those retiring on disability pensions in the 1980s were on average in their mid-fifties. As a consequence, the average age of all new retirees (including those retiring on old-age pensions) in Germany fell below 59 in the early 1980s.

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

[33] The 1992 pension reform abolished this gendered path to retirement, which effectively set the statutory retirement age for most women at 60.

[34] Another important route was through pre-retirement schemes. They allowed workers to leave their jobs early and receive severance pay and unemployment benefits before officially retiring at age 60 under the early retirement provisions for unemployed workers.

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.

Gaps in employment biographies. 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*)[35] 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.

C Level of and Expenditure on War Victims' Compensation

The war victims' 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). Figure C1 depicts compensation payments to war-disabled persons in percent of average gross earned income from 1951 to 1980. It distinguishes between basic and equalization pensions and between war-disabled with a reduction in their civilian earning capacity of 30%, 50%, 70% and 100%.

The left panel of Figure C1 shows the level of the basic pension (*Grundrente*). This part of the war victim's pension was not means-tested and was paid to all war victims with a reduction in civilian earning capacity of at least 25%. Depending on the degree of disability, its level ranged from about 5-7% to about 25-40% of gross labor income. The right panel shows the maximum attainable level of the equalization pension (*Ausgleichsrente*). Only war-damaged persons with a reduction in earning capacity of at least 50%, slightly less than half of all war-damaged persons, were eligible for this part of the war victims' pension. As shown, the maximum amount of the equalization pension was at least as high as the basic pension. However, because the equalization pension was means-tested, few of those eligible received the full amount.[36]

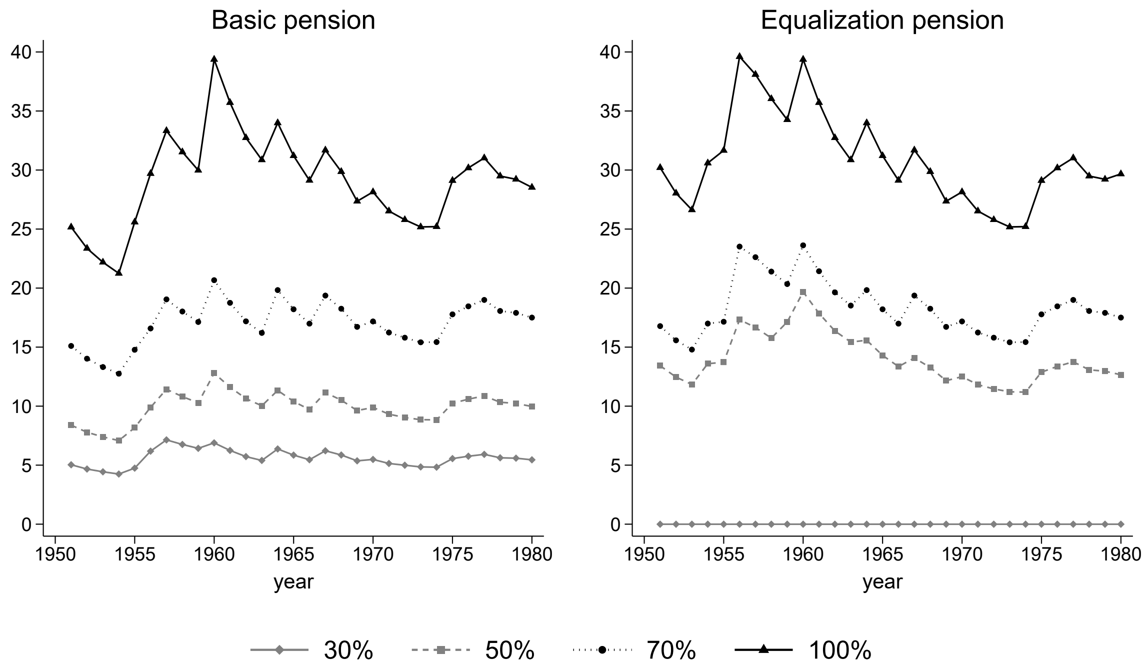
Figure C1 shows that after a peak in 1960, the level of war victims' pensions relative to average gross earnings declined again. However, additional benefits were introduced in 1960. In particular, severely disabled persons received an additional compensation (*Schadensausgleich*) if their income was below what they would have earned without the war injury. The compensation initially amounted to 30% and, from 1964, to 40% of the loss of income. Disabled persons, defined as those whose earning capacity was reduced by 90% or more, received additional supplements.

Total spending on war victims was substantial, especially in the immediate postwar period. C2 shows total social spending on war victims as a percent of total social spending from 1950 to 1980. Expenditure shares in Germany are compared with those in Austria, Finland, the United Kingdom and the United States. The figure shows that the share of

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

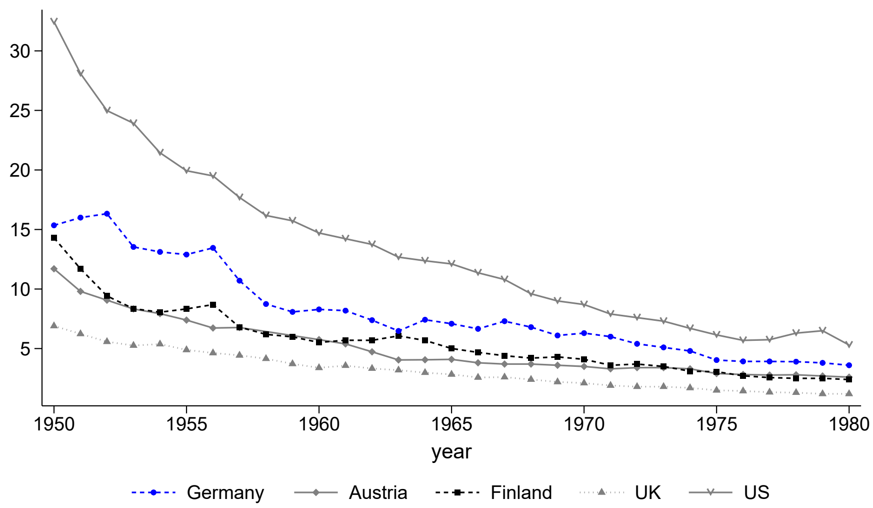
[36]In 1956, for example, 46.4% of all war-damaged persons were in principle eligible for an equalization pension because their earning capacity had been reduced by 50% or more (Presse- und Informationsamt der Bundesregierung, 1957). However, of those eligible, 63% received no equalization pension and only 12.6% received the full amount.

Figure C1: War victims' pension by reduction in earning capacity (in % of gross labor income), 1951-80



Notes: The figure shows compensation payments to war-disabled persons in % of average gross earned income. It distinguishes between war-disabled persons with a reduction in their civilian earning capacity of 30%, 50%, 70% and 100%. The left panel shows the basic pension levels, the right panel the maximum compensatory pension levels. See the description in Section 2 and Appendix C for further details.
Source: Author's calculations based on the *Bundesversorgungsgesetz* (in its various versions). Data on average gross labor income are taken from Bundesamt für Justiz and BMJV (2020).

Figure C2: Social expenditures on war victims (% of total social expenditures), 1950-80



Source: International Labour Organization. The cost of social security. Various volumes.

social expenditure on war victims in Germany hovered around 15% in the early to mid-1950s and then gradually declined. The decline was initially driven mainly by the decline in the number of orphans eligible for benefits (as the orphan's pension was only paid to minors) and by the deaths of the older cohorts who served in World War I (Presse- und Informationsamt der Bundesregierung, 1957).

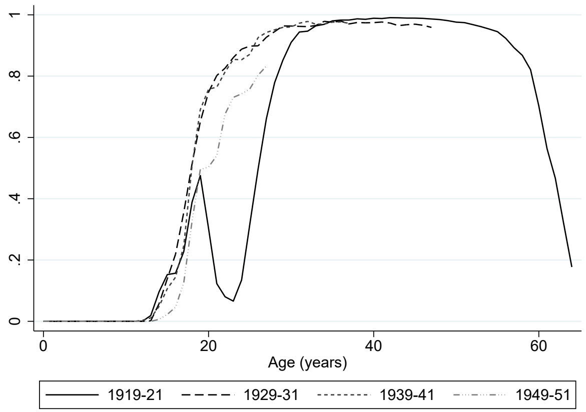
Germany's share of spending on war victims was comparatively high, reflecting the large number of military deaths. Only in the US was the share even higher, reaching one-third of total social spending. This is largely due to the fact that the welfare state was less developed in the US at the time (Obinger and Schmitt, 2018). In addition, unlike in Germany, all veterans were eligible for benefits in the US, not just the war-disabled. Nevertheless, as a percentage of GDP, Germany's spending on war victims in the early 1950s, at 2%, was about twice that of the US.

D Cohort Effects

Figure D3 compares the life-cycle profile of the 1919-21 cohort with later-born cohorts covered by the GHS-1, illustrating that their transition from education to work was dramatically different. As discussed in the main text, 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. The latter cohorts were either not (1929-31) or only partially (1939-41) conscripted after West Germany rearmed in 1955. 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.

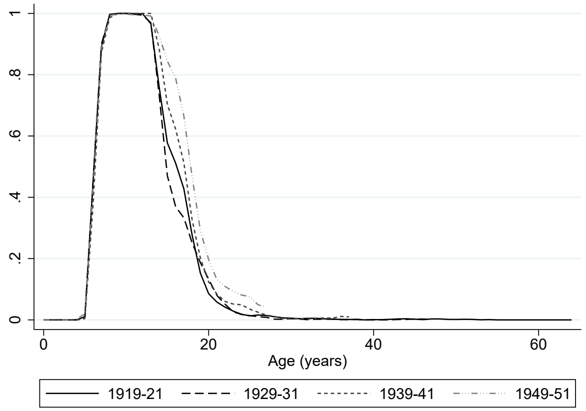
Figure D3: Education, participation, and non-participation over the life cycle, by gender and cohort

(a) Men, education



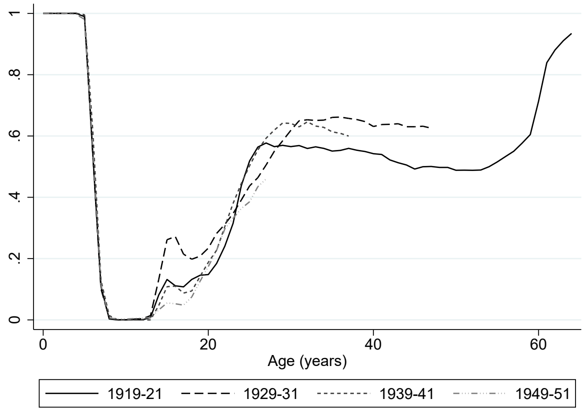
(b) Men, participation

(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.

E Multiple Shocks and Heterogeneous Effects

Table E2: Distribution of war-related shocks

(a) Frequencies			
War injuries	War captivity	Displacement	Observations
No	No	No	50
Yes	No	No	33
Yes	Yes	No	77
Yes	No	Yes	12
No	Yes	No	213
No	Yes	Yes	61
No	No	Yes	13
Yes	Yes	Yes	26
(b) Correlations			
War injuries	War captivity	Displacement	
1.000	–	–	War injuries
-0.107	1.000	–	War captivity
0.041	0.014	1.000	Displacement

Notes: Panel (a) reports the frequency of each possible combination of treatments in our sample. Panel (b) shows the correlation between treatments. The statistics refer to men born in 1919-21.

One concern is that soldiers can be subject to multiple war-related shocks. If the different shocks were correlated, we would risk capturing the consequences of multiple war experiences, rather than one specific shock. Appendix Table E2 shows that this is not a concern in our setting. Panel (a) reports the frequency of each possible combination of treatments, confirming that many individuals are hit by multiple shocks. For example, many displaced soldiers also experienced war captivity or war injuries. However, as shown in panel (b), displacement is not correlated with either imprisonment or wartime injuries. Imprisonment and wartime injuries show a slight negative correlation, presumably because wartime injuries reduced subsequent combat time and thus the risk of imprisonment. However, the correlation is small ($\rho = -0.11$), and Table 4 shows that our estimates change little when adding the other respective shocks as controls (i.e., when considering all shocks jointly).

Still, one might wonder if the different shocks interact in some way, and how this would affect the interpretation of our estimates. For example, war injuries might have a different effect on displaced than non-displaced soldiers. To understand the implications of such interaction effects for the interpretation of our estimates, imagine there are two treatments, war injuries ($inj = 1$) and displacement ($dis = 1$). The focus on just two treatments simplifies the exposition. The probability limit of the slope coefficient in an

OLS regression of an outcome y on an indicator for war injuries can then be expressed as

$$\beta_{\text{OLS}} = E[y \mid inj = 1] - E[y \mid inj = 0] \tag{E-1}$$
$$= E[E[y \mid inj = 1, dis]] - E[E[y \mid inj = 0, dis] \tag{E-2}$$
$$\begin{aligned} = \quad & \Pr(dis = 0 \mid inj = 1)E[y \mid inj = 1, dis = 0] \\ & + \Pr(dis = 1 \mid inj = 1)E[y \mid inj = 1, dis = 1] \\ & - \Pr(dis = 0 \mid inj = 0)E[y \mid inj = 0, dis = 0] \\ & - \Pr(dis = 1 \mid inj = 0)E[y \mid inj = 0, dis = 1] \end{aligned} \tag{E-3}$$
$$\begin{aligned} = \quad & \Pr(dis = 0)(E[y \mid inj = 1, dis = 0] - E[y \mid inj = 0, dis = 0]) \\ & + \Pr(dis = 1)(E[y \mid inj = 1, dis = 1] - E[y \mid inj = 0, dis = 1]) \end{aligned} \tag{E-4}$$

where in the second step we used the law of iterated expectations, and the last step follows because the treatments are uncorrelated, so that $Pr(dis = d|inj = 0) = Pr(dis = d|inj = 1) = Pr(dis = d)$ for $d = 0, 1$. Equation (E-4) clarifies that our approach captures the weighted average of the treatment effect of war injuries on soldiers who were not displaced ($E[y|inj = 1, dis = 0] - E[y|inj = 0, dis = 0]$) and those who were displaced ($E[y|inj = 1, dis = 1] - E[y|inj = 0, dis = 1]$). The weights correspond to the respective population shares of each group. If war injuries have different effects on displaced and non-displaced soldiers (*heterogeneous treatment effects*), we thus identify their effect on the "average person" in our sample. Alternatively, if the treatment effect of war injuries does not vary between displaced and non-displaced soldiers (*homogenous treatment effects*), then the fact that some individuals are affected by multiple treatments would be irrelevant for the interpretation of our estimates.

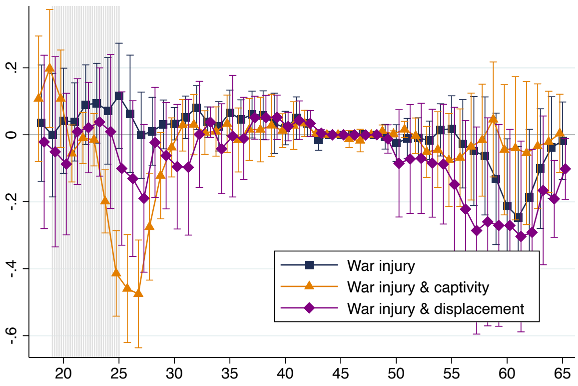
One might want to go a step further, and separately identify heterogeneous treatment effects, such as the effect of war injuries on individuals who were not displaced ($E[y \mid inj = 1, dis = 0] - E[y \mid inj = 0, dis = 0]$), and the effect on those who were displaced ($E[y \mid inj = 1, dis = 1] - E[y \mid inj = 0, dis = 1]$). While understanding the heterogeneity underlying our average treatment effects would be interesting, the sample size for some of these comparisons would be very small; for example, there are only 33 soldiers in our sample who experienced a war injury but were neither displaced nor in war captivity. For our baseline analysis, we therefore prefer to exploit the full variation of war exposures in the sample, to estimate an appropriately (population-share) weighted average effect of each war shock.

Still, to show that our main findings hold also in pairwise comparisons, we revisit our evidence on the employment effects over the lifecycle (Figure 2) to study combinations of treatment effects. The estimates are shown in Figure E4. For each figure, we consider four different groups, a control group that was not exposed to any of our three war-related shock, and three treatment groups that were exposed to different combinations of treatments. For example, in panels (a) and (b) we estimate separate effects for those who experienced a war injury but no other war-related shocks, those who experienced injury and captivity, and those who experienced injury and displacement.

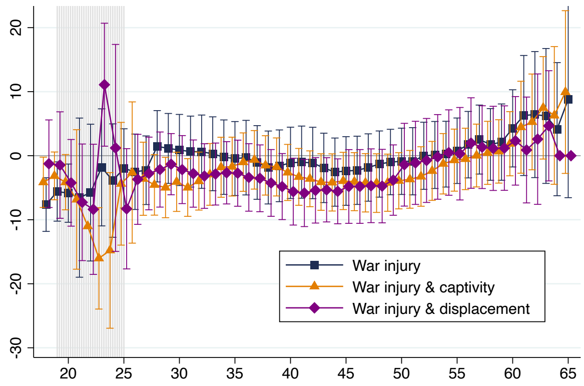
These subgroup-specific estimates are substantially more noisy, but otherwise confirm the patterns from our baseline analysis as shown in Figure 2. For example, soldiers experiencing a war injury have similarly high employment rates as the control group over most of their life, but are more likely to leave employment at older ages. We see this decline of old-age employment both for injured veterans who were displaced (purple line), and those who were not (black line), but not for those injured veterans who also experienced war

Figure E4: Life-cycle effects of war experiences, heterogeneity of treatment effects

War injury

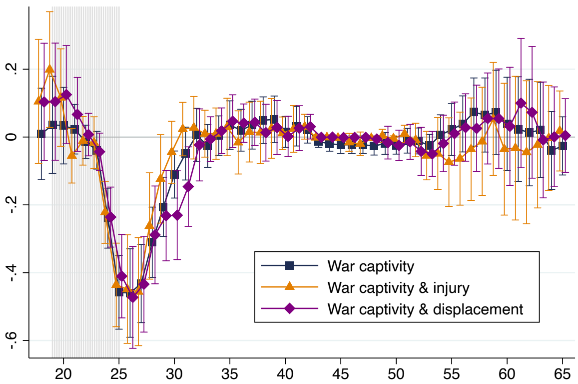


(a) Employment

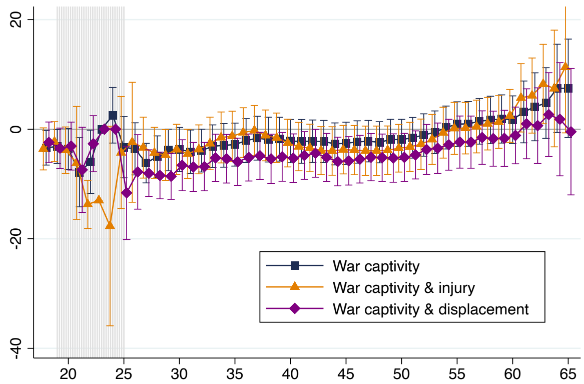


(b) Occupational Prestige

War captivity

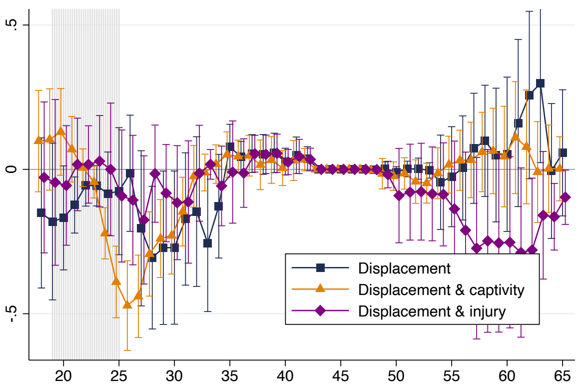


(c) Employment

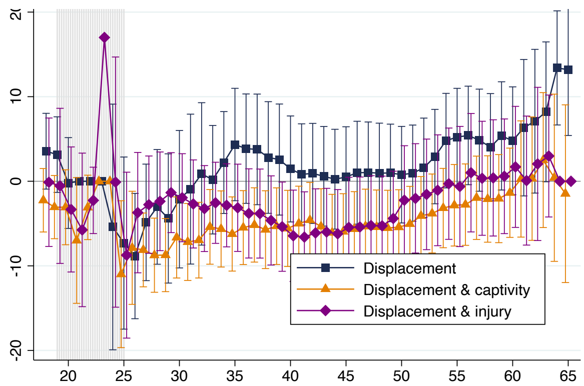


(d) Occupational prestige

Displacement



(e) Employment



(f) Occupational prestige

Notes: Heterogeneous effects of war-related injuries, war captivity, and displacement on employment (left panels) and occupational prestige (conditional on employment, right panels) over the life cycle. Estimates are from a pooled OLS regression, interacting indicators for the treatment group of interest and birth year with a full set of age indicators. The sample consists of males born 1919-21, and the control group was not exposed to any war-related shock. The vertical bands indicate the 95% confidence interval of each estimate. The shaded area indicates the duration of WWII.

captivity – consistent with our findings that war captivity tends to increase employment at older age. More generally, the estimated coefficient for double treatments as shown in Figure 2 tend to be similar to the combined effect of each as reported in our main analysis, although some are imprecisely estimated.

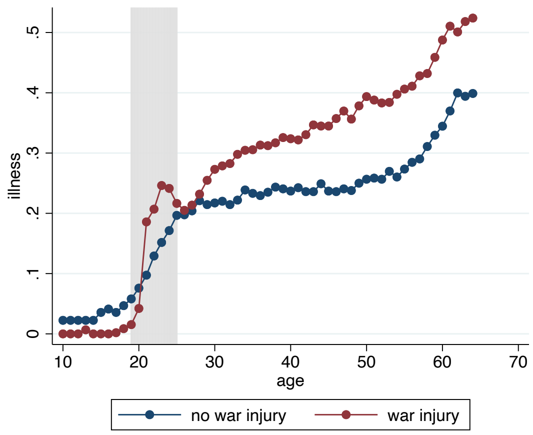
F Additional Figures and Tables

F.1 Figures

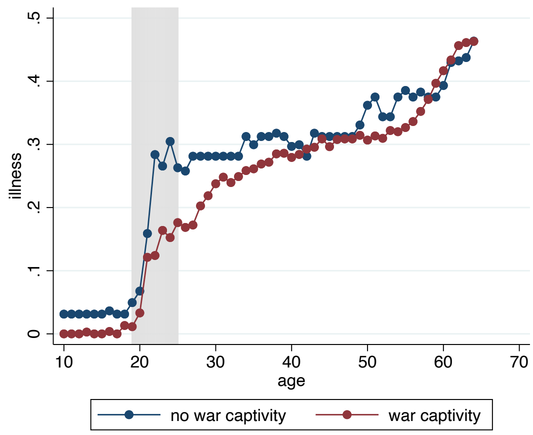
Figure F5: German territorial losses in World War I and II

Base maps: MPIDR and CGG (2011).

Figure F6: The effect of war injury or captivity on health over the life cycle, cohort 1919-21



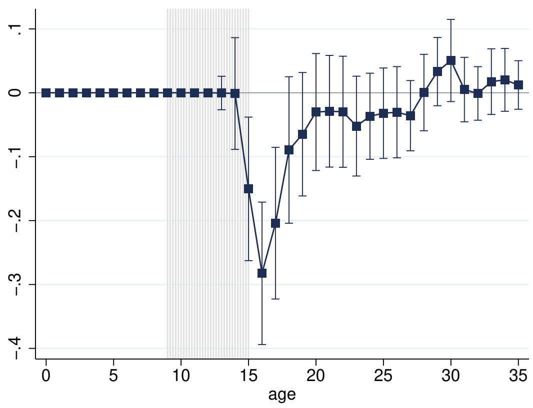
(a) War injury



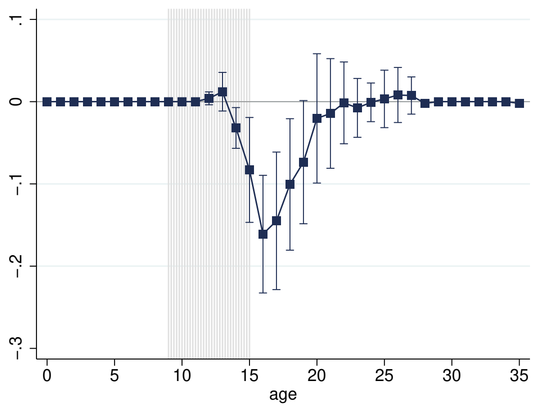
(b) War captivity

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 F7: The effect of displacement on education over the life cycle, cohort 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.

F.2 Tables

Table F3: Exogeneity of war service and war shocks (bivariate)

	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)
Pre-war characteristics				
Father's years of schooling	-0.002	-0.013	0.007	-0.003
	(0.006)	(0.012)	(0.011)	(0.006)
Mother's years of schooling	-0.012	-0.025	0.016	0.003
	(0.011)	(0.024)	(0.022)	(0.013)
Father's occupational score	-0.001	0.000	-0.002	0.000
	(0.001)	(0.002)	(0.002)	(0.001)
Birth year	0.014	-0.014	0.009	0.008
	(0.012)	(0.026)	(0.023)	(0.015)
# siblings	-0.005	0.006	0.005	0.006
	(0.004)	(0.009)	(0.008)	(0.005)
Years of schooling	0.001	-0.024*	0.003	0.016*
	(0.006)	(0.013)	(0.012)	(0.008)
Poor health before age 18	-0.273***	-0.050	-0.083	-0.096**
	(0.036)	(0.091)	(0.082)	(0.042)
Female				0.003
				(0.024)

Notes: The table reports coefficient estimates from bivariate regressions of the indicated war-related shock on each pre-war individual and parental characteristics for birth cohorts 1919-21. Estimates for war injuries and captivity are conditional on war service. Standard errors in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table F4: The effect of war captivity duration and location

	Educational attainment (years)	Years in employment age 20-55	age 56-65	Occup. prestige (maximum)	Old age income from work pension	war victim pension	nonpension sources
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(a) War captivity (in years)							
Raw	-0.135**	-0.792***	-0.060	-0.595**	-35.16	-20.89***	-15.38
	(0.053)	(0.078)	(0.068)	(0.278)	(31.44)	(6.34)	(30.24)
Baseline	-0.082*	-0.815***	-0.072	-0.400	-21.60	-20.09***	-1.32
	(0.049)	(0.079)	(0.071)	(0.284)	(33.93)	(6.64)	(33.09)
Extended	-0.057	-0.779***	-0.043	-0.336	-14.66	-21.42***	11.87
	(0.042)	(0.080)	(0.072)	(0.266)	(36.92)	(7.13)	(35.74)
(b) War captivity (in years), interacted with location of captivity							
War captivity	-0.164*	-0.433***	0.093	-0.184	-	-	-
(in years)	(0.089)	(0.104)	(0.156)	(0.656)			
East/USSR x	0.131	-0.714***	-0.344**	-0.099	-	-	-
War captivity	(0.104)	(0.235)	(0.167)	(0.783)			

Notes: Estimates of the effect of war captivity duration on various outcome variables. Each estimate is from a separate regression. The sample consists of males born 1919-21. In panel (a), 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, an indicator for poor health before age 18, and all other war shocks. Panel (b) corresponds to the "baseline" specification but interacts war captivity with an indicator for being interned in Eastern Europe (incl. USSR), which is observed only in the first part of the GHS-2 (N=153). Pension outcomes in columns (5) to (7) are observed only in the second part of GHS-2 conducted (see Footnote 5). Robust standard errors in parentheses, ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

Table F5: The effect of displacement by prewar SES

	Educational attainment (years)	Years in employment age 20-55	age 56-65	Occup. prestige (maximum)	Old age income from work pension	war victim pension	nonpension sources
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Displacement (0/1)							
Displacement	-0.229	-0.595	0.175	-2.556**	-78.039	18.749	-330.914***
	(0.248)	(0.362)	(0.309)	(1.031)	(147.677)	(40.637)	(95.582)
Displ. x Father's	-0.403	0.218	0.275*	-0.674	20.863	-10.125	-147.669**
schooling	(0.256)	(0.162)	(0.142)	(0.857)	(109.514)	(13.103)	(62.433)
Observations	427	427	427	427	254	254	269

Notes: Estimates of the effect of displacement on various outcome variables. Each estimate is from a separate regression. The sample consists of males born 1919-21. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table F6: 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: Estimates of the effect of war-related shocks on various outcomes (shown on the left) at different ages (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 in parentheses, ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

Table F7: The effect of displacement on education, by sex, cohort, and data source

	Males			Females		
	1919-21	1929-31	1939-41	1919-21	1929-31	1939-41
	(1)	(2)	(3)	(4)	(5)	(6)
(a) GHS						
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
(b) 1970 census						
Displacement (0/1)	-0.091***	-0.626***	0.217***	0.137***	-0.369***	0.207***
	(0.025)	(0.023)	(0.021)	(0.018)	(0.017)	(0.019)
	[11.390]	[11.431]	[11.860]	[9.452]	[9.501]	[10.366]
Observations	82,980	104,279	138,095	119,309	103,202	133,548

Notes: The table shows, by sex and cohort, estimates of the effect of displacement on years of education, drawing on data from the GHS (panel (a)) and 1970 census (panel (b)). Years of education include time spent in vocational training and at university. Estimates come from conditional OLS regressions. All regressions control for birth year (indicators). The GHS regressions additionally control for years of schooling of father and mother, number of siblings and (for males) time of entry into the war. Robust standard errors in parentheses, unconditional means for the non-displaced control group in square brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

G 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.

G.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

$$V = \int_0^T e^{-\rho t} u(c(t))dt - \int_0^R e^{-\rho t} f(t)dt, \tag{G-5}$$

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

$$\int_s^R e^{-rt} e^{\theta(s)} dt = \int_0^T e^{-rt} c(t)dt \tag{G-6}$$

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,

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

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,

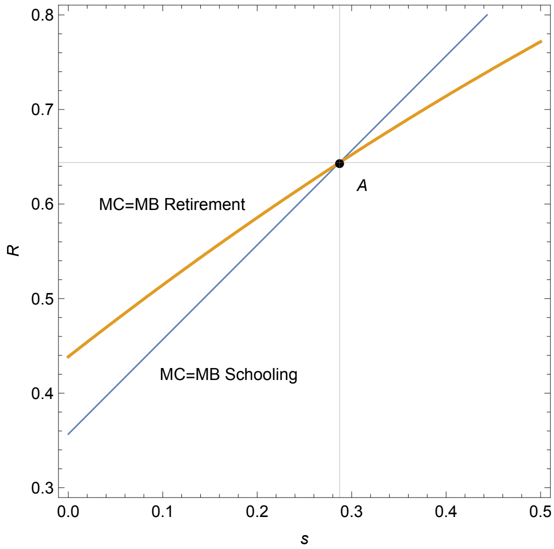
$$\frac{1}{\theta'(s)} = \frac{1 - e^{-r(R-s)}}{r} \tag{G-8}$$

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

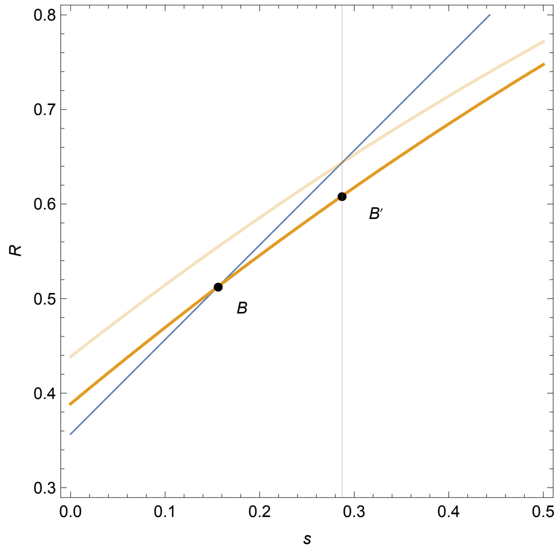
$$f(R) = u'(c(s, R))e^{\theta(s)}. \tag{G-9}$$

Figure G8a 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 (G-8) while the (thick) orange line corresponds to the optimal retirement decision represented by equation (G-9). The optimal schooling and retirement age are determined by the intersection of these two

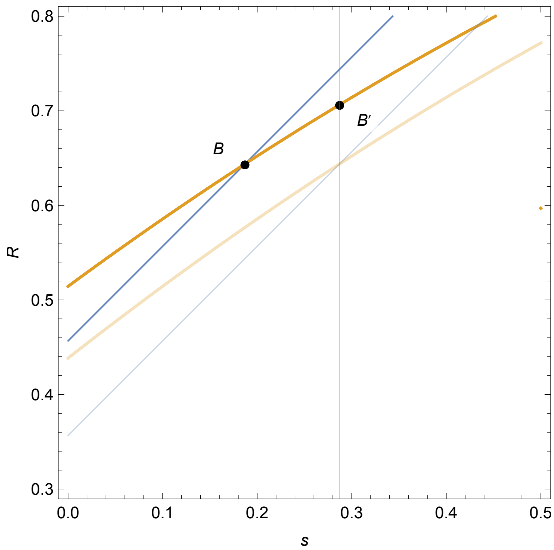
Figure G8: Theoretical predictions



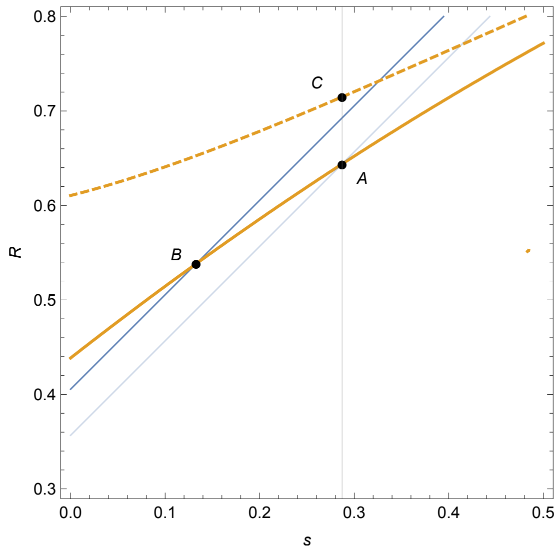
(a) Baseline



(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.

G.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 (G-9) 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.[37]

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.[38] 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.[39]

Figure G8b provides a numerical example. The increase in the disutility of work corresponds to a downward shift of the indifference curve associated with condition (G-9). 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).

[37] 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 (G-7), 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 (G-9)). However, this mechanism is less relevant in our context, as our empirical analysis conditions on survival until the statutory retirement age.

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

[39] 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.

G.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

$$\frac{1}{\theta'(s)} = \frac{1 - e^{-r(R-x-s)}}{r} \tag{G-10}$$

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 (G-9). 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 (G-9) increases because life-cycle income–and therefore consumption according to equation (G-7)–declines due to war captivity.[40] Specifically, the optimal consumption is now given by

$$c(s, R) = \frac{e^{\theta(s)} \left(e^{-r(s+x)} - e^{-rR}\right)}{1 - e^{-rT}}. \tag{G-11}$$

Therefore, consumption decreases and the marginal utility of consumption increases in x, ceteris paribus. To satisfy condition (G-9) we therefore need that the retirement age R increases and/or that s declines in response to time spent in captivity x.[41] 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 G8c provides a numerical example. Both the indifference curves associated with condition (G-8) and condition (G-9) 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.

[40] 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).

[41] While an increase in retirement age increases both sides of equation (G-9), it will ultimately increase the left side more (as $f(T) = \infty$).

G.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.[42] This wage decline affects the marginal utility of working $u'(c(s,R))e^{\theta(s)}$ on the right-hand side of equilibrium condition (G-9) 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 G8d 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 (G-8) upwards (thin blue line). The curve associated with condition (G-9) 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 (G-9) 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,

[42] 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

$$\int_s^d e^{-rt} e^{\theta(s)} dt + \int_d^{R_d} e^{-rt} e^{\theta_d(s)} dt = \int_0^d e^{-rt} c dt + \int_d^T e^{-rt} c_d dt \tag{G-12}$$

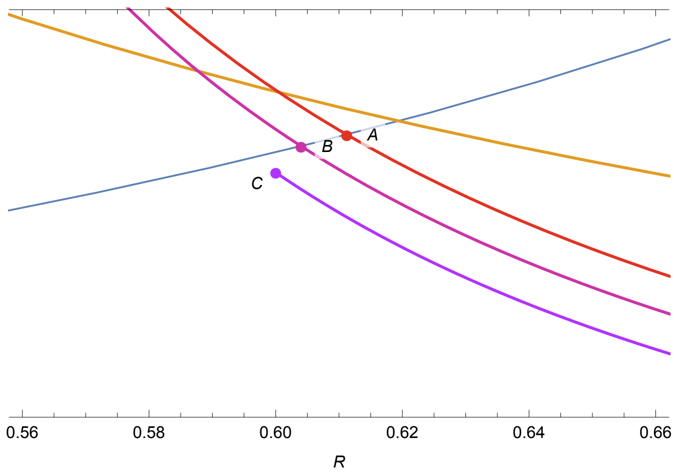
where the left-hand side is the sum of present discounted value of earnings at wage $e^{\theta(s)}$ before displacement (between end of schooling s and displacement d) and at wage $e^{\theta_d(s)}$ after displacement (between d and new retirement age R_d), and the right side is the PDV of consumption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

$$\begin{aligned} c_d &= \frac{e^{\theta(s)}\left(e^{-rd} - e^{-rs}\right) + e^{\theta_d(s)}\left(e^{-rR_d} - e^{-rd}\right) - c\left(e^{-rd} - 1\right)}{e^{-rT} - e^{-rd}} \\ &= c + \left(e^{\theta_d(s)} - e^{\theta(s)}\right)\frac{e^{-rd} - e^{-rR}}{e^{-rd} - e^{-rT}} + \left(e^{-rR} - e^{-rR_d}\right)\frac{e^{\theta(s)}}{e^{-rd} - e^{-rT}}. \end{aligned} \tag{G-13}$$

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 G9 illustrates these arguments by plotting the two sides of the equilibrium condition (G-9) 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 G9: 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 5c).

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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