DISCUSSION PAPER SERIES

IZA DP No. 2668

The Effect of Pensions on Longevity: Evidence from Union Army Veterans

Martin Salm

March 2007

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

The Effect of Pensions on Longevity: Evidence from Union Army Veterans

Martin Salm
MEA, University of Mannheim
and IZA

Discussion Paper No. 2668
March 2007

IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

IZA Discussion Paper No. 2668
March 2007

ABSTRACT

The Effect of Pensions on Longevity: Evidence from Union Army Veterans*

This study uses changes in pension laws for Union Army veterans as a natural experiment to estimate the causal effect of pensions on longevity, and to examine potential pathways underlying such a relationship. We examine the effects of the pension laws of 1907 and 1912, which granted old-age pensions to Union Army veterans. Life expectancy for veterans, who received such a pension, increased by 0.5 years and 2.7 years, respectively. The effect of veteran pensions on longevity was large across wealth groups and size of city. Pensions reduced mortality for both acute and non-acute causes of death.

JEL Classification: I12, J14, N41

Keywords: health gradient, pensions, mortality, Union Army veterans

Corresponding author:

Martin Salm
MEA
University of Mannheim
L13, 17
68131 Mannheim
Germany
E-mail: salm@mea.uni-mannheim.de

* I owe many thanks to Frank Sloan for numerous valuable suggestions. I also thank Axel Börsch-Supan, Hendrik Jürges, Jürgen Maurer, Alessandro Tarozzi, Hans Martin von Gaudecker, and seminar participants at the University of Mannheim for many helpful comments.

1. Introduction

Individuals with higher incomes tend to live longer (see surveys by Goldman 2001, Cutler, Deaton and Lleras-Muney 2006). This relationship is well documented not only for individuals with different incomes in the same country (Rogot, Sorlie, Johannson, and Schmitt 1992, Gaudecker and Scholz 2006), but it is also evident for average life expectancy across countries (Pritchett and Summers 1996) and across different time periods (Fogel 2004). However, the relationship between income and longevity is complex and multi-facetted. Not only is it possible that higher income extends life, but it is also possible that better health increases income (Smith 1999, Stewart 2001).

This study uses the passing of pension laws for Union Army veterans in the early 20th century as a natural experiment to examine the causal effect of pensions on longevity. Veteran pensions constituted the first large-scale old-age pension system in the United States. For some periods, pensions for Union Army veterans amounted to more than 40% of federal expenditures and covered more than 900,000 beneficiaries (Sanders 2000). We use longitudinal data from military and pension records which were collected from records housed in the national archives (ICSPR Series 6837), and information from the U.S. Federal Census in 1900 (ICSPR Series 6836). We examine the effects of the pension laws of 1907 and 1912, which granted pensions to all Union Army veterans, who had served in the army for a minimum of 90 days and were age 62+. The effect of pensions on longevity are examined separately by wealth levels, and for urban vs. rural populations, and we also investigate the effect of pensions on different causes of death. This approach allows us to explore not only the direction of causality for a possible effect

from income to longevity, but also to examine the size of the effect, and learn more about the relevance and relative importance of different pathways in the health-income relationship.

Several potential pathways for a causal effect from income to health have been debated in the previous literature. McKeown (1976) and Fogel (2004) argue that much of the increase in life expectancy during the past two centuries is caused by improved nutrition. Pensions might have enabled Union Army veterans to buy more and higher quality food, which made them more resistant against infectious diseases. Malnourishment is a rare problem in developed countries today, but poor nutrition is still a concern in many developing countries (Cutler, Deaton, and Lleras-Muney 2006). Another explanation for health differentials focuses on the psychosocial stress, which comes from low socioeconimic status and lack of control over one's life (Brunner and Marmot 1999). Such stress may cause biological reactions that increase the risk of chronic diseases, especially cardiovascular diseases. This theory is supported by evidence from British Civil Servants, for whom there is a strong association between health and rank in the British Civil Service (Marmot et al. 1991), and from other primates such as baboons, for whom there exists a relationship between low rank in the baboon hierarchy and increased risk of cardiovascular disease (Sapolsky 1993, 1998). A third possible explanations for a causal effect from pensions on longevity focuses on health behaviors. Philipson and Becker (1998) argue that annuities such as lifelong veteran pensions provide incentives for beneficiaries to invest in their health and live longer. A fourth possible explanation for a causal effect of pensions on longevity centers on labor supply.

Beneficiaries of a pension can afford to work less, which might improve their health (Ruhm 2000).

An important question, which has not been conclusively answered in the previous literature, is how redistributive government policies such as disability pensions or old-age pensions affect the health and longevity of beneficiaries. Previous studies on the effect of pensions on mortality arrive at opposite conclusions. Snyder and Evans (2006) use the Social Security notch in the 1970s as a source of exogenous income variation, and they find that lower pensions actually decrease mortality. Given the positive correlation between health and income, this finding is somewhat surprising. In contrast, in a study based on Union Army veterans, Logue and Blanck (2004) find that mortality rates were lower for veterans who received higher pensions. However, their estimation is based on time-invariant variables for the average pension amount, which each veteran received in the period between 1874 and 1890, and in the period between 1891 and 1907. Since pensions became more generous over time, average pensions are likely to be higher for veterans who survived longer. Also, during their study period the amount of pension depended on the degree of disability and was therefore not exogenous to health and mortality. To circumvent such endogeneity issues, our study examines the effect of old-age pensions, which did not depend on health.

Using Weibull hazard regression models, we find a large causal effect from veteran pensions on longevity. Life expectancy increases by about 0.5 years and 2.7 years for veterans who receive a law of 1907 pension and a law of 1912 pension, respectively. We find evidence for large causal effects across wealth groups and for both urban and rural populations, but the effects are largest for poorer veterans and veterans who live

outside big cities. Pensions also reduce mortality from both acute and non-acute causes. This study continues as follows. Section 2 describes the Union Army pension laws. Section 3 presents the data. Section 4 specifies the empirical model. Hazard regression results are presented in section 5. Results for the effect of pensions on life expectancy are explained in section 6. Section 7 shows estimation result for the effect of pensions on various causes of death, and section 8 concludes.

2. Union Army pension laws

The Union army pension program started with the General Law of July 14, 1862, which granted pensions to volunteer soldiers with war-related disabilities. The size of the pension depended on the severity of the disability. Subsequently, both the amount of pensions and the number of eligible veterans were increased in several stages (see overview in Table 1).[1] The Disability Act of June 27, 1890 introduced a new pension rating system that co-existed with provisions of the General Law. The Disability Act granted pensions to disabled Union Army veterans who had served for a minimum of 90 days and were unable to earn support by manual labor. Monthly pensions ranged from $6 to $12, depending on the degree of disability. Disability Act pensions were typically smaller than General Law pensions, which ranged to $125 monthly, but eligibility requirements were much less stringent, since disabilities no longer needed to be war-related.

The Union Army pension scheme was further expanded on February 6, 1907, when pensions were granted to all veterans age 62+ who had served for a minimum of 90

[1] Detailed descriptions of the Union army pension schemes are presented by Sanders (2000), Linares (2001), and Campbell (2004).

days. The monthly pension depended on age and was $12 for veterans aged 62 – 69, $15 for veterans aged 70 – 74, and $20 for veterans aged 75+. The law of May 11, 1912, further increased pensions, based on a rating system that depended both on age and the length of service. Monthly pensions now ranged from $13.50 to $30. In our analysis sample, mean monthly pensions based on the 1907 and 1912 laws were $14.50 and $20.92, respectively.

These pensions were generous by the standards of their time when mean monthly earnings for non-farm employees were $40.25 in 1900 (Lebergott 1984). Public expenditures on Union army pensions constituted substantial shares of the federal budget in the late 1800s and early 1900s--41% in 1893 and 24% in 1909 (Sanders 2000). One explanation for these large allocations on behalf of Union Army veterans was the political power of the Great Army of the Republic, a veterans´ organization, which yielded an influence that was disproportionate to the number of Union Army veterans in the population (Holcombe 1999, Linares 2001). Veterans of the Confederate Army were ineligible for federal pensions.

This study examines how enactment of the laws of 1907 and 1912 affected mortality rates for veterans who received pensions based on these laws. We focus on the impact of these later pension laws, because they did not link pensions to disability, and veterans who qualified for pensions under these laws were therefore not selected on health. Many of the law of 1907 pensioners already received a disability act pension before 1907[2]. However, after 1907 most disability act pensioners switched to the law of 1907 pension system, which had less restrictive eligibility requirements and provided

[2] Disability Act pensions were awarded generously. In 1904, President Roosevelt issued an executive order to grant pensions to all veterans age 62+, unless they were unusually vigorous (Costa 1998, p. 201). However, this was still a selection on health, which ended only after the law of 1907 was passed.

higher pensions. The size of the increase for the individual veteran depended on the veteran's age and previous pension. The law of 1912 also substantially increased pensions. The magnitude of the increase for the individual veteran depended on his age, and length of military service.

3. Data

We use longitudinal data on Union Army recruits, which are based on two sources of information. The first source is a dataset on Military, Pensions, and Medical Records (ICSPR Series 6837), assembled from military-related documents housed in the National Archives in Washington, DC, and which also includes applications made by veterans for pension support. The second source comes from U.S. Census Records in 1900 for all veterans who could be linked to Census documents (ICSPR Series 6836). Our analysis focuses on the period 1900-17. This period contains the passing of the laws of 1907 and 1912. Our observational period starts in 1900 because of the availability of matched Census data for this year, and ends in 1917, just before the outbreak of the flu pandemic of 1918.

Our sample includes recruits from 303 companies randomly selected among white volunteer infantry regiments by the University of Chicago, Center for Population Economics, the organization which assembled the data. This sample includes 22,051 veterans with non-missing information on dates of birth and death. Information on birth dates were collected from military, pension, and Census records. Information on death dates were assembled from pension files. Eighty-five percent of soldiers who survived the war have a pension file, because either the veteran or his dependents applied for a

pension (Costa 1998). Of the veterans without pension files, many were ineligible for a pension, i.e. because of desertion, or they died before 1890, when the veteran pension system was still very restrictive (Fogel 1993). We restrict our sample to 7,931 veterans who were alive at the beginning of 1900, and who did not receive a General Law pension for war-related disabilities. General Law pensions were typically higher than pensions under the laws of 1907 and 1912, so that most General Law pensioners had no incentive to apply for law of 1907 pensions or law of 1912 pensions. Our sample consists of veterans, who at the start of our study period in 1900 either received no pension or a disability act pension.

The data include detailed information on veterans' pension applications and the pension board's rulings. This includes information on the law that the application was based on, whether the pension board approved or rejected an application, and the date from which pension payment started. We create two binary time-varying variables, which are set to one if a veteran received a pension at the end of the year based on the law of 1907 or 1912, respectively. For example, for a typical veteran who received a disability act pension from 1900 to 1906, a law of 1907 pension from 1907 to 1911, and a law of 1912 pension from 1912 to 1917, the law of 1907 pension variable is set to zero for the period from 1900 to 1906; it is set to one for the period from 1907 to 1911, and the variable takes on the value zero again for the period from 1912 to 1917. Correspondingly, the variable for receiving a law of 1912 pension is zero for the period from 1900 to 1911, and it is one for the period from 1912 to 1917. In 1907, some veterans already received a Disability Act pension of $12 monthly, and had no incentive to apply for an equivalent $12 monthly act of 1907 pension. Starting from 1907, these veterans are counted among

those who receive a law of 1907 pension. The take up rate was 90.9% for the law of 1907 and 91.5% for the law of 1912 (Table 2). Take up rates are defined as the share of veterans in the sample who survive beyond 1907 or 1912, respectively, and who at some point of time receive a pension based on the relevant law. One potential concern is that take-up could be related to veterans' health. It is possible that some veterans were too sick to undertake the hassle of applying for a pension. But it is also possible that our reported take up rates are too low, because some pension records were lost or misplaced, or because some veterans in our sample were in fact not eligible for a pension, i.e. because they served for less than 90 days[3]. As a plausibility test, in analysis not shown we regressed a binary take-up variable on the observed characteristics listed in table 3. For the law of 1907, pension take-up was more likely for veterans who were farmers or service workers, and less likely for veterans who lived in cities with a population > 250,000. For the law of 1912, all explanatory variables were jointly insignificant in explaining pension take up. 5.8% of veterans, who survived beyond 1907, were rejected with at least one application for a law of 1907 pension (Table 2). The equivalent rejection rate for law of 1912 pensions was 3.4%. However, most applicants finally received a pension. Only 0.6% of veterans, who survived beyond 1907, applied for a law of 1907 pension at least once and never received such a pension. For law of 1912 pensions, the equivalent share was 0.4%.

We also control for individual veteran attributes that plausibly affect longevity, specified as a set of time-invariant binary variables based on 1900 Census data: literacy

[3] Our dataset includes a variable for pensionable length of service. We exclude four veterans from the sample, for whom we know that pensionable length of service was less than 90 days. However, this information is missing for 64.1% of the sample. Veterans with missing information on pensionable length of service were included in the sample.

(literate versus illiterate); marital status (married versus not married), occupation (classification following Wilcox (1992), with professional or proprietor as omitted category), home ownership (homeowner versus renter), and city size (using most 158 populated cities in 1909—top 19 (>250,000 population), next 139 cities (26,235-250,000 population), omitted category (population <26,235) (U. S. Census Bureau 1909). We use literacy as an approximation of education and homeownership as an approximation of wealth. Census records were linked to veterans' pension files based on name and place of residence (Fogel 1993). However, pension records were not available or not complete for all veterans. The share of missing observations ranged from 19.5% for marital status to 65.8% for place of residence. In order to account for missing observations, we create binary variables for missing information on literacy, marital status, occupation, homeownership, and population of place of residence.

The mean age in 1900 in our baseline estimation sample was 60.7 years (Table 3). The mean age at death was 75.9 years. Of those veterans with non-missing observations, 93.8% were literate and 81.7% were married. Most common occupation groups were farmers (34.9%), and artisans (15.1%). 67.6% were homeowners, 14% lived in cities with more than 250,000 populations and an additional 10.5% lived in the next 139 most populated cities.

4. Empirical Specification

We estimate a mortality hazard model, assuming a Weibull distribution and allowing for unobserved heterogeneity.[4] The mortality hazard is the risk of dying during the next period conditional on surviving until the end of the previous period. This represents for

[4] Lancaster (1990) provides an excellent review of the estimation of duration models.

example the risk of a 65 year old veteran of dying during the next year. The mortality hazard function for individual *i* at time *t* is:

$$\lambda(t) = \lambda_0(t)*exp(law1907_{it}\,\beta + law1912_{it}\,\gamma + X_i'\,\theta)*\eta_i,$$

where $\lambda_0(t) = \alpha * t^{\alpha-1}$ is the baseline hazard for the Weibull distribution with the shape parameter α, and $exp(law1907_{it}\,\beta + law1912_{it}\,\gamma + X_i'\,\theta)$ is the proportional hazard with parameters β, γ, and θ. $law1907_{it}$ and $law1912_{it}$ are time-varying binary variables which take on the value of one, if individual *i* at the end of period *t* receives a pension based on the law of 1907 or the law of 1912, respectively. For periods, in which veterans receive a law of 1907 pension, the corresponding pension variable is set to one, and for periods, in which veterans do not receive a law of 1907 pension, this variable is set to zero. X_i is a vector of individual-specific time-invariant covariates which control for individuals' initial literacy, marital status, occupation, wealth, and place of residence. This information does not vary over time, because it is not continuously observed. We account for individual-specific unobserved heterogeneity by including a multiplicative term η_i (>0), distributed as gamma with mean 1 and variance σ (see e.g., Lancaster 1979).[5] Time (*t*) represents the age of veterans. Time is left-censored. Veterans enter the observation period, which starts in 1900, at different ages. Age is accounted for through the shape of the baseline hazard function. There are no additional explanatory variables for age. Our observational period ends in 1917. Observations of Veterans who survived beyond 1917 are treated as right-censored.

[5] Three assumptions required to account for unobserved heterogeneity are: (1) the heterogeneity term is independent of the covariates; (2) the heterogeneity term has a distribution known up to some parameters; and (3) the heterogeneity term enters the hazard function multiplicatively. The mean also needs to be normalized to one for identification.

The estimation compares mortality hazards for veterans who receive a law of 1907 or a law of 1912 pension with mortality hazards for veterans who receive no such pensions. This comparison group includes observations for the time before the law of 1907 was passed as well as veterans who did not yet reach the pension age of 62 or did not take up a pension. The identification is based mostly on the comparison of mortality hazard rates for different time periods. Our identification strategy is illustrated in Figure 1. The drawn out line represents mortality risk at age 65 for Union Army veterans in our sample during the 1900-17 period. Before 1907, veterans received either no pension or a disability act pension. From 1907 to 1911, most 65 year old veterans received a law of 1907 pension, and from 1912 to 1917 most 65 year old veterans received a law of 1912 pension. The reduction in mortality after 1907, which is represented by arrow *a* in Figure 1, is attributed to law of 1907 pensions, and the further decrease in mortality risk after 1912, which is illustrated by arrow *b*, is attributed to law of 1912 pensions. One concern is that lower mortality in later years could be explained not by the effect of a pension, but by a time trend of increasing longevity. During our study period, there was no time trend in life expectancy at age 65 for males in the U.S. population overall (Table 4). Although male life expectancy at birth increased rapidly from 46.61 years in 1900 to 52.18 years in 1917, life expectancy at age 65 remained roughly constant; life expectancy for the total male U.S. population at age 65 was 11.35 years in 1900, 11.01 years in 1907, 11.49 years in 1912, and 11.22 years in 1917 (Bell and Miller 2005). During our study period there was also no time trend in life expectancy at age 65 for white males in northern states and for native-born white males in northern states[6]. In 1870, 52% of 25-29 year old men were

[6] Census records indicate that life expectancy in northern states at age 65 was 11.95 years in 1901 and 11.67 years in 1910 for white males, and 11.51 years in 1901 and 11.25 years for native-born white males

Civil War veterans (Campbell 2004)[7], and the Union Army veterans in our dataset are broadly representative for the general northern white population in terms of wealth before the war, and in terms of mortality around 1900 (Costa 1998, 2003). By eliminating General Law pensioners who received pensions because of war related disabilities, which were not common in the general population, our sample should arguably be even more representative of the overall white northern U.S. population. Therefore, any substantial reduction in mortality for veterans who received a law of 1907 or a law of 1912 pension can not be attributed to a time trend of rising longevity.

We compute estimates of the effect of pensions on life expectancy at age 65. Using results from our hazard estimation we compute predicted annual mortality rates for every veteran in our sample and for each year of age from age 65 to 99 under the counterfactual assumption that the pension laws of 1907 and 1912 were never enacted. We use these mortality rates to predict the life expectancy at age 65 for every veteran in the sample. Next, we compute an alternative set of predicted mortality rates under the equally counterfactual assumption that all veterans always received a law of 1907 pension. Based on the alternative mortality rates we predict life expectancy at age 65 for every veteran in the sample. The mean effect of a law of 1907 pension on life expectancy at age 65 is calculated as the difference between mean life expectancy with and without the 1907 pension law. We use a similar method to estimate the effect of law of 1912 pensions on the life expectancy of veterans at age 65.

(http://www.cdc.gov/nchs/data/lifetables/life1890-1910.pdf, accessed Feb 8, 2007). For 1919-1920, for white males in northern states only life expectancy at ages 62 and 67 is reported in Census records. For this group, in 1919-1920 life expectancy at age 67 was 10.56 years as opposed to 10.25 years in 1909-11 (http://www.cdc.gov/nchs/data/lifetables/life19-20.pdf, accessed Feb. 8, 2007).

[7] Since veterans comprised a significant share of the elderly male population, the effects of veteran pensions on life expectancy might show in population life expectancy. This could mean that in the absence of veteran pensions population life expectancy at age 65 might have declined.

5. Hazard regression results

Hazard regression results are shown in Table 5. Column 1 shows the baseline specification, which includes the full estimation sample. Coefficients show hazard ratios. A hazard ratio of one indicates that a variable has no effect on mortality. A hazard ratio of less than one indicates that a variable is associated with lower mortality. Estimated hazard ratios are 0.918 for veterans receiving a law of 1907 pension and 0.665 for veterans receiving a law of 1912 pension. These hazard ratios are significantly lower than one at the five percent level and one percent level, respectively. These findings indicate that there is a causal effect from receiving a pension to lower mortality. We find no significant effects of literacy, marital status, and occupation on mortality hazards. Mortality hazards for homeowners are significantly lower than for renters (hazard ratio = 0.816), and mortality for veterans who lived in cities with more than 250,000 inhabitants is significantly higher than mortality for veterans in small towns or country (hazard ratio = 1.227). Baseline mortality increases with age, as is indicated by the shape parameter of 8.22. In this specification as well as in all other specifications presented in this study, we find no evidence for unobserved heterogeneity; the estimated variance of the gamma distributed unobserved heterogeneity term is not significantly different from zero.

Columns 2 and 3 of Table 5 show estimates of the effect of pensions on mortality separately for the subgroup of homeowners and renters. We interpret homeownership as an approximation of wealth, assuming that homeowners were on average wealthier than renters. The size of the causal effect of income on health might well vary with different levels of wealth. For example, poor veterans might have been able to afford sufficient food only after receiving pensions, while their wealthier counterparts were already well

fed even before receiving a pension. If the marginal effect of income on longevity declines at higher wealth levels, then pensions should reduce mortality more for renters than for homeowners. This hypothesis is confirmed by our estimation results. The estimation results in column 2 show the same estimation specification as in column 1, but for the subsample of homeowners only. Column 3 shows estimation results for the subsample of renters. Hazard ratios for the two pension variables are lower for renters than for homeowners. For law of 1907 pensions, hazard ratios are 0.799 for renters and 0.995 for homeowners. The effect is statistically significant for renters, but not for homeowners. For law of 1912 pensions, hazard ratios are 0.610 for renters and 0.715 for homeowners. The effect is statistically significant for both groups. Homeowners for whom data on occupation are missing have lower mortality rates. All other coefficient estimates are not significantly different from one.

Columns 4 and 5 of Table 5 show estimation results for the effect of pensions on longevity separately for veterans who lived in the 158 largest cities (with a population > 26, 235) and veterans living in smaller towns or rural areas. During the early part of the 20th Century, mortality was higher in large cities than in smaller communities, a pattern that was already observed at the time (Glover 1921). Possible explanations are that the quality of food was lower in large cities, the effect of unsanitary conditions was larger, and spread of disease was easier in bigger, more crowded cities (Costa 2003, Cutler, Deaton and Lleras-Muney 2006). The estimation results in column 4 show the same estimation specification as in column 1, but for veterans who live in one of the largest 158 cities only. Column 5 shows estimation results for veterans who live outside the top 158 cities. The effects of pensions are less important in large cities than in towns or in the

countryside. For law of 1907 pensions, hazard ratios were 0.915 in the largest 158 cities, and 0.715 in smaller communities. Only the latter effect is statistically significant. For the law of 1912 pensions, hazard ratios are 0.716 in large cities and 0.589 in smaller communities. Both effects are statistically significant at the one percent level. These findings indicate that pensions had a bigger effect outside the biggest cities. One possible explanation is that pensions reduced mortality from some risk factors such as under-nutrition, but not from other risk factors such as poor water quality, and that exposure to risk factors, which were not affected by pensions, was larger in big cities. An alternative explanation could be that cost of living was higher in big cities so that in real terms pensions were smaller. Homeownership is negatively correlated with mortality in both regressions, but the negative relationship is stronger in cities. The hazard ratio for homeownership is 0.729 in larger cities and 0.837 in smaller communities. This might reflect that homeowners in big cities were on average wealthier than homeowners in smaller communities because of higher property prices. Parameter estimates for all other variables are not statistically different from one.

6. Life expectancy

Based on estimated mortality hazards, we calculate life expectancies at age 65, using the method described above.[8] Table 5 shows mean predicted life expectancies of veterans in the sample. Standard errors of mean life expectancies are calculated from 200 bootstrap repetitions. Mean predicted life expectancy at age 65 for the full sample is 11.13 years, which is close to the population mean life expectancy for men at age 65 of

[8] In results not shown, we also calculated life expectancies using a non-parametric Kaplan-Meir approach, which does not control for covariates other than pensions. We found that results were very similar for the law of 1912, but there was no significant effect for the law of 1907.

11.35 years in 1900 and 11.01 years in 1907 (see Table 4). With a law of 1907 pension, life expectancy increases to 11.68 years, and with a law of 1912 pension life expectancy is 13.83 years. Thus, the effect of a law of 1907 pension on life expectancy at age 65 is 0.53 years, and the effect of a law of 1912 pension on life expectancy at age 65 is 2.70 years. As discussed above, there was no time trend of increasing life expectancy at older ages during our study period, neither for the general population nor for the white northern male population, for which our sample is representative. This implies that higher life expectancy for veterans who receive a law of 1907 or a law of 1912 pension is attributable to pensions, not to time trends. A gain in life expectancy of 2.7 years is a very large effect for a policy measure. For comparison, the overall gain in male life-expectancy at age 65 during the 20th century was 4.56 years (Table 4). Thus, the effects of veteran pensions on life expectancy were equivalent to many decades worth of economic growth, and medical progress. However, it is not implausible that a change in the economic situation of veterans should have such a large impact on life expectancy. Van den Berg, Lindeboom, and Portrait (2006) find that being born during favorable business cycle conditions during the 19th century in the Netherlands increased life expectancy later in life by more than 2 years. Rablen and Oswald (2007) find that scientists who won a Nobel Prize during the first half of the 20th century lived about 2 years longer than their colleagues who had merely been nominated for a Noble prize, but never received the prize.

We also calculate life expectancy for all subgroups in Table 5. For homeowners, life expectancy at baseline is 11.98 years as compared to 10.05 years for veterans who did not own their home. This implies that wealthier veterans lived longer, as predicted by

the health gradient. Life expectancy for veterans living in cities with a population >26,235 is 10.07 years, while life expectancy in smaller communities is 10.66 years. This is in accordance with previous findings that during our study period life expectancy was lower in big cities (Glover 1921, Cutler, Deaton, and Lleras-Muney 2006). The effect of a pension on life expectancy is larger for renters than for homeowners. For renters the impact of a pension based on the laws of 1907 and 1912 are 1.44 and 3.26 years, respectively. For homeowners, the impact of a law of 1907 pension is 0.03 years and the impact of a law of 1912 pensions is 2.20 years. If homeownership is interpreted as an approximation of wealth, then the effect of pensions on longevity is stronger for poorer veterans, but there is still a large effect for the wealthier group. The impact of pensions on longevity is also larger in smaller communities than in large cities. In smaller communities, a law of 1907 pension increases life expectancy by 1.62 years, and a law of 1912 pension increases life expectancy by 3.38 years. The corresponding effects for veterans who lived in one of the biggest 158 cities is 0.53 years and 2.05 years.

7. Cause of death

As discussed in the introduction there are a number of potential pathways which could explain a large causal effect from pensions to longevity. Some of the pathways, which previous studies have emphasized as explanations for the health-income-gradient, such as early childhood conditions (Van den Berg, Lindeboom, and Portrait 2006) and education (Cuter, Deaton, and Lleras-Muney 2006) , do not apply here, because veteran pensions start only late in life. But this leaves a number of possible pathways, such as for example better nutrition, higher socioeconomic status, and less exposure to dangerous

working and living conditions. These pathways are likely to affect health in different ways. Our data includes information about the cause of death for veterans in our sample. This information can be used to draw inferences about the relevance of potential pathways. For example, better nourished people are less likely to succumb to infectious diseases. They resist most bacterial (though not viral) diseases better, and recover more rapidly and more often (McKeown 1976, Fogel 2004). Outside of economics the currently dominant theory is that poor health of low-income people is caused by psychosocial stress- the consequences of having low socioeconomic status and little control over one's life. This psychosocial stress causes biochemical reactions that lead to increased probabilities of chronic diseases, especially cardiovascular diseases (Brunner and Marmot 1999, Sapolsky 1993, 1998). Veteran pensions might have increased the social status of veterans in two ways. First, pensions provided higher income. Second, they also provided recognition of past patriotic service. Another possible pathway is that pensions allowed veterans to retire from work. Snyder and Evans (2006) argue that working at older ages actually decreases mortality, but working conditions were more dangerous in the past than they are today (Costa and Kahn 2004). Retirement from work could lead to a lower probability of fatal accidents, but also to a reduction in chronic diseases.

The data provide information on the cause of death for 47.8% of the veterans in the baseline sample in Table 5, Column 1. Veterans for whom cause of death is available tended to be those with remaining dependents who could claim widow or orphan pensions. Information about cause of death comes mostly from death certificates that were sent to the pension office by relatives of deceased veterans. Information about cause

of death in our data is very detailed and includes categories such as such as "struck by train (accidental)" and "struck by train (suicide)". Causes of death are grouped into eight categories, which follow broad ICD 9-CM code classes (Table 7). For the veterans in our sample with known death cause, the shares of causes of death by category are: infectious and parasitic diseases (6.9 %), diseases of the respiratory system (9.9%) , diarrhea (0.5 %), diseases of the circulatory system (29.2 %), cancer and neoplasms (5.5%), diseases of the genitourinary system (7.9 %), diseases of the digestive system (4.4%), accidents and violence (3.7%), and other (31.5 %)[9]. The total share of acute diseases is 17.4% (infectious and parasitic diseases, diseases of the respiratory system, diarrhea), and the share of non-acute diseases is 78.9% (diseases of the circulatory system, cancer and neoplasms, diseases of the genitourinary system, diseases of the digestive system, and other diseases). The frequency of death causes during our study period was different from today (Costa 2003, Cutler, Deaton, and Muney-Lleras 2006). Some of the most common causes of death a century ago are rare in developed countries today (e.g. death due to some infectious diseases such as tuberculosis or respiratory infections), while other causes of death are more common today (e.g., lung cancer). Overall, the share of people dying from infectious diseases has declined, while the share of people dying from chronic diseases, especially ischemic heart diseases and cancer, has increased (Costa 2003). The distribution of death causes in our data is more similar to developing countries than to developed countries today. In developing countries infectious diseases such as tuberculosis and respiratory infections are still a frequent cause of death (Cutler, Deaton, and Lleras-Muney 2006).

[9] Death causes that were grouped as other category include endocrine diseases, diseases of the blood and blood forming organs, diseases of the nervous system, diseases of the digestive system, diseases of the skin, diseases of the musculoskeletal system, and symptoms, signs and ill defined conditions.

We estimate separate mortality hazard models for different causes of death. Causes of death we examine are broad categories for all acute diseases, and for all non-acute diseases. We also estimate hazards for infectious and parasitic diseases only and diseases of the circulatory system[10]. We restrict the estimation sample to veterans with known cause of death. Estimation results are shown in Table 8. Column 1 shows the results for the risk of dying from all acute diseases. Observations for veterans who died for other reasons are right-censored at time of death. Otherwise, the estimation specification is as in the baseline hazard regression (Table 5, Column 1). The hazard ratio for dying of acute diseases is 0.83 for veterans who received a law of 1907 pension and 0.69 for a law of 1912 pension. These findings indicate that pensions reduce the risk of dying from acute diseases, but the effect is statistically significant only for law of 1912 pensions. The risk of dying from acute diseases is lower for literate veterans (hazard ratio = 0.689) and homeowners (hazard ratio = 0.749), and it is higher for artisans (hazard ratio = 1.583) and manual laborers (hazard ratio = 1.482). All other coefficients are not statistically significant. Column 2 shows estimation results for the risk of dying from infectious and parasitic diseases. The effect of pensions on the risk of dying from infectious and parasitic diseases is even stronger than for all acute diseases, with a hazard ratio of 0.611 for law of 1907 pensions, and 0.504 for law of 1912 pensions. These effects are statistically significant at the 5 percent level and one percent level, respectively. The shape parameter of 4.427 is noticeably lower than for all other specifications. For example, in the baseline specification (Table 5, Column 1) the shape parameter is 8.22. This indicates that the slope of the baseline hazard is less steep in age

[10] In results not shown, we also estimated hazard regressions fort the other death categories listed in table 8, but the results were often very imprecise due to small sample sizes.

for the risk of dying from infectious and parasitic diseases, than it is for other causes of death. Hazard regression results for the risk of dying from all non-acute diseases are shown in column 3. Hazard ratios are 0.909 for veterans who receive a law of 1907 and 0.687 for law of 1912 pensions. Only the latter effect is statistically significant. Homeowners face a lower risk of dying from acute diseases (hazard ratio = 0.831) and married veterans are more likely to die from non-acute diseases (hazard ratio = 1.737). Column 4 shows estimation results for the risk of dying from diseases of the circulatory system. Veterans who receive a law of 1907 pension are less likely to die from circulatory diseases (hazard ratio = 0.892), but the effect is not statistically significant. The hazard ratio for veterans with a law of 1912 pension is 0.769 which is significantly lower than one at the 10 percent level. The risk of dying from circulatory diseases is also lower for homeowners (hazard ratio = 0.735), and it is higher for married veterans (hazard ratio = 1.444).

In summary, we find that veteran pensions decrease mortality for a broad range of causes. These findings indicate that multiple pathways might play a role in explaining the effect of higher pensions on lower mortality. Our finding that pensions strongly reduce mortality from acute causes, especially from infectious diseases, is consistent with the hypothesis, advocated for example by McKeown (1976) and Fogel (2004), that better nutrition played an important role in historic mortality declines. However, we find that pensions also reduced mortality from circulatory diseases and other non-acute conditions. Possible explanations for lower mortality from circulatory diseases and other chronic conditions include improved socioeconomic status, changes in health behaviors or retirement from hazardous work conditions.

8. Conclusions

Changes in veteran pension laws provide us with a series of natural experiments, which allow estimating the causal effect of pensions on longevity. We study mortality patterns for Union Army veterans during the period from 1900 and 1917, and we examine the effects of the pension laws of 1907 and 1912, which introduced or substantially increased veteran pensions. Starting from 1907, every Union Army veteran with at least 90 days of service was entitled to a pension at age 62+. Using a Weibull hazard model, we find that veteran pensions decrease mortality considerably. Life-expectancy increases by about 0.5 years and 2.7 years for veterans who receive a law of 1907 pension and a law of 1912 pension, respectively. During our study period there was no increase in life expectancy for the overall elderly male population so that these effects can not be attributed to a time trend of increasing life expectancy. We find evidence for large causal effects from pensions to longevity across wealth groups and for both urban and rural populations, but the effects are largest for poorer veterans and for veterans who live outside big cities. Studying the effect of pensions on various causes of death allow us to draw inferences about the relative importance of alternative pathways in the income-health relationship. Pensions reduced mortality for both acute and non-acute diseases, indicating that multiple pathways might be important. Pensions had the biggest effect on lower mortality from infectious diseases. This finding is consistent with the explanation that better nutrition was an important pathway for an effect from veteran pensions on health. But pensions also reduced mortality from circulatory diseases and other non-acute conditions. These findings could be explained by the effect of improved socioeconomic status, changes in health behaviors, or retirement from dangerous working conditions.

The main policy conclusion of our findings is that government transfers such as veteran pensions can not only improve the quality of life for beneficiaries, but can also substantially extend their length of life. The effects of veteran pensions on life expectancy were equivalent to the effect of many decades worth of medical progress and economic growth. This relationship was already suspected by contemporaries. In 1889, General M. Trumball speculated that "nothing increases longevity like a pension" (Logue and Blanck 2004). One important question is whether conditions during our study period can in any way be compared with contemporary conditions. In many ways, health conditions in early 20th century America were more similar to developing countries today than to developed countries. For example, factors such as poor nutrition, mortality from infectious diseases, and hazardous working and living conditions were common in the United States during our study period. Such factors are less important in the United States today, but they are still an urgent concern in many developing countries. However, health inequalities have not become smaller since the days of Union Army veterans (Cutler, Deaton, and Lleras-Muney 2006), and the health-income gradient is not confined to the desperately poor and undernourished (Marmot et al. 1991). Other pathways from higher income to lower mortality, such as reduced psychosocial stress, are still likely to be relevant in contemporary rich countries.

Many important questions about the effect of pensions and other government transfers on the health of beneficiaries are still unresolved. One interesting question this study does not address is the relationship between the amount of pension and mortality. The amount of pension Union Army veterans receive depends on age and length of service, two factors that are not exogenous of health. Therefore we examine only the

effect of whether a veteran received a pension based on the laws of 1907 and 1912, but not the effect on mortality of how much pension veterans received. Also, if there is any substantial effect of government pensions on the health of beneficiaries, it is important to better understand the underlying pathways. The results of this study indicate that multiple pathways might be important. However, there are still many open questions about the relative importance of alternative explanations, which provide ample opportunities for future research.

References

Adams, P., M. Hurd, D. McFadden, A. Merrill, and T. Ribeiro (2003). Healthy, wealthy, and wise? Tests for direct causal paths between health and socioeconomic status, *Journal of Econometrics*, 112, 3 –56.

Brunner, E. and M. Marmot (1999). Social organization, stress, and health. in: Social determinants of health, edited by M. Marmot and R Wilkinson. Oxford University Press, 17 – 43.

Bell, F. and M. Miller (2005). Life tables for the United States Social Security area, 1900 – 2100. Social Security Administration, Actuarial Study No. 120.

Census (1909), General statistics of cities, report for the department of commerce.

Costa, D. (1998). The evolution of retirement: An American economic history, 1880 – 1990. University of Chicago Press.

Costa, D. (2003), Understanding mid-life and old age mortality declines: Evidence from Union Army veterans, *Journal of Econometrics*, 112, 175 – 192.

Costa, D. and M. Kahn (2004), Changes in the value of life, 1940 – 1980, *Journal of Risk and Uncertainty*, 29, 159 – 180.

Cutler, D., A. Deaton, and A. Lleras-Muney (2006). The determinants of mortality, *Journal of Economic Perspectives*, 20, 97-120.

Campbell, A. (2004). The invisible welfare state: establishing the phenomen of 20th century veteran benefits, *Journal of Political and Military Sociology*, 32, 249 – 267.

Fogel, R. (1993). New sources and new techniques for the study of secular trends in nutritional status, health, mortality, and the process of aging. *Historical Mehtods*, 26, 5 – 44.

Fogel, R. (2004). The escape from hunger and premature death, 1700 – 2100. Cambridge University Press.

Gaudecker, H. von, R. Scholz (2006). Lifetime earnings and life expectancy. University of Mannheim, MEA discussion paper 102 - 06.

Glover, J. (1921). United States life tables, 1890 – 1910, Department of Commerce, Bureau of the Census.

Goldman, N. (2001). Social inequalities in health: disentangling the underlying mechanisms. In: Weinstein, M., Hermalin, A. (Eds.), Strengthening the Dialogue between Epidemiology and Demography. Annals of the New York Academy of Sciences

Holcombe, R. (1999). Veteran interests and the transition to government growth, *Public Choice*, 99, 311 – 326.

Lancaster, T. (1979). Econometric methods for the duration of unemployment, *Econometrica*, 47, 939 – 956.

Lancaster, T. (1990). The econometric analysis of transition data. Cambridge University Press.

Lebergott, S. (1984). Americans. W. W. Norton and Co.

Linares, C. (2001), The Civil War pension law, University of Chicago CPE Working Paper 2001 – 6.

Logue, L. and P. Blanck (2004), "There is nothing that promotes longevity like a pension": Disability policy and mortality of civil war union army veterans, *Wake Forest Law Journal*, 39, 49 - 67

Marmot, M.. G. Smith, S. Stansfeld, C. Patel, F. North, J. Head, I. White, E. Brunner, and A. Feeney (1991). Health inequalities among British Civil Servants: The Whitehall II study, *Lancet*, 337, 1387 – 1393.

McKeown, T. (1976). The modern rise of population. Academic Press.

Philipson, T. and G. Becker (1998). Old-age longevity and mortality contingent claims, *Journal of Political Economy*, 106, 550 – 574.

Pritchett, L. and L. Summers (1996). Wealthier is healthier, *Journal of Human Resources*, 31, 841 - 868.

Rablen, M. and A. Oswald (2007). Mortality and immortality. IZA Bonn, Discussion Paper No. 2560.

Rogot, E., P. Sorlie, M. Johnson and C. Schmitt (1992). A mortality study of 1.3 million persons, Bethesda, MD. National Institutes of Health, National Heart, Lung, and Blood Instituite.

Ruhm, C. (2000). Are recessions good for your health? *Quarterly Journal of Economics,* 115, 617 – 650.

Sanders; M. (2000), History of the Civil War Pension Laws, mimeo, University of Chicago

Sapolsky, R. (1993). Endocrinology Alfresco: Psychoendocrine studies of wild baboons. *Recent Progress in Hormone Research,* 48. 437 – 468.

Saplolsky, R. (1998). Why zebras don't get ulcers: An updated guide to stress, stress-related diseases, and coping. Freeman.

Smith, J., 1999. Healthy bodies and thick wallets: the dual relation between health and economic status. *Journal of Economic Perspectives*, 13, 145–166.

Snyder, S. and W. Evans (2006). The effect of income on mortality: evidence from the social security notch. *Review of Economic and Statistics,* 88, 482 – 495.

Stewart, J. (2001), The impact of health status on the duration of unemployment spells and the implications for studies of the impact of unemployment on health status, *Journal of Health Economics*, 20, 781 –796.

Van den Berg, G., M. Lindeboom, and F. Portrait (2006). Economic conditions early in life and individual mortality, *American Economic Review,* 96, 290 – 302.

Wilcox N. (1992) A note on the occupational distribution of the urban United States in 1860, in Robert W. Fogel *et. al.* (eds.), *Without Consent or Contract: The Rise and Fall of American Slavery, vol. 2 Evidence and Methods.* W.W. Norton and Co.

Tables

Table 1: Overview of Union Army Pension Laws

Pension Law	Who was eligible?	Range of monthly pension	Average monthly Pension[1)]
General Law (since 1862)	Veterans with war related disabilities	$2 - $125	-[2)]
Disability Act (since 1890)	Veterans with disabilities, even if their origin was unrelated to war. The amount of pension depended on disability.	$6 - $12	$9.45
Act of 1907	Any veteran who has served 90 days or more and is over age 62. The amount of pension depended on age.	$12 - $20	$14.50
Act of 1912 (replaces act of 1907)	Any veteran who has served 90 days or more and is over age 62. The amount of pension depended on age and length of service.	$13 - $30	$20.92

[1)] For pension rulings in estimation sample in nominal U.S. dollars. For comparison: average monthly earnings for non-farm employees were $40.25 in 1900 (Lebergott 1984)

[2)] Veterans who received general law pensions are not included in estimation sample

Table 2: Take up and rejection rates (in %)

	Law of 1907 [1)]	Law of 1912 [2)]
Take up rate	90.9	91.5
Rejected at least once	5.8	3.4
Rejected and never approved	0.6	0.4

[1)] For sample of 6,087 veterans who survive beyond 1907

[2)] For sample of 4,617 veterans who survive beyond 1912

Table 3: Sample statistics

Variables[+]	Mean	Standard Deviation
Age in 1900	60.7	6.5
Age at death	75.9	8.7
Literate	0.938	0.433
Married	0.817	0.474
Occupation (professional or proprietor is omitted category)		
Farmer	0.349	0.400
Artisan	0.151	0.283
Service	0.075	0.203
Manual Labor	0.134	0.266
Farmhand	0.038	0.149
Unproductive	0.031	0.132
Homeowner	0.676	0.498
City pop > 250,000 in 1909	0.140	0.214
Next 139 cities in 1909	0.105	0.187
N	7931	

[+] Variables on being literate, marital status, occupation, homeowner status, and location are based on Census data for the year 1900. All shares are reported based on non-missing information for the respective variables. Information is missing for 20.2% of observations for being literate, 19.5% for marital status, 42.7% for occupation, 31.6% for homeowner status, and 65.8% for location.

Table 4: Population life expectancy for men by age and calendar year

Calendar Year	At Birth	Age 60	Age 65
1900	46.41	14.18	11.35
1907	48.29	13.69	11.01
1912	52.34	14.34	11.49
1917	52.18	14.11	11.22
2000	74.03	19.55	15.91

Source: Social Security Administration 2005, Table 10 in Actuarial Study No. 120 by F. Bell and M. Miller

Table 5: Mortality Hazard Regression, Period 1900 to 1917[+]

	Full Sample	Homeowner	Does not own home	Top 158 city in 1909	Smaller town or country
	(1)	(2)	(3)	(4)	(5)
Received pension based on law of 1907	0.918**	0.995	0.799**	0.915	0.765***
	(0.032)	(0.053)	(0.063)	(0.112)	(0.056)
Received pension based on law of 1912	0.665***	0.715***	0.610***	0.716**	0.589***
	(0.027)	(0.043)	(0.054)	(0.099)	(0.048)
Literate	0.993	0.874	1.063	1.824	1.052
	(0.069)	(0.088)	(0.130)	(0.665)	(0.149)
Literate missing	1.015	0.935	1.313	1.547	1.000
	(0.160)	(0.333)	(0.491)	(0.780)	(0.347)
Married	0.925	0.891	1.179	0.968	0.952
	(0.044)	(0.064)	(0.121)	(0.148)	(0.082)
Marital status missing	1.023	1.080	1.728	0.542	- [1)]
	(0.150)	(0.559)	(1.251)	(0.390)	
Occupation (professional or proprietor is omitted category)					
Farmer	0.988	0.919	0.944	1.482	0.930
	(0.061)	(0.072)	(0.120)	(0.517)	(0.114)
Artisan	1.103	1.022	1.193	1.046	1.113
	(0.074)	(0.097)	(0.135)	(0.155)	(0.113)
Service	1.198	1.017	1.279	1.146	1.110
	(0.096)	(0.134)	(0.181)	(0.222)	(0.159)
Manual Labor	1.079	0.957	1.103	0.912	1.137
	(0.077)	(0.104)	(0.129)	(0.174)	(0.123)
Farmhand	0.988	0.986	0.979	- [1)]	1.149
	(0.109)	(0.179)	(0.208)		(0.247)
Unproductive	1.010	0.872	1.428	1.140	0.870
	(0.110)	(0.126)	(0.322)	(0.343)	(0.150)
Occupation missing	1.002	0.839**	1.102	0.959	0.933
	(0.057)	(0.065)	(0.115)	(0.136)	(0.081)
Homeowner	0.816***			0.729***	0.837**
	(0.033)			(0.084)	(0.059)
Homeowner status missing	0.911			0.965	0.954
	(0.054)			(0.154)	(0.100)
City pop > 250,000 in 1909	1.227***	1.103	1.194		
	(0.090)	(0.147)	(0.127)		
Next 139 cities in 1909	1.071	1.026	1.170		
	(0.089)	(0.141)	(0.147)		
Location missing	1.010	0.996	1.070		
	(0.040)	(0.053)	(0.082)		
Shape parameter (α)	8.220***	9.064***	7.924***	8.798***	9.034***
	(0.156)	(0.246)	(0.340)	(0.570)	(0.331)
Variance of unobserved heterogeneity (σ)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	(0.0002)	(<0.0001)	(0.0001)	(0.0002)	(0.0002)
N	7,931	3,679	1,738	672	2,034

[+] Weibull hazard model, with gamma distributed heterogeneity term; Age is controlled for by initiating time at risk in the year of birth; time under observation starts in the year 1900. Whether veteran received a pension under law of 1907 (or 1912, respectively) is a time varying variable. All other covariates are fixed over time and are based on Census data for the year 1900. Estimation coefficients reflect hazard ratios; Standard errors in brackets.

* Significant at 10% level, ** significant at 5% level, *** significant at 1% level

[1)] Variable was omitted due to collinearity

Table 6: Life expectancy for Union Army veterans at age 65[+]

	Baseline	Pension based on law of 1907	Difference to baseline	Pension based on law of 1912	Difference to baseline
Full sample	11.13	11.68	0.53	13.83	2.70
	(0.23)	(0.25)	(0.28)	(0.26)	(0.35)
Homeowner	11.98	12.01	0.03	14.18	2.20
	(0.34)	(0.32)	(0.41)	(0.37)	(0.48)
Does not own home	10.05	11.49	1.44	13.31	3.26
	(0.57)	(0.63)	(0.66)	(0.63)	(0.77)
Top 158 city in 1909	10.07	10.60	0.53	12.12	2.05
	(0.90)	(0.99)	(1.19)	(0.84)	(1.24)
Smaller Town or country	10.66	12.32	1.62	14.04	3.38
	(0.45)	(0.53)	(0.54)	(0.58)	(0.71)

[+]Life expectancies are calculated based on hazard rates predicted from Weibull regression models in Table 4. Standard errors in brackets are based on 200 bootstrap repetitions

Table 7: Causes of death in sample (in %)

Variable	Period
	1900 – 1917
Proportion surviving	
Entire Sample	38.2
Proportion of deceased	
With cause of death	47.8
Cause of death (of all known causes)	
All acute	17.4
Infectious and parasitic diseases	6.9
Diseases of the respiratory system	9.9
Diarrhea	0.5
Not acute	78.9
Diseases of the circulatory system	29.2
Cancer and Neoplasm	5.5
Diseases of the genitourinary system	7.9
Diseases of the digestive system	4.4
Other[*]	31.5
Violence and accidents	3.7

*Other causes included endocrine diseases, diseases of the blood and blood forming organs, diseases of the nervous system, diseases of the skin, diseases of the musculoskeletal system, and symptoms, signs, and ill defined conditions.

Table 8: Mortality hazard regression, by cause of death

	All acute	Infectious and parasitic diseases	Not acute	Diseases of the circulatory system
	(1)	(2)	(3)	(4)
Received pension based on law of 1907	0.830	0.609**	0.909	0.892
	(0.106)	(0.131)	(0.055)	(0.102)
Received pension based on law of 1912	0.693**	0.519***	0.687***	0.760*
	(0.099)	(0.129)	(0.052)	(0.119)
Literate	0.689*	1.074	1.132	1.327
	(0.145)	(0.426)	(0.140)	(0.313)
Literate missing	0.847	1.3256	1.011	1.444
	(0.479)	(1.262)	(0.284)	(0.739)
Married	0.809	1.002	1.737***	1.444*
	(0.155)	(0.338)	(0.193)	(0.276)
Marital status missing	0.981	1.449	1.685*	1.340
	(0.542)	(1.335)	(0.458)	(0.639)
Occupation (professional or proprietor is omitted category)				
Farmer	0.979	0.994	0.969	0.918
	(0.225)	(0.355)	(0.097)	(0.165)
Artisan	1.583**	1.543	1.090	1.267
	(0.346)	(0.542)	(0.114)	(0.230)
Service	1.304	1.907	0.966	1.158
	(0.361)	(0.759)	(0.129)	(0.261)
Manual Labor	1.482*	1.516	0.927	1.113
	(0.341)	(0.562)	(0.106)	(0.216)
Farmhand	1.100	2.213	1.194	1.583*
	(0.419)	(1.065)	(0.202)	(0.441)
Unproductive	1.359	2.444	0.852	0.911
	(0.565)	(1.395)	(0.175)	(0.341)
Occupation missing	1.174	1.210	0.978	0.865
	(0.237)	(0.392)	(0.088)	(0.142)
Homeowner	0.749**	0.765	0.831***	0.735**
	(0.099)	(0.154)	(0.054)	(0.090)
Homeownership missing	0.707	0.476*	1.000	0.894
	(0.150)	(0.181)	(0.102)	(0.161)
City pop > 250,000 in 1909	1.420*	1.245	1.076	0.983
	(0.299)	(0.435)	(0.120)	(0.199)
Next 139 cities in 1909	0.726	0.819	0.920	0.893
	(0.222)	(0.388)	(0.122)	(0.210)
Location missing	0.945	1.176	0.896	0.952
	(0.129)	(0.255)	(0.058)	(0.110)
Shape parameter (α)	6.500***	4.427***	9.044***	9.084***
	(0.555)	(0.890)	(0.481)	(1.071)
Variance of unobserved heterogeneity (σ)	<0.0001	<0.0001	0.012	0.417
	(0.0014)	(0.016)	(0.079)	(0.592)
N	3,865	3,865	3,865	3,865

[+] Weibull hazard model, with gamma distributed heterogeneity term; Age is controlled for by initiating time at risk in the year of birth; time under observation starts in the year 1900. Veterans who died because of other causes are treated as censored. Whether veteran received a pension under law of 1907 (or 1912, respectively) is a time varying variable. All other covariates are fixed over time and refer to information in the year 1900. Estimation coefficients reflect hazard ratios; Standard errors in brackets.
* Significant at 10% level, ** significant at 5% level, *** significant at 1% level

Figure 1: Illustration of the identification strategy (i.e. for mortality at age 65)