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Authors

Costa, Dora L
Yetter, Noelle
DeSomer, Heather

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Wartime Health Shocks and the Postwar Socioeconomic Status and Mortality of Union Army Veterans and their Children

Dora L. Costa,
UCLA Department of Economics, 9272 Bunche Hall, Los Angeles, CA 90095-1477 and NBER

Noelle Yetter,
National Bureau of Economic Research

Heather DeSomer
National Bureau of Economic Research

Abstract

We investigate when and how health shocks reverberate across the life cycle and down to descendants in a manual labor economy by examining the association of war wounds with the socioeconomic status and older age mortality of US Civil War (1861–5) veterans and of their adult children. Younger veterans who had been severely wounded in the war left the farm sector, becoming laborers. Consistent with human capital and job matching models, older severely wounded men were unlikely to switch sectors and their wealth declined by 37–46%. War wounds were correlated with children's socioeconomic and mortality outcomes in ways dependent on sex and paternal age group.

Is health just a consumer durable which provides well-being as argued by Arrow et al. (2014) or is it also an important input into productivity? Researchers and policymakers have pointed to health as spurring economic growth, both in the past and today (e.g. Fogel 1994; Gallup and Sachs 2001; WHO 2001; Bloom et al. 2004), and a large body of literature has emphasized the impact of health shocks in utero and in childhood on later socioeconomic status and health (e.g. Almond 2006; Scholte et al. 2015; Bleakley 2007, 2010; Case et al. 2002; Currie and Hyson 1999), of health shocks at older ages on hours worked and labor force participation (e.g., Smith 2005; McClellan 1998) and thus wealth, and of disability on earnings (e.g., Bartel and Taubman 1979; Charles 2003; Mok et al. 2008; Halla and Zweimüller 2013) and a smaller literature has examined the impact of health shocks at young adult ages on wealth accumulation (Lee 2005). However, estimated wealth returns to early childhood health as measured by height in the past are low (Bleakley et al. 2014), suggesting a relatively small role for health as a driver of economic growth in the past (cf. Fogel 1994 and Lee 2005).

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costa@econ.ucla.edu.

This paper examines how the destruction of health capital at prime adult ages affected socioeconomic status, wealth, and older age health in the past when much of the labor force was in manual labor. Specifically, we investigate the impact of war wounds on the postwar socioeconomic status and older age mortality of US Civil War (1861–65) veterans and we examine how paternal war wounds affected the socioeconomic status and mortality of veterans' daughters and sons using a new intergenerational database that covers the complete lifespans of two generations. Our findings have implications not just for understanding the relationship between health and economic growth in the long-run but also for understanding this relationship in developing countries where longitudinal and intergenerational data often are sparse. Our findings also will help us understand the impact of health on socieconomic status, a relationship which can be hard to disentangle from the impact of socioecconomic status on health (Smith 2005).

The US Civil War provides a unique opportunity to examine the long-run and intergenerational impact of disability. War wounds are an arguably exogenous health shock which can lead to immediate and permanent disability. The percentage of men with non-mortal wounds was more than twice as large as in many previous wars.[1] War injuries also are more analagous to accident related injuries, a danger in manual labor economies both today and in the past.[2] In addition, because the US Civil War drew combatants from a broad age distribution, we can investigate how age at the end of the war influenced adjustments to health shocks. If human capital is occupation or industry specific (Manovskii and Kambournov 2009; Neal 1995; Parent 2000), standard human capital and occupational matching models predict that the opportunity cost of switching occupations or industries rises with age. While there is evidence that earnings and labor force participation depend on the age when an individual becomes disabled in advanced economies (Charles 2003; Mok et al. 2008; Halla and Zweimüller 2013), few individuals in advanced economies become disabled at young ages and the impact of disability on their earnings and labor force participation also depends on the work disencentives inherent in disability programs. We can estimate the effects of disability on occupational change in the absence of work disincentives.

Our findings can also help us understand the intergenerational transmission of health shocks. Both biological and socioeconomic channels have been implicated. There is evidence from intergenerational and multigenerational data consistent with epigenetic transmission of health in cases of extreme maternal, paternal, and grandparental over- and under-feeding (e.g. Kaati et al. 2007; Heijmans et al. 2008; Vågerö et al. 2018; Costa et al. 2018). Economic theory points to a role for the transmission of parental health through socioeconomic channels. Less healthy parents have fewer resources to invest in their children's health, education, and financial assets. Children's health at older ages then could arise directly from their health at younger ages or from their own socioeconomic status.

[1]The percentage of US Army recruits with non-mortal battlefield wounds was 2% during the Vietnam War, 5% during World War II, and 13% during the Civil War. Estimated from https://dcas.dmdc.osd.mil/dcas/pages/report_principal_wars.xhtml Accessed on November 11, 2018.

[2]In the first decade of the twentieth century, the age adjusted death rate from accidents peaked at 122.3 per 100,000 whereas in the first decade of the twenty-first century the peak age adjusted death rate from accidents was 40.4 per 100,000. See https://www.cdc.gov/nchs/data-visualization/mortality-trends/. Accessed on January 7, 2019.

Evidence showing that parental socioeconomic status affects child health and that child health affects child future educational and labor market outcomes has been pointed to as suggestive of the role that health could play in the intergenerational transmission of economic status (Currie 2009; Johnson and Schoeni 2011). However, empirical research has been stymied by the absence of data with at least two full generations and a health shock to the first generation.

1 Data

1.1 Dataset

Our primary sample consists of 6,228 Union Army veterans who were not ex-POWs, who survived to 1900, who had children and who were drawn from a sample of 39,341 men in 330 randomly drawn Union Army volunteer infantry companies. The sample of 39,341 men consists primarily of volunteers (95%), as did the Union Army, and is representative of the Northern-born and pre-war immigrant male population of military age (see the Data Appendix for details). We linked veterans, their children, and children's mothers to death records and all available manuscript census schedules to obtain occupational, residential, and family information under the program project Early Indicators, Intergenerational Processes, and Aging (NIA P01 AG10120, PI: Costa). Although our linkage of veterans' children oversamples children of ex-POWs, we restrict ourselves in this analysis to nonex-POWs to focus on the impact of wounds alone. Our empirical analyses of veterans use men linked to the 1870 and the 1880 censuses, yielding samples of 5,076 and 5,731 veterans, respectively.

Linkage rates in our original records to both on-line death records and to manuscript census schedules are high both for veterans and children. Children's linkage rates to the census are highest for 1880 (93%), when most of them were in their fathers' households (mean year of birth is 1878), and fall as they start to establish their independent households. Wound status does not predict whether a veteran could be found in a census; the main predictor of linkage to an early census for a veteran was whether he enlisted in one of the large cities. Seventy-four percent of children were linked to death records. In the veterans' children sample, sons are slightly over-represented with 1.09 sons for every daughter. (See the Data Appendix for additional details.) Children's and veterans' characteristics explain very little of the variation in the availability of children's death records and their causes of death (available for 40% of children with death records). Decisions by individual states to make their records freely available on-line, including which information to release, determines whether we can link to death records and cause of death (see the Supporting Information to Costa et al. 2018).

The veterans and their wives in the sample are representative, in terms of cohort mortality, to a random sample of the population drawn from genealogies, but are higher than those from period life tables of the population which are for disproportionately urban populations. The children's mortality data are best suited to examining mortality at older ages; a comparison of cohort life expectancies with those from a genealogical database suggests that among veterans' children deaths prior to age 40 or 50 are understated, particularly for women (see the Supporting Information to Costa et al. 2018).

Our analyses of veterans' children use 9,811 children who were born after the war and who were in the 1910 census, married, and either with own occupational information if a son or husband's occupational information if a daughter. We impose the last restrictions to examine occupational status for both daughters and sons. We impose the first restriction because children born after the war constitute the bulk of our sample.[3] In our original data, 88% of children were linked to the 1910 census (see the Data Appendix). The children who were married and in the 1910 census were more likely to be the children of native-born fathers. When we examine mortality we examine survivorship after age 45 because, as previously noted, our sample is best suited to examining mortality at older ages. This yields a sample of 9,130 children. Although our primary analyses of mortality focus on those married and in the 1910 census, our investigations of mortality revealed similar patterns regardless of sample restrictions.

1.2 Variables

Our primary variable of interest is whether a veteran had been wounded in the war. We classify wounds into two types: 1) a severe wound, that is, a wound which led to a discharge for disability from the army, amputation, or blindness (all blindness was in one eye only in our sample) and 2) all other types of wounds. A severe wound is more likely to lead to a permanent disability.

Our dependent variables of interest for our analyses of veterans are veterans' occupational class in 1880 (classified as farmer, professional or proprietor, artisan, and laborer), veteran's total wealth in 1870 (the last census year this information was asked), and years lived after 1900. Our control variables for veterans are birth year (or age at the end of the war), occupational class at enlistment (farmer, professional or proprietor, artisan, and laborer), dummies for enlistment year, a dummy equal to one if the veteran enlisted in a city of population size 50,000 or more (and thus one of the 16 largest US cities), and father's real estate and personal property wealth. We also control for pension recipiency either in 1870 or in 1880.

Our dependent variables of interest for our analyses of children's outcomes are sons' occupational class in 1910 (farmer, professional or proprietor, artisan, and laborer), the occupational class of daughters' husbands in 1910, and years lived after age 45. The control variables are birth year, veterans' enlistment characteristics (occupational class, enlistment year dummies, and the city size dummy, as for our analysis of veterans), veterans' post-war socioeconomic status (total wealth in 1870 and occupational class in 1880), population density in childhood county, the number of siblings, and, in examining mortality, socioeconomic status in 1910.

In the full Union Army sample of 39,341 soldiers, 21% of men suffered a non-mortal wound during wartime, 5% died from war injuries or wounds, and 25% of men who survived the war had been wounded (see Table 1). (Wartime mortality rates were 14%, largely from disease.) Non-mortal wounds may have removed men from the field, thus lowering their risk of death. Nineteen percent of men were discharged for disability, but the cause is often

[3]Age at first marriage for white men circa 1860 was a bit over age 25 (Fitch and Ruggles 2000).

unknown (9% of all men were discharged for disability without any given reason). Only 3% of all men were known to have been discharged because of war wounds. Thirty-one percent of veterans who survived to 1900 and whose date is death is known were wounded during the war. Amputees were a relatively small proportion of the population (less than 3% among survivors to 1900). In the sample we use for our analyses, 35% of veterans were wounded, 23% had been discharged for disability, and 12% had a severe wound (see Table 2).

The wounded were more likely to have enlisted earlier, to have enlisted in a large city, and to be laborers rather than farmers at enlistment (see Table 2). Early enlistees were at greater risk of a wound because of their longer wartime service. The young and the less skilled were at greater risk of a wound because they were less likely to have become corporals or sergeants immediately after enlistment. The same patterns persist for children of wounded veterans (see Table 3). Although the fathers of wounded men had less real estate wealth, we did not find a statistically significant correlation between wounds and paternal real estate wealth once we controlled for occupational class at enlistment. There were no differences by paternal wounds in birth year or number of siblings for veterans' children.

1.3 Wounds and Sample Selection

There are two potential sample selection concerns. One concern is wartime selection, particularly by age. If older wounded soldiers were more likely to die in the war than their younger wounded counterparts then older war survivors may have suffered from less serious wounds than their younger counterparts. The second concern is that the sample is restricted to children and their veteran fathers thus raising the issue whether those most severely wounded were the least likely to be in the sample.

We found no evidence that the war led to selection in the severity of wounds by age. There was no difference between the wounded and the non-wounded in the relationship between the probability of dying during the war and age, suggesting that there was no difference in unobserved severity of wounds by age group (details are in the Data Appendix).

Men who had been wounded in the war and who were not married prior to the war were slightly less likely to have any children and thus to be in the sample and also had fewer children, potentially leading to underestimates of the impact of war wounds on veteran and child outcomes; but, as shown in the Data Appendix, the magnitude of the association was small. Veterans' probability of having a child was 0.88 and being wounded decreased this probability by 0.02, a 2% decline. Almost all of those without children were unmarried. Conditional on having children, men who were wounded had one quarter fewer children when the average number was 5, an 8% decline. Pension recipiency increased the probability of having any children by 0.03 but did not have a statistically significant impact on the number of children, conditional on having children.

2 Empirical Strategy

2.1 Health Shocks and Later Socioeconomic Outcomes

A health shock can lead to mismatch, particularly for individuals in physically demanding sectors such as agriculture. While switching industries or jobs can lead to a better match,

investments in new skills may be required. The older the individual experiencing the health shock, the less likely he is to switch because the opportunity cost of switching rises with tenure and because the pay-off period from investing in new skills or learning about the match quality is shorter.

An individual who changes occupation may pick a low-skill job if the health shock increases the financial or time cost of investment in a new skill. Because poorer individuals require less compensation to take an unpleasant or less prestigious job, then, provided that income effects dominate, as shown by Weiss (1976), an individual whose earnings capacity has declined uniformly in all jobs is more likely to pick an unpleasant or less prestigious work activity, such as being a laborer. He also is more likely to choose an occupation with risky monetary returns.

The age at which an individual experiences a health shock affects earnings and thus wealth. Because it is costlier for an older individual to switch occupations, he will pay a relatively greater earnings penalty than his counterpart who experiences the same health shock at a younger age. However, because older individuals will have had more time to acquire skills and wealth prior to a health shock than younger individuals, they could experience lower earnings and wealth declines.

We are agnostic about the exact age range in which men who experience a health shock are likely to switch occupations or to experience a decline in wealth. When we examined 2 year age groups, we found that wound status had no statistically significant effect on the probability of being a farmer or a laborer among men who were age 29 and age 26, respectively, after the end of the war. We also found that wealth declined after age 30 among men who had been wounded in the war. We therefore divide the veteran sample into those less than age 30 and those age 30 or older at the end of the war.

Our data also permit us to examine the correlation between wealth effects and occupational choice by examining both the impact of pension recipiency and of paternal wealth on occupational outcomes. (We focus on pension recipiency rather than pension amount because relatively few men were on the pension rolls in 1870 or 1880.) Wealth effects would lead men to choose pleasant or prestigious low-paying work activities (Weiss 1976). Pensions and paternal wealth thus would push men to be farmers or small proprietors. However, as shown in Weiss (1976), pensions and paternal wealth would push men toward monetarily higher risk occupations, which in this time period would be that of laborers.[4]

We examine the relationship between wounds, age and four occupational outcomes (farmer, professional or proprietor, artisan, or laborer) by, within each age-selected sub-sample, estimating multinomial logit models where the probability that the response is equal to the ith outcome is

[4]Risk was estimated as the occupational class specific standard deviation of the residuals from a regression of the logarithm of personal property wealth or total wealth on dummies for state of birth, age, and occupational group. The sample we used was the 1870 IPUMS (Ruggles et al. 2018) restricted to white men age 25–59 who were born in a Union State or its territories. Professionals and proprietors had the highest mean personal property and total wealth followed by farmers whereas laborers had the lowest.

$$\Pr(y = i) = \frac{\exp(\gamma_i SW + \delta_i OW + \beta_i X)}{1 + \sum_{m=2}^{4} \exp(\exp(\gamma_m W + \delta_m D + \beta_m X)} \quad (1)$$

if $i > 1$ and the base outcome is 1 and where SW is a dummy indicator if the veteran had been severely wounded, OW is dummy indicator if he had another wound, and X is a set of control variables which includes dummy variables for his occupational class at enlistment, a dummy variable indicating whether he enlisted in a city of 50,000 or more, his age at the end of the war, the logarithm of his father's real estate wealth, the logarithm of his father's personal property wealth, and a dummy indicator for whether he was receiving a pension in 1880. (We cannot interact age group dummies with wound dummies because of computational issues.) We cluster standard errors at the company level. We present marginal estimates.

We examine the impact of wounds on 1870 wealth holdings, w, by estimating quantile regressions within our two age-selected subsamples,

$$\log(w) = \gamma SW + \delta OW + \beta X \quad (2)$$

where SW is a dummy variable indicating if the veteran was wounded, OW is a dummy variable indicating if the veteran had another wound, and the control variables are age at the end of the war, occupational class at enlistment and enlistment year, a dummy variable indicating if enlistment was in a city of 50,000 or more, the logarithms of paternal real estate and of father's personal property wealth. We also run regressions where we control for post-war variables: pension recipiency in 1870, farm occupation in 1870, and the company death rate from injuries. We control for these variables to avoid underestimating the impact of wounds (in the case of pension recipiency), to understand mechanisms behind wealth declines (in the case of farm occupations), and to avoid confounding the effects of being wounded with general stress. We also investigate the impact of severe and all wounds on median wealth.

2.2 Paternal Health Shocks and Child Outcomes

We investigate how the interaction between paternal wounds and age affected children's socioeconomic status and mortality. If a wound reduces earnings capacity, particularly at older ages, wounded fathers would have fewer resources to invest in their children. Children might receive less schooling, fewer health investments, and lower financial transfers as adults. Sons might receive less occupational training. Daughters' circumstances might be more proscribed and their marriage market limited to men within the same occupational class or social circle as their fathers.

Our analysis of children's socioeconomic and mortality outcomes subdivides the sample four ways: by sex and by our two paternal age groups (less than age 30 and age 30 or older at the end of the war). When we examine mortality we look at children who survived to age 45 to ensure sample representativeness.

We examine the four occupational classes (farmer, professional/proprietor, artisan, laborer) of veterans' sons and sons-in-law using a multinomial logit where the probability that the response is equal to the ith outcome is

$$\Pr(y = i) = \frac{\exp(\gamma_i SW + \omega_i OW + \beta_i X)}{1 + \sum_{m=2}^{4} \exp(\exp(\gamma_m SW + \omega_m OW + \beta_m X)} \quad (3)$$

if $i > 1$ and the base outcome is 1 and where SW indicates a paternal severe wound, OW indicates a paternal "other" wound, and X includes birth year, paternal enlistment characteristics (occupational class, enlistment year, and city size), and, in one of the specifications, paternal post-war characteristics (1880 occupational class and 1870 total wealth). Standard errors are clustered at the family level.

We estimate the association between paternal wound type and children's mortality by running Cox proportional hazard regression models of years lived after age 45,

$$h(t) = h_0(t)\exp(\beta_1 SW + \beta_2 CW + \beta_3 X) \quad (4)$$

where h(t) is the hazard, SW is a dummy variable equal to one if the veteran had been severely wounded, OW is a dummy indicator if the veteran suffered a non-severe wound, and X is a set of control variables. The specifications include as control variables birth year, paternal enlistment characteristics, and paternal post-war characteristics from the 1880 census. The standard errors are clustered at the family level. We also present specifications in which we control for sons' or daughters' husbands' occupational class in 1910 by stratifying on these occupations to ensure that the proportionality assumption is satisfied.

2.3 Interpreting the Results

A causal interpretation of our regression results would require wounds to be exogenous, conditional on observable characteristics. While such an assumption is plausible (although we lack an instrumental variable to test), we acknowledge that the wounded may have had different unobservable characteristics, including love of risk or conscientiousness, than the non-wounded. If the wounded were higher risk takers we may overestimate the impact of war wounds on occupational change. If the wounded were more conscientious, we may overestimate the impact of wounds on wealth. In addition, a causal interpretation of our results also requires us to assume that those wounded at older ages do not differ on unobservable characteristics from those wounded at younger ages. We can overcome some of these challenges by comparing veterans with a severe wound to those with a non-severe wound under the assumption that, conditional on being wounded, the severity of the wound was exogenous.

Either a causal or correlational interpretation of our findings on wounds as a proxy for disability in the labor force needs to account for confounding factors. Wounds may proxy for combat stress: the wounded would also have been more likely to have seen their comrades killed. We found, consistent with Costa and Kahn (2010), that veterans from companies with above median combat fatalities were shorter-lived than men from other types of companies. We therefore add a control for above median company combat fatalities to our regressions.

Another possible confounding factor is pension recipiency and we investigate both the inclusion and exclusion of pension recipiency in our analyses. Men who received pensions were in worse health and, because the criterion until 1890 was a war-related disability, the wounded were the ones most likely to be on the pension rolls. The correlation between pensions and health may lead to an underestimate of the negative impact of wounds on outcomes. We therefore show results for controls with pension recipiency and without when pension inclusion affects the results.[5]

Wounds may proxy not just for disability but also for the availability of family resources. The wounded who married after the war married women whose fathers had 17 to 22% less personal property wealth than their non-wounded counterparts (details are in the Data Appendix). Because we do not have the sample size to control for maternal grandfather's wealth in our specifications, we may overestimate a pure disability effect of wounds on occupational change or wealth among younger men.

3 Results: Veterans' Socioeconomic Outcomes

Men wounded in the war were less likely both to remain and to become farmers by 1880 than the non-wounded (see the transition matrices between enlistment and 1880 occupation in Table 4). Fifty-eight percent of wounded farmers remained farmers compared to 62% of non-wounded farmers. Farmers who switched occupational class were disproportionately professionals, proprietors or laborers in 1880 if wounded. Wounded professionals and proprietors were more likely to remain in their occupational class if wounded (53% if wounded vs 44% if not), Very few men had no occupation at all, consistent with the absence of work disincentives in pensions.[6] For younger men occupations may have been aspirational rather than actual and thus the costs of switching might be lower; however, there should be no differences in aspirational versus actual occupations by wound status.

A severe wound received when young was associated with a decrease of 0.09 in a veteran's probability of being a farmer and an increase of 0.03 in his probability of being a professional or proprietor. Although a severe wound was associated with a decreased probability of 0.04 in being a laborer, the effect was statistically significant only at the 10% level (see Table 5). Other wounds received when young were associated with an increased probability of 0.03 of a veteran being a laborer but were not associated with a decreased probability of being in another occupational class. There was not a statistically significant difference in the association of severe and other wounds on the probability of being a laborer whereas there was a difference in the probability of being a farmer ($\chi^2(1) = 9.61$, $p = 0.002$) or a professional or proprietor ($\chi^2(1) = 10.14$, $p = 0.002$). In contrast, among veterans who were age 30 or older at the end of the war, there was no statistically significant association of

[5]We do not have a good instrumental variable for pension recipiency in the 1870s and 1880s: political variables such as closeness of elections were too weak. In 1900, when law changes provided exogenous variation, there was no evidence of selection in who received a pension (Costa 1995). The only statistically significant predictors of receiving a pension between 1870 and 1880, conditional on not having one in 1870, were having been wounded and having been discharged for disability. (The impact of a having been wounded was twice as large as having been discharged for disability.) Observable characteristics such as 1870 property wealth did not affect recipiency, suggesting no selection on observable characteristics. Our results are from a probit regression where the dependent variables was receiving a pension on or before 1880 conditional on not having one in 1870.

[6]We find that neither wounds or pension recipiency were either statistically significant or, in terms of estimated magnitudes, economically meaningful predictors of having no occupation in 1880.

wounds with 1880 occupational class and no statistically significant difference in the probability of being in an occupational class by type of wound severity.

Table 5 also suggests that farming was a desirable occupation. Pension recipiency was positively and statistically significantly associated with being a farmer in 1880 among younger men, the group switching occupational categories. There was no statistically significant assocation among older men. The positive association for younger veterans between the veteran's father wealth and the veteran's probability of being a farmer, professional or proprietor also suggests that farming was a desirable occupation. A standard deviation increase in the logarithm of paternal personal property wealth was associated with an increased probability of 0.04 that a veteran was a farmer and a decreased probability of 0.04 that he was a laborer. For older veterans the logarithm of father's real estate wealth was statistically significantly associated with a change in an occupational class (an increase in the probability of being a professional or proprietor) but there were no associations for younger veterans. However, the magnitude of some of our estimated correlations of paternal wealth and veterans' occupational probabilities suggests that we may be underpowered to find statistical significance.

Older veterans had less wealth in 1870 if they had been wounded (see Table 6). A severe wound was associated with 37% less wealth at the median among older veterans and with 46% less wealth when we added controls for pension recipiency in 1870 and farm occupation in 1870 and thus account for much of the working capital of farmers being tied up in their wealth. Less severe wounds were not statistically, significantly associated with wealth among older men but the estimated association was up to −28% and the coefficients on severe and other wounds were not statistically significantly different from each other. For younger veterans other wounds were statistically significantly inversely associated with wealth when we controlled for pre-war characteristics and pension recipiency. The estimated effect was halved and became statistically insignificant once we controlled for farm occupation in 1870, suggesting that moves out of the farm sector explained much of the impact of wounds on total wealth holdings for younger men. Adding a control for the company wartime death rate from injuries did not change the results, suggesting that wounds are proxying for physical disability rather than combat trauma.

Younger men maintained their wealth despite their wounds, perhaps because of their occupational transitions. Older men were more likely to see wealth losses if they had been wounded, perhaps because occupational changes had low future pay-offs. For older men the impact of wounds was greater than that of a 1% increase in paternal personal property wealth, which increased an older veteran's wealth holdings by 32.5% ($\hat{\sigma} = 0.130, \mathrm{P} > |z| = 0.012$) when we did not control for farm occupation in 1870 and by 27.1% ($\hat{\sigma} = 0.086, \mathrm{P} > |z| = 0.002$) when we controlled for farm occupation in 1870.

Our estimated wealth effects are broadly consistent with the 37% decline in wealth because of war wounds found by Lee (2005) using a small and different sample of Union Army veterans. Lee's (2005) sample did not allow him to examine how the age at which the health shock was received affected later wealth and occupational status.

We could not find a correlation of wounds, regardless of severity and of inclusion or exclusion of post-war controls, on veterans' mortality (results not shown). While severe wounds may have been disabling and affected productivity (at least immediately after the war), they may not have affected mortality.

4 Results: Children's Socioeconomic and Mortality Outcomes

We found that among the children of veterans less than age 30 at the end of the war, the daughters of severely wounded fathers were less likely to be married to farmers and more likely to be married to laborers in 1910. The probability that a daughter would be married to a farmer was 0.084 lower if her father was severely wounded (Table 7). Her probability of being married to a laborer was 0.072 higher if her father was severely wounded. There was no statistically significant association between a non-severe wound and husband's occupational class. The increase in the probabilities of being married to a farmer or a laborer associated with a severe and a non-severe wound were statistically significantly different ($\chi^2(1) = 5.13$, $p = 0.024$ and $\chi^2(1) = 7.89$, $p = 0.005$, respectively). When we controlled for paternal wealth in 1870 and paternal occupational class in 1880, our estimated association between a severe paternal wound and the probability that a daughter would be married to farmer declined by 8%. Our findings suggest that marriages of daughters to farmers may have been limited by occupation-specific family and neighborhood social circles. The association between paternal wound and the probability of being married to a laborer remained unchanged. In contrast, we found no association between sons' occupational class and paternal wounds received by veterans less than age 30 at the end of the war.

The occupational class of sons was statistically, significantly asssociated with paternal war wounds if the veteran was age 30 or older at the end of the war (see Table 8) and the association was related to the decline in paternal wealth for the wounded among older, wounded veterans. The sons of fathers with severe and other wounds had probabilities of being farmers that were 0.127 and 0.049 lower, respectively, than those of sons of non-wounded fathers. The probability that the son of a severely wounded man would be a laborer was 0.118 higher than that of a non-wounded man. Our estimates of the increase in probabilities of a son being a farmer or laborer if the father had a severe or other wound were not statistically distinguishable ($\chi^2(1) = 1.31$, $p = 0.253$ and $\chi^2(1) = 0.81$, $p = 0.367$ for the change in the probability of being a farmer and a laborer, respectively). When we controlled for paternal wealth in 1870 and paternal occupation in 1880, the increase in the probability of being a farmer for those with a severe wound fell by 26% and the association was statistically significant only at the 10% level, suggesting that paternal wealth assisted sons in becoming farmers. Paternal wealth does not appear to have helped daughters marry farmers.

We also investigated the relationship between paternal wounds and children's educational outcomes. We did not find a statistically significant association between paternal war wounds and a child being in the 1880 census and with educational levels reported in 1940.

A severe paternal wound at older ages was associated with mortality above age 45 for daughters but not for sons (see Table 9). A daughter was 1.311 times more likely to die at

any age above 45 if her father had been severely wounded in the war and was older than age 30 at the end of war, controlling for paternal wealth in 1870 and for paternal occupational class in 1880. Additionally controlling for the occupational class of the daugher's husband increased the hazard rate to 1.322. Adding additional controls for population density in the 1880 county of residence and for paternal farm occupation in 1870 increased the hazard ratio to 1.340 ($\hat{\sigma} = 0.152, \mathrm{P} > |z| = 0.010$). The hazard ratio was 1.290 ($\hat{\sigma} = 0.142, \mathrm{P} > |z| = 0.021$) when we controlled only for pre-enlistment paternal characteristics. Our sample size is large enough such we are unlikely to be detecting a spurious statistical result; to find a hazard ratio of 1.32 for a binary variable at the 1% level of significance we need a sample of 607, assuming power of 0.8 and an unrealistically high correlation with the other variables of 0.5.[7] We also did not find that older fathers' daughters who were born prior to paternal enlistment faced a statistically significant mortality risk if their fathers were wounded; however, a caveat is that our sample contains only 508 such daughters.[8]

We suspect older fathers faced productivity declines within occupations which our wealth measure, taken 5 years after the end of the war, does not capture. We found statistically significant associations of severe wounds with mortality for the daughters of older veterans who were farmers at enlistment but not for the daughters of non-farmers. For the daughters of farmers, the hazard ratio on a severe wound was 1.449 ($\hat{\sigma} = 0.227, \mathrm{P} > |z| = 0.021$) whereas it was only 1.084 ($\hat{\sigma} = 0.158, \mathrm{P} > |z| = 0.579$) for the daughters of non-farmers.

Severe paternal war wounds were associated with excess deaths from cardiovascular disease for daughters of fathers age 30 or older at the end of the war, consistent with the association of cardiovascular disease with early life conditions (e.g., Barker and Martyn 1992). A daughter whose father had been severely wounded in the war was 2.383 ($\hat{\sigma} = 0.892, \mathrm{P} > |z| = 0.020$) times as likely to die at any age after age 45 from a cardiovascular disease compared to a daughter whose father had not been wounded. However, the hazard ratio on a severe wound was not statistically significantly different from the hazard ratio of 1.380 ($\hat{\sigma} = 0.572, \mathrm{P} > |z| = 0.438$) on a non-severe wound.

Why did paternal severe wounds received at older ages reduce daughters' but not sons' lifespans, if the mechanism is early life conditions? Girls may be more sensitive to early in-utero nutritional shocks as seen in findings from the the Dutch Hunger Winter (Stein et al. 2007, Lumey et al. 2009, Tobi et al. 2009). Nutritional shocks may have been more severe among farm households who were growing food both for their own consumption and for sale. Alternatively, because exposure to infectious disease may have been greater in households of lower socioeconomic status, girls may have been differentially exposed because they were not working outdoors or they may be more susceptible to infectious disease between age 5 and 25 (Goldin and Lleras-Muney 2019). The burden of adult caregiving does not appear to play a role: we found no evidence that adult daughters were more likely to live with a father if he had been wounded in the war (results not shown).

[7]The highest correlation was with the father's enlistment year dummies and it was only −0.06 for those enlisting in 1864.
[8]The hazard ratios on severe and other wounds were 1.090 ($\hat{\sigma} = 0.168, \mathrm{P} > |z| = 0.574$) and 1.033 ($\hat{\sigma} = 0.120, \mathrm{P} > |z| = 0.781$), respectively.

5 Comparing Paternal Shocks

Paternal experiences can be transmitted to children either through biological or socioeconomic channels. In previous work (Costa et al. 2018), we found that paternal ex-POW hardship was transmitted to sons only and argued that the transmission was most consistent with an epigenetic mechanism. We compare our findings for paternal wounds with those for paternal ex-POW trauma by sex and by different paternal end of war age groups. We re-run our Cox proportional hazard models hazard models for the paternal end of war age groups less than age 22, ages 22–29, and greater than or equal to age 30, stratifying on own or spouse's occupation in 1910. We use the data in Costa et al. (2018) to re-run our 1910 occupation stratified results for these age groups. All of our regressions examine mortality after age 45 and are for those married and in the 1910 census.

We found that paternal wounds and POW trauma led to very different tranmission patterns by paternal age at the time of the shock, not just to different sex-specific transmission. Ex-POW trauma was transmitted to the sons of fathers who were young at the time of the shock (see Table 10 which examines survival after age 45 by different paternal age groups for children stratifying on either own or husband's occupational class). The sons of veterans who suffered severe POW camp hardship were 1.45 times as likely to die at any age after age 45 compared to the sons of non-POWs, provided the veteran was less than age 22 at the end of the war. The sons of ex-POWs during times of milder POW camp hardship were 1.20 times as likely to die compared to the sons of non-POWs. The hazard ratios on severe and milder hardship were statistically, significantly different from each other at the 5% level ($\chi^2(1) = 4.06$, $P > \chi^2(1) = 0.044$). For sons of fathers who were between age 22–29 at the end of the war the association between severe paternal POW camp hardship and sons' mortality was statistically significant only at the 10% level and the hazard ratio was 1.13, statistically indistinguishable from that for less severe POW camp hardship. There were no statistically significant associations among sons of fathers who were age 30 or older at the time of the war, but statistical power is potentially an issue. In contrast, paternal wounds were associated only with the mortality of daughters of fathers who were older at the end of the war.

We previously hypothesized that the correlation between POW camp hardship and sons' mortality was caused by starvation which induced an epigenetic effect. The relationship between paternal POW camp hardship and older age mortality among sons of fathers who were less than age 22 at the end of the war is consistent with the positive correlation between paternal grandfather's food supply in his late teens and grandsons' mortality in the classic studies of Överkalix in northern Sweden (Bygren 2013). In contrast to our prior results, we suspect that the correlation between severe wounds and daughter's mortality among fathers who were age 30 or older at the end of the war was related to productivity declines among farmers which diffentially affected girls.

6 Conclusion

The twentieth century witnessed a radical transformation in the types of goods and services produced and in the processes used to produce them. Concurrent with these changes,

professional, managerial, clerical, sales, and service workers grew from one-quarter to three quarters of total employment between 1910 and 2000 (Wyatt and Hecker 2006). This shift has been implicated as a cause in the long-run decline in musculoskeletal disabilities at older ages (Costa 2000). Another outcome of this shift, and of jobs becoming less dangerous in the two decades after World War II, is the decline in permanent disability from on the job accidents (Costa and Kahn 2004).[9] We found that men could partially adapt to injuries received when they were young (though at the cost of lower socioeconomic status), but could not adapt when they received injuries after age 30, consistent with human capital and job matching models. The cost of an injury for an older man was a 36–46% decline in wealth 5 years after the end of the war, implying a sizable impact of health shocks at prime adult ages on productivity. The magnitude of our effect is larger than the 10–15% wealth decline experienced today by older Americans who have had a severe health shock, as might be expected in comparing the wealth outcomes of health shocks in brawn versus brain based economies.[10] While health shocks today affect the wealth of older Americans through changes in their labor force participation, in our sample virtually all men were in the labor force suggesting that in the past health shocks affected wealth either through productivity or the amount of time worked. Regardless of the exact pathway, our findings provide strong evidence of the importance of health on economic outcomes as argued by Smith (2005). Our finding that a health shock could affect productivity in an age-specific way but not own mortality also suggests that the literature on health and economic growth needs to distinguish between types of health shocks and their timing (see Bleakley 2010 for a discussion).

We found that there were intergenerational associations of paternal health shocks with child socioeconomic and mortality outcomes. We argued that the decline in paternal wealth affected the ability of sons to become farmers, probably because they had less access to working capital. We argued that shifts out of the farm sector among younger veterans reduced their daughters' probabilities of marrying farmers, perhaps because they were less likely to meet farmers. Our mortality findings raise several issues for further research. We found that the daughters of fathers who were older when they were wounded faced a greater mortality risk at all ages after age 45 than the daughters of men who were not wounded, an association which persisted when we cntrolled for paternal wealth 5 years after the end of the war and which was concentrated among the daughters of farmers. We found no effects of wounds on the adult socioeconomic status of daughters of older veterans, suggesting that research should focus on the direct health effects of intergenerational shocks. Our observed outcomes by sex and by the timing of the original shock are in contrast to our results for the intergenerational transmission of ex-POW trauma (Costa et al. 2018) and suggest that more research is needed on the intergenerational transmission of paternal shocks by sex and by the timing of the original shock.

[9]Additional evidence on the extent of accident risk in the past comes from an examination of World War I draftees age 18–30 which revealed that 21 out of 1000 men suffered from injuries due to accidents, including losses of extremities, with higher rates in the Southern states (Love and Davenport 1920, pp. 126–8, 143).

[10]Smith (2005) estimates that a major health shock leads to a cumulative wealth decline of $52,000 over 8 years. This represents a 10–15% wealth decline.

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Data Appendix

6.1 Original Union Army Sample

Veterans are drawn from a sample of 39,341 men in 330 randomly drawn Union Army volunteer infantry companies, collected by the program project, Early Indicators of Later Work Levels, Disease, and Death (NIA P01 AG10120, PI: Fogel). The sample was constructed from hand written military service and pension records (including detailed examining surgeons' exams), preserved in the National Archives, and from selected manuscript census schedules. The sample is representative of the Northern population of military age in 1860 in terms of socioeconomic status (Fogel 1993).

The military service and the pension records contain enlistment information, including occupation and place of enlistment, and also wartime experiences such as illnesses and wounds. The Union Army pension records exist because in 1862 Congress established a program to provide pensions for soldiers who had incurred permanent bodily injury or disability while in the service and for the dependents of soldiers who had died from causes that could be traced directly to injuries received or diseases contracted while in Union Army service. The pension program effectively became a universal disability and old age pension program in 1890 and the number of veterans on the rolls doubled.

6.2 Veterans' Children Sample

We are collecting the records of the children of 8,500 white non-POWs who survived to 1900 and of 1,999 white ex-POWs who survived to 1900. Only the children of veterans who survived until 1900 were traced because information in the pension records is needed to link children to death records and manuscript census records, but only in 1900 was pension coverage close to universal. However, the biases introduced by not examining veterans who survived the war but died before 1900 appear to be minimal because our inability to find them in the 1870 and 1880 censuses suggests that most excess deaths from wartime causes were before 1870. At the time of analysis not all children's records had been cleaned and coded so we focus on a subset of the data in our analyses.

Information on veterans' children was obtained from veterans' manuscript census schedules which list all members of the household and from family circulars which were part of the veteran's pension file (and would have been completed by all of the veterans in the sample). The family circulars contain children's names, birth and death dates and often daughters' married names. All of the veterans' children were linked to on-line death records and to all of the manuscript census schedules from 1850 to 1940, with the exception of 1890, using

familysearch.org, ancestry.com, Find A Grave, and deathindexes.com, with each record often leading to another record. Records that were found may include (not necessarily in order) death records (often with parents' names, exact birth dates, exact death dates and other family member names), birth records (with exact birth dates and parents names), marriage records (with spouses' names and often with parents' names), WWI draft registration cards (with exact birth dates and next of kin, often a parent or a spouse), and Social Security claim or death index (with exact birth dates and frequently with parents' names).

Linkage rates are given in Table 11. The availability of on-line death records is the primary determinant of linkage to death records. Although death sources are available in some form on-line for all 50 states, each state varies in the types of death information and dates available. Census linkage rates in the current children's sample are high for the following reasons: the pension records often provide names of the veterans' spouses and children (including daughters' married names), various addresses for the veteran, date of birth and birthplaces for the veterans and their children, birth date and marriage date and place for the veterans' spouses, and, at times, death dates for the veterans' children; 2) the sample is a Northern sample (the North had better records), and the children are all native-born; 3) when daughters' married names are unavailable in the pension records, these names can be found in on-line marriage records using their parents' names and places of residences. All linkages were done by staff with extensive training in genealogical research, and all links undergo an extensive series of cross-checks.

Linkage methods are designed to reduce the rate of false positives. By using Ancestry trees, inputters follow the hints provided, attach relevant documents, and see multiple match points from a variety of sources that corroborate new information when it is found. Inputters determine on a case by case basis which information is the strongest to use in their search parameters, then examine the actual record image and determine the strength of the match by reviewing all the available information. Inputters can also recognize indexing errors, decipher poor handwriting, sort through mistakes on the record and make informed decisions.

We have investigated the use of mechanized algorithms for finding birth, death, and census records, but these yielded too many false positives relative to our manual searches because, unlike humans, extant matching algorithms do not recognize matching points from a variety of records nor connect the dots to follow the clues when one record leads to the next. Mechanized methods are limited to digitized records and cannot open the document to examine the image in order to recognize errors in indexing and recording; they cannot alter the search sequence nor change the importance of search fields on a case by case basis, and are unable to eliminate results that make no sense. Common linkage methods such as those examined in Bailey et al. (2017) and those used on Family Search yield numerous false positives. The advantage having human inputters use extensive information to find individuals is that it avoids probabilistic matches, such as those used by the Census Bureau in their linkage projects, which permit only coarse inference when the number of entities relative to the number of records is small (Johndrow et al. 2018).

6.3 Sample Selection

We investigate entry into the sample by using a probit model in which the dependent variable is a dummy equal to one if a veteran who was not married before the war had a child using a probit equation. Conditional on having children, we examine the impact of wounds on number of children using a poisson model. Marginals for both the probit and poisson model are in Table 12. We found some evidence of differential effects of being wounded by broad age group. When we examined veterans who were older than age 25 at the end of the war and unmarried we found that the impact of being wounded on having any children was −0.036 ($\hat{\sigma} = 0.015$, $P > |z| = 0.016$), a 4% decline compared to the 2% decline among all age groups. Conditional on having children, we found no differential age effects of being wounded on the number of children (results not shown). Our results suggest that the older veterans who were in our sample of men with children were the relatively healthy because those who were unhealthy dropped out. We thus may underestimate the impact of wounds on veteran and child socioeconomic and mortality outcomes.

6.4 Father-In-Law's Wealth

We run quantile regressions where the dependent variables is the logarithm of father-in-law's personal property wealth in 1860 (see Table 13). The impact was statistically significant at the 1% level at the 50th and 75th quantiles, but not at the 25th. Controlling for wounds, a discharge for disability was not statistically significantly correlated with father-in-law's wealth.

Figure 1 in the Appendix compares the probability of a wartime death for the wounded and the non-wounded by two year age group (measured at war's end) as estimated from a probit regression with controls for enlistment year dummies, enlistment occupational class, and a dummy for city size.

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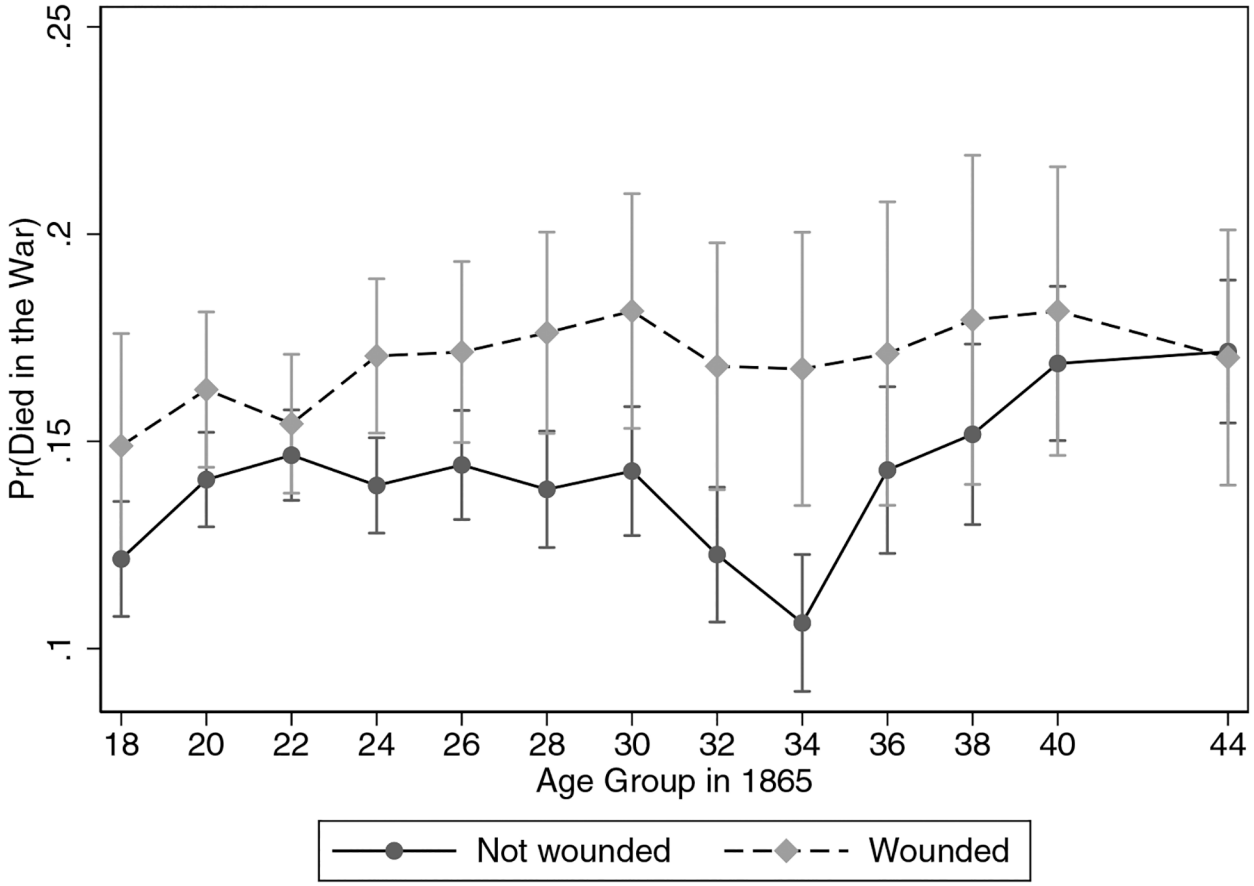

Figure 1:

Impact of Wounds on Probability of Wartime Death by Age

Confidence intervals indicated by the vertical lines. Estimated from the Union Army sample of 39,341 men using a probit regression in which the dependent variables is a dummy equal to 1 if the soldier died in the war and the independent variables are dummy variable indicating if the soldier was wounded, dummy variables for 2 year age groups (except for the first and last age groups), the interaction between the wounded dummy and the age dummies, and controls for enlistment characteristics (occupational class and city size).

Table 1:

Percentage Disabled, Injured, or Wounded

	During War	Survived to	
		1866	1900
Wounded or Injured	26.27	25.15	30.95
Non-mortal wound or injury	21.41		
Non-mortal battlefield wound	13.64		
Discharged disability (any cause)		18.77	18.99
Discharged for			
Wounds or Injuries		3.00	3.42
Vague reason (e.g., disability)		0.76	0.71
Other reason (e.g., disease)		7.49	7.77
No reason given		8.58	8.21
Amputation		2.07	2.60
Observations	39,341	33,485	15,133

Estimated from the full Union Army sample.

Table 2:

Mean Characteristics of Veterans by Wound Status

	All	Not Wounded	Severe Wound	Other Wound
Veterans				
Dummy=1 if				
Severe wound	0.124			
Any wound	0.346			
Discharged disability	0.233	0.196	0.855	0
On pension rolls in 1870	0.108	0.039	0.0425	0.134
Enlisted in city with population of 50,000+	0.032	0.025	0.048	0.043
Enlistment Occupation				
Farmer	0.621	0.640	0.572	0.591
Professional/Proprietor	0.040	0.044	0.040	0.032
Artisan	0.160	0.155	0.178	0.163
Laborer	0.167	0.148	0.201	0.202
Unknown	0.012	0.013	0.009	0.012
Enlistment Year	1862.261	1862.411	1861.911	1862.022
Age at end war	26.162	26.272	26.822	25.482
Father’s real estate wealth ($)	946.693	982.956	939.271	847.127
Father’s personal property wealth ($)	763.472	765.120	875.498	763.472
Fraction of company died of wartime injuries	0.052	0.046	0.067	0.059
Total wealth in 1870 ($)	1263.632	1312.758	1324.426	1086.325
Dummy=1 if farmer in 1870	0.430	0.447	0.407	0.391
Dummy=1 if Occupation in 1880				
Farmer	0.472	0.492	0.399	0.454
Professional/Proprietor	0.107	0.106	0.137	0.093
Artisan	0.141	0.138	0.155	0.143
Laborer	0.260	0.244	0.282	0.293
No occupation	0.020	0.020	0.026	0.017

Means are for the sample of 6,228 Union Army veterans. Means for 1870 and 1880 characteristics are for men linked to those censuses (5,076 and 5,726 respectively). Means for the veteran’s father wealth are for 4,139 fathers.

Table 3:

Mean Characteristics of Veterans' Children by Paternal Wound Status

	All	Not Wounded	Severe Wound	Other Wound
Dummy=1 if veteran				
Severe wound	0.108			
Any wound	0.234			
On pension rolls in 1880	0.190	0.122	0.397	0.285
Enlisted in city with population of 50,000+	0.020	0.019	0.025	0.023
Veteran's enlistment Occupation				
Farmer	0.681	0.698	0.623	0.659
Professional/Proprietor	0.021	0.031	0.045	0.027
Artisan	0.128	0.129	0.137	0.122
Laborer	0.146	0.127	0.181	0.182
Unknown	0.014	0.015	0.014	0.010
Veteran's enlistment year	1862.268	1862.429	1861.878	1861.995
Veteran's total wealth in 1870 ($)	1103.348	1147.779	1126.072	965.911
Veteran's occupation in 1880				
Farmer	0.563	0.581	0.505	0.540
Professional/Proprietor	0.080	0.078	0.116	0.066
Artisan	0.120	0.115	0.127	0.133
Laborer	0.221	0.210	0.232	0.247
No occupation	0.016	0.016	0.020	0.014
Dummy=1 if female	0.451	0.452	0.452	0.454
Birth year	1874.580	1874.616	1874.505	1874.512
Number of siblings	5.843	5.885	5.886	5.702
Own or spouse's occupation in 1910				
Farmer	0.334	0.342	0.287	0.331
Professional/Proprietor	0.227	0.230	0.227	0.217
Artisan	0.174	0.169	0.176	0.187
Laborer	0.265	0.258	0.310	0.265

The means are for all children who were married in the 1910 census and who had own or spouses' occupational information.

Table 4:

Occupational Transitions between Enlistment and 1880 by Wound Status

Enlistment Occupation	1880 Occupation F	PP	A	L	None	Total
Not wounded						
Farmer (F)	1,531	196	186	482	44	2,439
	62.77%	8.04%	7.63%	19.76%	1.80%	100.00%
	83.75%	51.44%	36.54%	52.79%	57.79%	65.79%
Professional/Proprietor (PP)	38	69	17	26	7	157
	24.20%	43.95%	10.83%	16.56%	4.46%	100.00%
	2.08%	18.11%	3.34%	2.85%	9.21%	4.24%
Artisan (A)	116	67	250	128	9	570
	20.35%	11.75%	43.86%	22.46%	1.58%	100.00%
	6.35%	17.59%	49.12%	14.02%	11.84%	15.38%
Laborer (L)	143	49	56	277	16	541
	26.43%	9.06%	10.35%	51.20%	2.96%	100.00%
	7.82%	12.86%	11.00%	30.34%	21.05%	14.59%
Total	1,828	381	509	913	76	3,707
	49.31%	10.28%	13.73%	24.63%	2.05%	100.00%
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Wounded						
Farmer (F)	682	103	93	265	25	1,168
	58.39%	8.82%	7.96%	22.69%	2.14%	100.00%
	79.86%	50.49%	31.96%	47.24%	65.79%	59.96%
Professional/Proprietor (PP)	12	35	4	14	1	66
	18.18%	53.03%	6.06%	21.21%	1.52%	100.00%
	1.41%	17.16%	1.37%	2.50%	2.63%	3.39%
Artisan	60	35	139	86	3	323
	18.58%	10.84%	43.03%	26.63%	0.92%	100.00%
	7.03%	17.16%	47.77%	15.33%	7.89%	16.58%
Laborer	100	31	55	196	9	391
	25.58%	7.93%	14.07%	50.13%	2.30%	100.00%
	11.71%	15.20%	18.90%	34.94%	23.68%	20.07$
Total	854	204	291	561	38	1,948
	43.84%	10.47%	14.94%	28.80%	1.95%	100.00%
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

The means are for all men who were linked to the 1880 census and who had known occupations at enlistment and in 1880 (i.e., not illegible or unclassifiable).

Table 5:

Wounds and Change in Occupational Class Probabilities in 1880 (Marginals)

	< 30 yrs at end war			≥ 30 yrs at end war		
	$\frac{\partial Y}{\partial x}$	$\hat{\sigma}$	*p*	$\frac{\partial Y}{\partial x}$	$\hat{\sigma}$	*p*
Variable: Severe Wound						
Farmer	−0.089	0.023	0.000	−0.008	0.037	0.830
Professional/proprietor	0.034	0.015	0.024	0.003	0.018	0.856
Artisan	0.021	0.015	0.178	−0.001	0.024	0.963
Laborer	0.035	0.021	0.104	0.006	0.033	0.861
Variable: Other Wound						
Farmer	−0.014	0.017	0.432	0.005	0.033	0.891
Professional/proprietor	−0.019	0.013	0.138	−0.012	0.021	0.585
Artisan	−0.000	0.013	0.988	−0.009	0.022	0.674
Laborer	0.033	0.016	0.036	0.016	0.032	0.606
Variable: On pension in 1880						
Farmer	0.040	0.020	0.045	0.016	0.029	0.570
Professional/proprietor	0.004	0.011	0.744	0.004	0.015	0.770
Artisan	−0.021	0.014	0.144	−0.046	0.025	0.071
Laborer	−0.022	0.017	0.182	0.024	0.028	0.368
Variable: Logarithm father’s real estate wealth						
Farmer	0.006	0.002	0.001	0.002	0.005	0.667
Professional/proprietor	0.002	0.001	0.200	0.007	0.004	0.040
Artisan	0.000	0.001	0.788	−0.002	0.004	0.479
Laborer	−0.008	0.002	0.000	−0.007	0.004	0.126
Variable: Logarithm father’s personal property wealth						
Farmer	0.036	0.011	0.001	0.021	0.045	0.646
Professional/proprietor	0.022	0.006	0.001	−0.027	0.015	0.084
Artisan	−0.021	0.008	0.005	0.040	0.024	0.091
Laborer	−0.037	0.010	0.000	−0.034	0.046	0.457

Marginals estimated from the multinomial logit model in Equation 1. The sample consists of 4,213 veterans less than age 30 at the end of the war and 1,398 veterans age 30 or older at the end of the war. Standard errors are clustered on the company. Additional control variables include the veteran’s age at the end of the war, his occupational class at enlistment, enlistment year dummies, a dummy indicator for a city of 50,000 or more, and dummies indicating that wealth information is unknown. Standard errors are clustered at the company level.

Table 6:

Wounds and Change in Total Median 1870 Wealth Holdings (Quantile Regressions)

	< 30 yrs at end war			≥ 30 yrs at end war		
	β	$\hat{\sigma}$	p	β	$\hat{\sigma}$	p
Dependent variable: log(total wealth)						
With pre-war controls only						
Dummy=1 if						
severe wound	−0.203	0.183	0.268	−0.368	0.178	0.039
other wound	−0.278	0.135	0.040	−0.222	0.166	0.183
Plus control for pension in 1870						
Dummy=1 if						
severe wound	−0.190	0.181	0.292	−0.409	0.171	0.017
other wound	−0.256	0.111	0.021	−0.278	0.165	0.092
Plus control for farmer in 1870						
Dummy=1 if						
severe wound	−0.091	0.131	0.490	−0.462	0.129	0.000
other wound	−0.121	0.125	0.334	−0.252	0.163	0.122
Plus control for company injury death rate						
Dummy=1 if						
severe wound	0.029	0.199	0.885	−0.439	0.147	0.003
other wound	−0.127	0.133	0.339	−0.193	0.159	0.226

Estimated from the median quantile regressions in Equation 2. The additional independent variables are age at the end of the war, occupational class at enlistment, dummy variables for enlistment year, a dummy variable indicating if enlistment was in a city of 50,000 or more, the logarithm of paternal real estate wealth, the logarithm of paternal personal property wealth, and dummy indicators if paternal wealth information was missing. The sample consists of 3,731 veterans less than age 30 at the end of the war and 1,345 veterans age 30 or older at the end of the war.

Table 7:

Paternal Wounds and Change in Occupational Class Probability of Daughters' Husbands and of Sons (Marginals), Father Less than Age 30 at the End of the War

	Daughters' Husbands			Sons		
	$\frac{\partial Y}{\partial x}$	$\hat{\sigma}$	*p*	$\frac{\partial Y}{\partial x}$	$\hat{\sigma}$	*p*
No Paternal Post-War SES Controls						
Severe wound						
Farmer	−0.084	0.032	0.008	−0.002	0.026	0.934
Professional/Proprietor	0.019	0.025	0.459	−0.015	0.023	0.533
Artisan	−0.006	0.023	0.791	−0.008	0.022	0.719
Laborer	0.072	0.024	0.003	0.025	0.025	0.327
Other wound on						
Farmer	−0.007	0.022	0.751	0.010	0.019	0.614
Professional/Proprietor	−0.012	0.018	0.522	−0.014	0.018	0.432
Artisan	0.021	0.015	0.173	0.010	0.015	0.501
Laborer	−0.002	0.019	0.906	−0.006	0.018	0.750
With Paternal Post-War SES Controls						
Severe wound						
Farmer	−0.077	0.030	0.009	0.010	0.024	0.697
Professional/Proprietor	0.012	0.025	0.628	−0.023	0.023	0.308
Artisan	−0.007	0.023	0.758	−0.010	0.021	0.654
Laborer	0.072	0.024	0.002	0.023	0.024	0.329
Other wound						
Farmer	−0.004	0.021	0.832	0.014	0.018	0.435
Professional/Proprietor	−0.006	0.017	0.722	−0.009	0.017	0.612
Artisan	0.016	0.015	0.278	0.007	0.014	0.638
Laborer	−0.005	0.019	0.772	−0.012	0.018	0.486

Marginals are estimated from the multinomial logit model in Equation 3. The dependent variable is either the occupational class of the daughters' husbands or the sons. The samples consists of the 3,665 daughters who were married in the 1910 census and whose husbands had an occupation and 4,366 sons who were married in the 1910 census and had an occupation. The standard errors are clustered on the family. The regressions control for birth year and paternal enlistment characteristics (occupational class, enlistment year dummies, and a dummy if the city population size was 50,000 or more). The paternal post-war ses controls consist of the logarithm of total paternal wealth in 1870, paternal occupational class in 1880, and the number of siblings.

Table 8:

Paternal Wounds and Change in Occupational Class Probabilities of Daughters' Husbands and of Sons (Marginals), Father Greater than Age 30 at the End of the War

	Daughters' Husbands			Sons		
	$\frac{\partial Y}{\partial x}$	$\hat{\sigma}$	***p***	$\frac{\partial Y}{\partial x}$	$\hat{\sigma}$	***p***
No Paternal Post-War SES Controls						
Severe wound						
Farmer	0.014	0.059	0.817	−0.127	0.058	0.028
Professional/Proprietor	−0.032	0.052	0.535	−0.046	0.044	0.301
Artisan	0.030	0.042	0.479	0.055	0.039	0.155
Laborer	−0.011	0.049	0.816	0.118	0.048	0.015
Other wound						
Farmer	−0.027	0.050	0.586	−0.049	0.044	0.269
Professional/Proprietor	−0.012	0.042	0.782	−0.040	0.033	0.226
Artisan	0.010	0.038	0.791	0.021	0.033	0.514
Laborer	0.029	0.044	0.510	0.068	0.038	0.075
With Paternal Post-War SES Controls						
Severe wound						
Farmer	0.039	0.061	0.527	−0.094	0.053	0.074
Professional/Proprietor	−0.052	0.052	0.317	−0.047	0.043	0.277
Artisan	0.032	0.041	0.447	0.034	0.036	0.344
Laborer	−0.018	0.048	0.702	0.108	0.045	0.016
Other wound						
Farmer	−0.008	0.049	0.873	0.036	0.043	0.406
Professional/Proprietor	−0.027	0.041	0.510	−0.031	0.040	0.430
Artisan	0.012	0.039	0.749	0.019	0.034	0.582
Laborer	0.022	0.044	0.611	−0.023	0.043	0.591

Marginals are estimated from the multinomial logit model in Equation 3. The dependent variable is either the occupational class of the daughters' husbands or the sons. The samples consists of the 761 daughters who were married in the 1910 census and whose husbands had an occupation and 1,019 sons who were married in the 1910 census and had an occupation. The standard errors are clustered on the family. The regressions control for birth year and paternal enlistment characteristics (occupational class, enlistment year dummies, and a dummy if the city population size was 50,000 or more). The paternal post-war ses controls consist of the logarithm of total paternal wealth in 1870, paternal occupational class in 1880, and the number of siblings.

Table 9:

Hazard Ratios of Mortality by Paternal Wound Status

	Daughters					Sons				
	e^{β}	$\hat{\sigma}$	$p > \|z\|$	χ^2	Pr > χ^2	e^{β}	$\hat{\sigma}$	$p > \|z\|$	χ^2	Pr > χ^2
Father < 30Y at end war										
No controls for 1910 occupation										
Severe wound	1.053	0.060	0.361			1.095	0.062	0.112		
Other wound	0.942	0.040	0.157			1.002	0.042	0.971		
Test of equality severe and other wound				3.32	0.069				2.07	0.150
Test of proportional hazards assumption				15.70	0.868				31.98	0.101
Stratifying on 1910 occupation										
Severe wound	1.048	0.059	0.400			1.085	0.063	0.159		
Other wound	0.939	0.040	0.136			1.004	0.042	0.925		
Test of equality severe and other wound				3.30	0.069				1.54	0.215
Test of proportional hazards assumption				15.61	0.871				29.12	0.176
Father ≥ 30Y at end war										
No controls for 1910 occupation										
Severe wound	1.311	0.144	0.014			1.137	0.117	0.214		
Other wound	0.870	0.087	0.162			1.044	0.085	0.598		
Test of equality severe and other wound				9.33	0.002				0.53	0.467
Test of proportional hazards assumption				26.72	0.268				18.85	0.710
Stratifying on 1910 occupation										
Severe wound	1.322	0.147	0.012			1.130	0.116	0.234		
Other wound	0.873	0.085	0.164			1.043	0.085	0.609		
Test of equality severe and other wound				10.56	0.001				0.48	0.491
Test of proportional hazards assumption				26.09	0.297				16.68	0.825

Estimated from the Cox proportional hazard model in Equation 4. The dependent variables is the number of years lived after age 45. Standard errors are clustered on the family. All specifications control for birth year, paternal enlistment characteristics (occupational class, enlistment year dummies, a dummmy indicator if city population was 50,000 or more), paternal post-war characteristics (occupational class in 1880, the logarithm of total wealth in 1870), the number of siblings, and husband's occupational class in 1910. The samples consists of 3,665 daughters and 3,809 sons of fathers who were less than age 30 at the end of the war and 761 daughters and 895 sons of fathers who were age 30 or older at the end of the war. The proportional hazards assumption is tested on the basis of the Schoenfeld residual using a $\chi^2(23)$ test.

Table 10:

Hazard Ratios of Mortality by Paternal Wound and ex-POW Status and by Age at End of War

	Daughters			Sons		
Wounds						
Father < 22 at end war						
Severe wound	1.003	0.111	0.980	1.036	0.123	0.766
Other wound	1.034	0.088	0.694	1.084	0.077	0.256
Father age 22–29 at end war						
Severe wound	1.062	0.070	0.363	1.081	0.072	0.381
Other wound	0.905	0.045	0.045	0.966	0.050	0.511
Father ≥ 30 at end war						
Other wound	1.322	0.147	0.012	1.130	0.116	0.234
Severe wound	0.873	0.085	0.164	1.043	0.085	0.609
Ex-POW Status						
Father < 22 at end war						
Severe POW hardship	1.057	0.107	0.584	1.454	0.142	0.000
Less severe POW hardship	0.956	0.092	0.641	1.199	0.098	0.026
Father age 22–29 at end war						
Severe POW hardship	1.057	0.107	0.584	0.130	0.074	0.062
Less severe POW hardship	0.956	0.092	0.641	1.025	0.065	0.696
Father ≥ 30 at end war						
Severe POW hardship	1.016	0.171	0.926	1.107	0.173	0.515
Less severe POW hardship	1.114	0.193	0.535	1.176	0.129	0.141

The regressions for wounds are estimated using the Cox proportional hazards model in Equation 4. The regressions for POW hardship are estimated using a Cox proportional hazards model and the data in Costa et al. (2018). Both regressions examine mortality after age 45. The samples are all children who were married in the 1910 census, for whom we have own or spouse's occupation, and who survived to age 45.

Table 11:

Linkage Rates to Census and Death Information for Veterans (Survived to 1900) and their Children Born After 1866

	Veterans Living in Census Year	Children	
		Not Known to be Dead	Alive, Year of Death Known
Death records	99.9	73.7	100.0
Census (born before census)			
1850	75.0		
1860	78.2		
1870	83.6	78.0	79.7
1880	95.2	88.9	93.0
1900	95.6	78.8	89.4
1910	96.0	73.4	88.0
1920	92.4	70.9	88.0
1930	94.5	68.6	88.3
1940	62.5	60.3	83.2

Both children known to be alive and children with missing death dates are included in “Not Known to be Dead.” Children “Not Known to be Dead” were searched for in all censuses. The higher linkage rates for those known to be alive suggest that many children with missing death dates were probably dead.

Table 12:

Impact of Wounds on Probability of Having Any Children and on Number of Children, Marginal Effects, Not Married Before the War

	Any Children			Number of Children		
	$\frac{\partial Y}{\partial x}$	$\hat{\sigma}$	***p***	$\frac{\partial Y}{\partial x}$	$\hat{\sigma}$	***p***
Dummy=1 if						
wounded	−0.019	0.010	0.066	−0.251	0.101	0.012
discharged disability	−0.001	0.011	0.944	−0.214	0.111	0.054
on the pension rolls	0.025	0.011	0.020	0.048	0.115	0.678

Marriages known to have occurred during or prior to the war are excluded, yielding 6,172 observations for everyone and 5,138 observatons where veterans had children. The probability of having a child was 0.883. Those with children had a mean number of 5 children. Additional control variables were age at the end of the war, indicator variables for father's US birth and Irish birth, occupational class at enlistment, enlistment year dummies, and a dummy for enlistment in a city of over 50,000. Standard errors are clustered at the company level.

Table 13:

Wounds and Father-In-Law's Wealth, Post-War First Marriages

Dependent Variable:	**Father-In-Law's Personal Property Wealth in 1860**								
	25th Quantile			**50th Quantile**			**75th Quantile**		
	$\boldsymbol{\beta}$	$\hat{\sigma}$	***p***	$\boldsymbol{\beta}$	$\hat{\sigma}$	***p***	$\boldsymbol{\beta}$	$\hat{\sigma}$	***p***
Specification 1									
Dummy=1 if									
wounded	−0.173	0.108	0.109	−0.223	0.075	0.003	−0.194	0.072	0.007
discharged disability	0.009	0.126	0.942	0.000	0.089	1.000	0.061	0.084	0.471
Specification 3									
Dummy=1 if									
wounded	−0.118	0.105	0.261	−0.140	0.081	0.084	−0.186	0.078	0.018
discharged disability	0.053	0.121	0.664	0.068	0.094	0.471	0.046	0.091	0.617
on pension in 1870	−0.288	0.166	0.084	−0.243	0.128	0.058	−0.175	0.125	0.162

Marriages known to have occurred during or prior to the war are excluded. The sample is restricted to those with information on father-in-law's wealth yielding 1,130 observations. Additional control variables in all three specifications were enlistment year dummies, dummies for occupational class at enlistment, age at the end of the war, and a dummy for enlistment in a city of 50,000 or more.