Wealth is Health: Pensions and Disease Onset in the Gilded Age

Shari Eli*

U.C. Berkeley

November 9, 2010 – [Job Market Paper]

Abstract

How did increases in individual income contribute to improvements in adult health during the late 19th and early 20th century? To disentangle the effect of income as opposed to medical advancements or public health interventions, I use exogenous variation in income from the first wide-scale entitlement program in the U.S. – the Union Army pensions. Documenting that Republican Congressional candidates boosted veterans' pensions in order to secure votes, I exploit exogenous increases in income stemming from Republican corruption to estimate income effects on morbidity and mortality. The effects of income on disease onset are large - an extra $1 of monthly pension income, a 9% average real income increase, lowered the probability of infectious disease onset by 38%. In addition, I find that an extra $1 of monthly income lowers the crude death rate by .008. I find the largest income effects for infectious illnesses, smaller effects for respiratory and digestive illnesses, and no effect for the onset of most endocrine diseases. Results shape our understanding of the U.S. mortality transition and inform today's debates on the health benefits of cash transfers to adults in regions with wide SES gradients in health, as was the case in the U.S. a century ago.

*I thank Barry Eichengreen, Dora Costa, Ronald Lee and Brad DeLong for their comments and suggestions. I also thank Martha Bailey, Hoyt Bleakley, Joseph Burton, Louis Cain, David Card, Susan Carter, Colleen Donovan, William Dow, Robin Einhorn, Robert Fogel, Michael Haines, Nicholas Li, Ted Miguel, Suresh Naidu, Martha Olney, James Powell, Christina Romer, Richard Sutch, Carlos Villareal and Noam Yuchtman for their comments and insight. I thank Noelle Yetter at the Center for Population Economics for her advice and assistance with the Union Army sample. I gratefully acknowledge the financial support of the NICHD grant T32-HD007275, NIA grant T32-AG000246, and the All-UC Group in Economic History. All errors are my own.

1. Introduction

At the end of the nineteenth and early twentieth century, crude death rates from infectious illnesses fell dramatically in the U.S. Between 1900 and 1930, the crude death rate from tuberculosis dropped by 63% and that of influenza and pneumonia fell by 82%.[1] The dramatic decreases in mortality from infectious illnesses were followed by large gains to life expectancy and decreases in death rates for all age groups. Between 1900 and 1925, the infant mortality rate fell by 53%, and the death rate for those aged 45 to 54 fell by 15%.[2]

Much of the recent work on the U.S. mortality transition between 1870 and 1930 attribute the sharp decrease in death rates from infectious illnesses to the emergence of public health interventions in the period. With the acceptance of the germ theory of disease during the 1880s and 1890s, macro public health initiatives to improve sanitation, construct sewer systems, and chlorinate or filter municipal water sources have been credited as the drivers of the large declines in mortality. Cutler and Miller (2005) find that the purification of water in U.S. cities explains half of the mortality reduction in the early twentieth century. Similarly, Ferrie and Troesken (2005) find that one-third to one-half of the 60% mortality reduction in Chicago between 1850 and 1925 can be explained by the city's efforts to purify water. While these findings shed light on the mortality transition experienced in cities, they do not explain significant drops in morbidity and mortality outside of urban areas.

Besides improvements in public health, the unprecedented advances in medical science during the early twentieth century also play a role in reducing morbidity and mortality. While there were few effective medical treatments in the late 1800s,[3] vaccination against a wide range of infectious illnesses including diphtheria, pertussis, tuberculosis, tetanus and yellow fever were discovered shortly after 1920. During the 1930s, sulfa drugs were developed and widely used to treat infection. Jayachandran et al. (2010) find that sulfa drugs accounted for 2% to 4% of the mortality reduction between 1937 and 1943. McKinlay and McKinlay

[1] (*Historical Statistics*, 1960, p. 26).
[2] (*Historical Statistics*, 1960, p. 29).
[3] Variolation against smallpox was one of the few effective treatments available in the U.S. beginning in the early eighteenth century (Cutler et al. 2006, p. 103).

(1977) posit that medical measures account for approximately 3.5% of the decline in mortality from infectious disease between 1900 and the mid-1970s.

Lastly, improvements in socioeconomic status stemming from increases in individual income greatly contributed to the U.S. mortality transition at the end of the last century. Increased income in this period led to a rise in retirement rates (Costa, 1995) and allowed individuals to exit hazardous work environments. Increases in income in this period also allowed individuals to alter their living arrangements and reduce crowding (Costa, 1997), which decreased prevalence rates of contagious illnesses. In addition, rising income levels led to improved nutrition levels. McKeown (1976) argued that improvements in nutrition explain the majority of the mortality decline before 1900 in the industrialized world.[4] Similarly, Fogel (2004) shows that improvements in socioeconomic status over time led to increases in net nutritional status, body size and longevity. However, Fogel emphasizes that increases in socioeconomic status come not just in the form of increased wages but also in the form of medical care to the individual as well as public health interventions. Fogel, therefore, highlights the difficulty in disentangling the effect of income on health as opposed to the effects of public health interventions or advancements in medical science. By estimating the effect of income on health status at a time when effective medical care for the individual is largely absent, and by finding an exogenous source of variation in income which does not operate through public health interventions, I disentangle confounding effects to estimate the impact of income on health.

In this analysis, I investigate the contribution of increases in individual income to the decrease in adult morbidity and mortality by examining the cohort of Union Army soldiers who enlisted in the American Civil War. There are several advantages to using the Union Army dataset to examine my research question. First, the data set includes demographic and socioeconomic information for veterans until death. Second, the data include detailed information regarding a veteran's health that is not self-reported but rather recorded by surgeons employed by the Pension Bureau. Third, Union Army veterans received sizable and varying pension payments from the U.S. government which were documented

[4]With specific regard to declining rates of tuberculosis, McKeown (1976) asserts that the 80% decrease in the rate of tuberculosis, which transpired before the advent of any effective treatments for the illness, was likely the result of improved nutrition in the population.

from the time of a soldier's enlistment until his death. Finally, Union Army veterans are a representative sample of Northern white men of their birth cohort.[5]

One drawback of using the Union Army data set in this analysis is that veterans received pensions for war-related illnesses and disabilities before 1890, and for disabilities unrelated to the war experience after 1890.[6] In order to circumvent the problem of reverse causality, the case in which an individual's health could influence his income, I utilize two sources of exogenous variation in pension income: the presence of close elections for Republican Congressional candidates in the individual's district and changes in pension legislation. As I show, there is evidence that Republican Congressional candidates boosted the pension income of veterans in an effort to secure votes in elections. Another contribution of my research is thus to highlight the pervasiveness of corruption in 19th century politics and show how it helped shape the largest entitlement program the country had ever seen.

I first use a proportional hazard model to estimate the effect of monthly pension income on the probability of contracting or dying from a specific illness from 1873 to 1906. I restrict this first part of the analysis to 1906 because that is the final year before the Pension Bureau began administering pensions based on age as opposed to disability. Estimating income semi-elasticities and proportional hazards for a variety of diseases, I find that respiratory, infectious, digestive, and cardiovascular conditions are significantly responsive to income. For example, I find that an extra dollar of monthly pension income, which is equivalent to 4% of a farm laborer's monthly earnings in 1900[7] or a 9% increase in the average veteran's monthly pension income, decreases the likelihood of developing an infectious illness by an average of 38%, reducing the hazard rate by .0015.

For the period after 1906, when the Bureau began dispensing pensions based on the age of veterans, I use a regression discontinuity framework to test whether older cohorts had a differing chance of disease onset relative to younger cohorts. I find strong effects for respiratory illnesses and some cardiovascular illnesses. Besides exploiting the change in pension legislation, a second benefit of using the regression discontinuity framework in the period after 1906 is that I am able

[5] See section 4.1.

[6] After 1890, veterans could still receive pensions for war-related illnesses and disabilities.

[7] (Preston and Haines, 1991, p. 212-20.)

to identify effects based on variation between adjacent birth-year cohorts during a period of growth in public health interventions and emergence of more modern medical treatments.

This paper is organized as follows. Section 2 contains an historical background of the Union Army pension system and the political environment which shaped its evolution. Section 2 also contains a brief account of the medical knowledge and advancements during the lifetime of the Union Army cohort. Section 3 provides the econometric framework. Section 4 describes the data and provides summary statistics. Section 5 contains results, and Section 6 contains robustness checks. Section 7 concludes.

2. Historical Background

2.1. The Union Army Pension in the Patronage Era

The U.S. political climate at the end of the 19th century was defined by protectionist tariffs, an unruly patronage system and, with the exception of the Cleveland administrations, Republican domination of the White House. Republicans and Democrats quarreled over how to spend the budget surplus which resulted from the high tariffs, and the proper way of reforming the patronage system. In this intensely corrupt political environment, the Union Army pension system, initiated in 1862 to provide assistance to veterans suffering from war-related disabilities, evolved into a large-scale entitlement program. The pension system was the Republican answer for how to spend the surplus and, as benefits increased, served as a way for Republicans to keep Civil War veterans faithful to the party.

2.1.1. Passage of the General Law of 1862

During the Civil War, 2.7 million men enlisted, and 87% of recruits survived the war.[8] These veterans could qualify for public assistance. Under the General Law passed on July 14, 1862, veterans became eligible for a pension if their physical disabilities were shown to result from the war experience. Therefore, the General

[8](Dyer, 1959)

Law excluded veterans whose disabilities resulted from aging or any incidents unrelated to the war. Disabilities pensioned under the General Law included loss of sight, hearing, limbs or their usage, and illnesses caught while in the camps. In order to determine whether a causal link existed between illnesses/injuries and war experience, veterans were required to undergo medical examinations by physicians, called examining surgeons, hired by the Pension Bureau. Upon completion of each exam, examining surgeons filled out a surgeon's certificate, which was then sent to the Pension Bureau and added to the veteran's application for pensions.

2.1.2. The Pension Office: A Political Machine

During the 1870s and 1880s, many Republican candidates began boosting pensions awarded to veterans in their constituency in an effort to secure the vote of the old soldier. Evidence of this practice is abundant. While all of the correspondence of the Pension Bureau between 1870 and 1914 is suspiciously missing from the documents of the Pension Bureau found at the National Archives, the correspondence (letters and telegrams) of the Commissioner of Pensions can still be found in texts outlining corruption at the Bureau. Perhaps the best surviving collection of evidence regarding Republican corruption at the Pension Bureau comes from a 104-page booklet *Republican Abuses at the Pension Bureau* put out by the Democratic party before the election of 1888. Similarly, *The Campaign Book of the Democratic Party,* published in 1886, also provides evidence of Republican corruption at the Pension Bureau and more concretely outlines the methods by which Congressional candidates were able to augment the pensions of their constituents. In these two works, Democrats published private letters between the Commissioner of Pensions and Congressional candidates, testimony from pensioners as well as clerks from the Bureau, and data regarding the party affiliations of all clerks hired by the Bureau during the 1870s and 1880s in order to outline the pervasiveness of the corruption. Much of the evidence provided by the Democratic Party in these two texts, that which is included in this research, is drawn directly from the transcriptions of testimony and evidence given at the 48th Congress' session of the Committee on the Payment of Pensions, Bounty and Back Pay.

In order to secure the votes of Union Army veterans, Republican Congressional candidates wrote letters to the Commissioner of the Pension Bureau on behalf of constituents who had previously applied for pensions. For cases in which a veteran was still waiting for his application to be processed by the Bureau, the candidate asked that the Commissioner speedily review the case and send special examiners to the district if there were remaining questions about a veteran's claim. For veterans already receiving pensions and having applied for an increase, candidates requested that the Commissioner either increase the pensions or that he similarly send a special examiner to the district to reassess the case. In their letters, Republican candidates frequently were found expressly stating that they were interested in boosting pensions in order to win the upcoming election.[9]

The Commissioner, who hired mostly Republican clerks[10] at the Bureau, gave priority to the processing of the claims of veterans in the Republican candidate's district, especially during election season. Clerks were not in charge of deciding the amount of pension paid to veterans. Instead, the Medical Reviewers of the Pension Bureau decided the dollar amount.[11] Clerks had the power to stall the application of veterans during election seasons to prevent the loss of votes to Democrats.[12] Therefore the Pension Office remained a Republican political

[9]Many examples of letters written from Congressmen to the Commissioner of the Pension Bureau can be found in *Republican Abuses at the Pension Bureau*. The following is one such example. On August 4, 1884, the Republican Congressman from Ohio wrote the following to Commissioner Dudley: "My dear sir: I am just entering upon my canvass for Congress with a first-rate fighting chance. I know you will render me all the aid which you properly can. Mr. H. H. Wallace, special examiner, just sent to Springfield, Illinois, is one of the best 'button-holers' If he could be adjacent to Butler and Preble counties, he would be of the very greatest assistance to me. Can't you put him just over the line in Indiana? He is thoroughly well acquainted in Butler and Preble and can do me great good, and he will be zealous to do so. He does not know of me writing this letter, and I write it solely in the interest of my canvass and of a Republican House of Representatives." p. 31.

[10]In 1886, for example, there were 1,472 Republican clerks employed by the Pension Bureau as opposed to only 28 Democratic clerks (*The Campaign Book of the Democratic Party, 1886*, p. 7).

[11](*Instructions to the Examining Surgeons*, 1882, p. 9)

[12]In 1885, during the session of the Committee on the Payment of Pensions, Bounty and Back Pay (H.D. 2683, 48th Congress, 2d Session), several clerks employed by the Pension Office were sworn in to testify about the ways in which pensions were adjudicated. In the testimony of these clerks, each one says that he was informed by the Commissioner not to reject any cases whatsoever before the election of 1884 for "political purposes." One clerk in particular testified that when he asked the assistant-chief (his superior at the Bureau) about rejecting a specific case,

machine used to secure the veteran vote throughout the patronage era.

Democratic candidates for Congress were largely unable to boost the pension payments of their veteran constituents by writing letters to the Commissioner because of the partisan nature of the Bureau during this period. Additionally, there is evidence that veterans supporting Democratic candidates were threatened with the loss of their pension or with having their applications stalled indefinitely by special examiners sent from Washington into districts during election season to aid the Republican cause.[13]

The corrupt practices of the Pension Bureau continued through the late 1880s and into the 1890s. During the election of 1888, Civil War veteran and New York commander of the Grand Army of the Republic James Tanner "had, by his own account, 'plastered Indiana with promises' of more generous pensions under the Republicans. 'God help the surplus revenue!' the new commissioner declared, as he set about handing out new and readjusted pensions with gusto." Once Harrison took office, Tanner was appointed Commissioner of the Pension Bureau.[14] Republican congressmen continued to easily augment pensions by specially appointing clerks, who were loyal to the party, to review the red-taped[15] pension applications.

---

he was told "No no no; we are not rejecting any cases now. If you reject that case it will lose us six votes" (*The Campaign book of the Democratic Party, 1886* p. 45-48).

[13]There are a number of examples beginning on page 49 of *The Campaign Book of the Democratic Party, 1886*. The following is one example of testimony from a veteran: "John M. Mattingly, being first sworn, deposes as follow: My name is John M. Mattingly; I have resided at Olney, Ills., for the past four years; I am forty-two years of age, and a laborer by occupation. During the late war I was a private in Company A, Tenth Kentucky Infantry; I am an applicant for pension, and my claim has been pending since the year 1879. During the political contest of 1884, which resulted in the election of Grover Cleveland, my case was in the hands of Special Examiner Epert for the purpose of examination. When he came to me to take my preliminary statement, he asked me my politics; when I told him I was a Democrat, he told me I was on the wrong side to ever get a pension: that I never would get a pension as long as I voted the Democratic ticket, but that if I voted the Republican ticket my claim for pension would be allowed" (p. 50).

[14](Skocpol, 1992, p. 128).

[15]Pension applications arrived to the Department of the Interior (and after 1884, to the Pension Bureau) wrapped in red twill tape. The origins of the phrase red tape, describing excessive bureaucratic regulations that slow or halt decision-making, come from the processes of the Union Army Pension System.

2.1.3. The Passage of the Invalid Pensions Act of 1890 and Age-Based Laws of 1907, 1912 & 1918

Later, under the Invalid Pensions Act of June 27, 1890,[16] which awarded pensions to veterans with disabilities from causes other than the war, previously excluded veterans were finally able to claim pensions on the basis of non-war injuries.[17] The passage of the Invalid Pensions Act of 1890 enabled thousands of veterans to begin receiving pensions and drop the federal government from a surplus to a deficit. By 1892, expenditure on veterans compensation and pensions accounted for approximately 40% of the federal budget.[18]

In 1907, the pension system changed once again by granting payouts based on the veteran's age. Under the 1907 Act, any veteran over age 62, who was otherwise eligible for a pension under the 1890 Act, received $12 per month; if over age 65 received $15 per month; and if over age 70 received $20 per month.[19] In the years 1912 and 1918, these payouts were increased once again.[20] These pension amounts were substantial for the time and large enough to allow veterans to retire.[21] In 1900, the average pensioner received $10.02 per month, which was approximate half of the average monthly income of a farm laborer.[22] By 1890, the Union Army pension was comparable to today's Social Security Program in that approximately 42% of income is replaced by the SSA upon retirement.

2.2. Medicine in the Gilded Age

2.2.1. Medical Treatment: From the Age of Heroic Medicine to Fleming

In 1800, only two cities in the U.S. had a hospital - New York and Philadelphia.[23] By the close of the Civil War, the Union boasted over 200 hospitals, which could

[16] The Invalid Pensions Act of 1890 was passed under the Harrison administration as an answer to the budget surplus debate.
[17] (Glasson, 1918 p. 126).
[18] (*Historical Statistics of the United States, Colonial Times to 1957*, 1960, p.718).
[19] (Linares, 2001, p.16).
[20] See Appendix A for exact pension amounts paid by the laws of 1907, 1912 and 1918.
[21] (Costa, 1995).
[22] (Preston and Haines, 1991 p. 212-20).
[23] (Rosenberg, 1987, p. 337).

accommodate as many as 137,000 patients.[24] However, this rapid increase in the number of hospitals did not signify advances in medical science which could alter mortality trends. Physicians of the 1870s still relied on the same treatments used in the 1830s, a period in which few useful treatments were known.[25]

Until the beginning of the twentieth century, many Americans found it preferable to remain at home instead of seeking treatment from private physicians or being admitted to a hospital when they fell ill. Since the primary function of hospitals in this period was to provide patients with a warm, clean place to rest and eat well, all of which income could buy, those of the middle and upper classes, unlike the poor, seldom sought care in hospitals during this period.[26]

Public opinion regarding the efficacy of hospital care for the middle and upper classes changed beginning in the 1890s. With the invention of the x-ray in 1895, the wide acceptance of germ theory by the 1890s, and the use of antiseptics, hospitals made great advances in surgery and boasted dramatically lowered death rates from post-operative infections. By the 1920s, the public viewed hospitals as institutions with physicians able to perform surgery effectively as opposed to the nineteenth century view of the hospital as an ineffective and unsanitary shelter for the disabled poor to convalesce. However, even during the 1920s, hospitals could do little to help non-surgical patients such as those suffering from

[24](Rosenberg, 1987, p. 97).

[25]One famous medical intervention was bloodletting. Bloodletting was thought to "moderate vascular excitement, reduce inflammation, relieve congestion, allay spasm and pain, relax the muscular system, and arrest hemorrhage" (Kaufman, 1976, p. 59). There are instances in which bloodletting can be beneficial according to our understanding of modern medicine. In the case of pulmonary edema, which is an accumulation of fluid in the alveoli of the lungs and is frequently due to heart failure, bloodletting decreases blood pressure and helps fluid drain from the alveoli so that the patient can breathe more easily. Today, diuretics are given which achieve the same outcome by draining fluid from the alveoli. Despite a few cases in which bloodletting is beneficial, the majority of the time it did more harm than good.

A second treatment widely used by physicians of the era was the administration of calomel, which is a diuretic and purgative composed of mercury chloride. Physicians gave their patients calomel for cholera as well as a wide variety of other illnesses and with the usual result of the patient's death from mercury poisoning (p. 59-62).

Since the majority of treatments of physicians were ineffectual and frequently seen as worse than the disease itself, many Americans avoided doctors and sought out self-treatment alternatives. In addition, the emergence of homeopaths and eclectics, who were seen by orthodox medical practitioners as rival groups, helped solidify the common beliefs that physicians administered frightening allopathic treatments with little beneficial results. (p. 62.)

[26](Rosenberg, 1987, p. 115-116).

chronic illnesses.[27] The public's reluctance to seek medical attention from physicians or in hospitals continued until the early 20th century when the germ theory of disease gained wide acceptance and when the research on life-saving vaccines began.

2.2.2. Medical Education and Licensing

In 1813, there were only seven medical colleges in the United States[28] and during the early nineteenth century medical education can be described as poor, at best.[29] With the emergence of the Association of American Medical Colleges and the American Medical Association's Council on Medical Education and an improvement of the public's opinion of traditional physicians during the second half of the 19th century, medical education underwent a reformation during which the requirements for the certification of medical colleges and physicians became stringent.[30]

It was during this era of reform that the Pension Office began hiring examining surgeons to diagnose the ailments resulting in the disability of Union Army veterans. All examining surgeons hired by the Pension Office graduated from U.S. medical schools and were required to have practiced medicine for a min-

[27] (Rosenberg, 1987, p. 246).

[28] (Kaufman, 1976, p. 36).

[29] In response to the growing demand for medical education, medical colleges opened in rural areas. However, since professors at medical schools made their income from students' tuition payments, they were incentivized to admit any student wishing to become a doctor regardless of his academic abilities, (Kaufman, 1976, p. 52-53) which lowered the quality of instruction and the curriculum. During this period, students were not required to partake in dissections, study anatomy or undertake clinical work (p. 106). In addition, medical colleges possessed the authority to license physicians to practice, as opposed to independent state medical societies, (p. 96) which lowered the quality of physicians with medical degrees even further.

[30] During the 1870s and 1880s, states mandated that each practicing physician be licensed. In order to receive a license, physicians frequently had to prove they had received a diploma from a college that adhered to the standards put forth by the state's medical board. The requirements for the certification of colleges were more rigorous. In the case of Illinois, medical colleges required students to attend a least three years of instruction. During these three years of instruction, students were required to spend two years gaining clinical and hospital experience as well as engage in dissections (Kaufman, 1976, p.132). These new licensing regulations enforced by individual state boards greatly reduced the number of "quacks" masquerading as experienced physicians and resulted in the closure of many medical colleges which were little more than "diploma mills" (p.131-132).

imum of five years prior to their hiring.[31] Examining surgeons were therefore subject to the new licensing laws enacted by states and therefore likely to be quite knowledgeable relative to the other physicians of their time.

Examining surgeons were hired by the Pension Bureau to accurately diagnose and report health conditions and disabilities faced by Union Army veterans, which would prevent veterans from performing manual labor.[32] For diseases which were easily diagnosed without the use of imaging tools such as the x-ray, not invented until 1895, examining surgeons in different parts of the U.S. uniformly classified and named the veterans' illnesses.[33]

Further insight into the diagnostic skills and treatment ideas of the examining surgeons hired by the Pension Bureau to assess the illnesses of Union Army veterans can be found in their annual journal *Transactions*. Beginning in 1902, examining surgeons gathered in a different U.S. city each year to discuss diagnostic methods and causal factors leading to the diseases they diagnosed in veterans and in patients of their private practices. While many of the causal links they inferred have been proven inaccurate over the last 100 years, their diagnostic approach closely mirrors many of the practices of doctors today.

2.3. Public Health Interventions

While public health interventions were largely absent in rural areas, attempts at securing cleaner sources of water, constructing of sewers, and removing of garbage and other waste had begun in many major cities by the middle of the nineteenth century. Whereas in 1870 access to filtered water was rare in urban

[31] US Pension Bureau, Report of the Commissioner of Pensions, June 30 1891,19.

[32] (*Instructions to Examining Surgeons*, 1882, p. 6).

[33] International Classification of Diseases (ICD) is the standard by which health conditions are registered in the United States and worldwide. The first list of such diseases was composed in 1900. Since then there have been 10 revisions to the list. However, the concept of a standardized list of diseases was first introduced, even earlier, by the British epidemiologist William Farr in 1837. In later years, he advocated for a complete list of diseases grouped by anatomical site and suggested that it be adopted internationally. Farr stressed the uniformity of disease classification across countries. A variant ICD of today was available in an early form by the 1850s. Based on the lists composed by William Farr, which were precursors to the ICD list, doctors made uniform diagnoses. Therefore, diagnoses made by examining surgeons employed by the Pension Bureau, would match diagnoses made by today's physicians for illnesses which do not require imaging tools but instead require an analysis of symptoms. A brief history of the International Classification of Disease can be found at www.who.int/classifications/icd/en/HistoryOfICD.pdf.

America,[34] by 1900, 1.86 million urban Americans had access to filtered water.[35] Besides the introduction of clean water supplies and efforts at waste removal, other public health interventions included the use of quarantine, urban sanitation projects, efforts to secure clean milk and new legislation to reduce air pollution.[36]

The introduction of public health improvements during the period of analysis is not a concern for this study unless the timing and location of these improvements is influenced by the election of Republican Congressmen to office. If this were the case, the exclusion restriction – that close elections can only affect the health of veterans through pension income – would be violated. However, the evidence suggests that public health improvements in cities were enacted by local governments and that the timing of specific projects such as water chlorination were largely arbitrary.[37]

3. Empirical Strategy

I divide this analysis into two parts: the period before the enactment of age-based laws from 1865 to 1906 and the period from 1907 to 1935. The reason I divide the analysis is because the Pension Bureau began awarding pensions based on age in the years after 1906, and thus there was little need for new exams.[38] Information about disease onset between the years 1907 and 1920[39] comes primarily from death certificates.

3.1. Part I

[34](Haines, 2001 p. 13).
[35](ibid).
[36](ibid).
[37](Cutler and Miller 2005, p. 5-6).
[38]Veterans applying for new pensions or pension increases under the Invalid Pensions Act of 1890 were still required to undergo exams.
[39]Figure 5 shows the drop in the number of exams after 1906. Veterans could still apply for pensions under the preceding laws, such as the General Law of 1862 or the Invalid Pensions Act of 1890. However, practically all those eligible to collect pensions under the General Law of 1862 had already applied by 1907. Therefore, new exams were largely unnecessary.

3.1.1. Identification

Prior to 1890, veterans could only apply under the Law of 1862, which granted pensions based on illnesses and injuries related to the war experience. Therefore, a veteran who had a chronic illness between the years 1862 and 1890 was not likely to apply for a new pension or pension increase if he felt that his illness could not be traced to the war experience during a medical exam. Instead, the veteran was likely to only report his non-war-related condition after the passage of the Law of 1890, which granted pensions to veterans facing any debilitating illness.[40] Figure 5 shows the total number of exams undergone by veterans applying for new pensions and pension increases between the years 1865 and 1935. Given the dramatic spike in the number of exams shortly after 1890, it is unlikely that over 4,000 veterans suddenly contracted pensionable illnesses between 1890 and 1892. Instead, veterans were most likely reporting illnesses they faced during the 1870s and 1880s, which they did not report because the illnesses were not pensionable under the Law of 1862. Because veterans underreported non-war-related illnesses during the 1870s and 1880s, I divide the sample of veterans into two parts. The first sub-sample consists of those who first applied for a pension under the Law of 1862 by the year 1873. The second sub-sample consists of those who first applied by 1893 under the Law of 1862 or the Law of 1890. By restricting the second sub-sample to those who applied by 1893, I ignore first illnesses reported by the group of veterans who applied under the Law of 1890 (between 1890 and 1892) because these first illnesses were likely to be reported long after the veteran faced initial symptoms of the illness. I then estimate the effect of pension income on subsequent morbidity and mortality conditions. Finally, I restrict both subsamples to those who were admitted onto the pension rolls.[41]

Under the pension acts prior to 1907, veterans could only receive pensions

[40] Illnesses thought to be the result of vicious habits, such as syphilis, were not pensionable under the Law of 1890.

[41] Date of death and cause of death information is largely unavailable for veterans who were not on the pension rolls. Including veterans who did not collect pensions in the sample would bias estimates. This is because there is no disease information for veterans who were not on the pension rolls. If veterans who did not collect pensions died before having the opportunity to claim pensions, their inclusion in the sample will bias estimates. Therefore, I restrict the sample to veterans who applied by the baseline year (1873 or 1893) and who were admitted onto the pension rolls by the baseline year.

based on health status. Because of this fact, pension income is endogenous to health outcomes. Since veterans receiving larger pensions were likely to be in worse health, and likely to have continually deteriorating health, relative to those who received smaller pensions, it is difficult to identify the true effects of income on health without finding an exogenous source of variation in pension income. In addition, it is likely that estimates of the effect of pension income on health will be biased downward causing it to seem as though pensions increase the chance of sickness in veterans. However, in actuality, it may simply be that poor health status initially has overshadowed the effects of income. While controlling for prior health status partly controls for this effect, it is preferable to use an exogenous source of variation in pension income. I use variation in Republican Congressional vote share.

My measure of close elections for Republican Congressional candidates is an indicator variable equal to 1 if Republican Congressional vote share is between 0.3 and 0.7 inclusive. Republican Congressional candidates and incumbents were more likely to boost pensions in close elections. In Figure 6 to Figure 7, the graphs of the relationship between median pension income and Republican Congressional vote share are shown for the 1873-sample in 1888 and the 1893-sample in 1900. From the figures, it is clear that median pension income rises significantly if elections are in the close range. The positive relationship between close elections and pension income remains over the span of all three decades between 1870 and 1900.

In order to use the presence of close elections for Republican Congressional candidates in a pensioner's district as an exogenous source of variation in pension income, the presence of close elections must satisfy the following exclusion restriction: Conditional on my other control variables, close elections can only affect health through their effect on pension income. Three additional assumptions are required. First, close elections must have a quantitatively and statistically significant effect on pension income. Second, individual health status cannot affect the presence of close elections in a district. One example of this might be if sick veterans moved to areas of close elections for Republican Congressional candidates.[42]

[42] I show that this is not the case in Section 6.1.1.

Third, it cannot be the case that the likelihood to apply for a pension (and then undergo exams) varies between close election districts and non-close election districts. Figure 8 shows the frequency of exams per year for all veterans in the sample. With the exception of the year 1890, there is little difference between non-close and close election districts between 1860 and 1907. Figure 9 shows the frequency of first exams per year for veterans not yet on the pensions rolls. Prior to 1890, there is little difference in the frequency of exams between veterans in non-close election districts as opposed to those in close election districts. In 1890, veterans in non-close election districts were approximately 20% more likely to undergo first exams to apply for pensions. Veterans who first applied between 1890-1891 would be excluded from the 1873-sample but would be included in the 1893-sample. After 1893, those in non-close election districts undergo first exams at a slightly higher frequency than those in close election districts. However, veterans admitted onto the pension rolls after 1893 are not included in either the 1873 or 1893-subsample and are entirely excluded from this analysis. Figure 10 shows the frequency of exams per year for those already on the pension rolls. For those in the 1873-sample, the large biannual spikes in the frequency of exams during the 1870s reflect the requirement that veterans on the rolls return for biannual exams.[43] However, there is virtually no difference in the frequency of applications during the 1870s. With the exception of the mid-1880s and early 1890s, there is little difference in the frequency of applications between close and non-close election districts.

Controls in this section include rank while in the army, birth year, an indicator equal to 1 if the veteran lived in one of the hundred most populated cities, average farm land value per acre, prior health status, prisoner-of-war status and battle wounds. Each of these can affect income. High-ranking veterans received higher pensions than their lower-ranked counterparts. It is important to control for birth year because incidence of disease increases with age. County-level average farm land values per acre are used to control for increasing wealth in the county.

Information about disease comes from the surgeon's certificates. The empir-

[43] In figure 9, there are no spikes in the frequency of the exams in the 1870s because this figure shows the frequency of *first* exams.

ical strategy of this research hinges on the validity of the statements testifying to the diseases faced by veterans on these certificates. It does not affect this research if examining surgeons embellished the severity of illnesses faced by veterans because I am testing the effect of pension income on the *first* incidence of the disease. In data cleaning, disease conditions preceded by adjectives such as "severe" or "acute" were ignored as were explicit descriptions. For example, if a surgeon states that a veteran has "severe" asthma and had "prolonged inspiration, shortened expiration, and whistling heard all over the lungs" during an exam, as was the case for veteran Henry Greeley during his first exam in 1888, the dummy variable for asthma would be 1 for the year 1888 until Greeley's death. Alternatively, if the examining surgeon had simply described Greeley's condition as "asthma caught at camp Banks at Georgetown," the dummy variable would still equal 1. Therefore, the asthma variable is simply a dummy equal to one if the surgeon diagnoses the veteran with asthma, using the exact word "asthma," and zero otherwise.

It is, however, imperative that surgeons report the correct disease conditions as opposed to fabricating a story of illness when the veteran is perfectly healthy. If surgeons made honest mistakes when diagnosing patients, this would just create noise in the dependent variable but would not bias coefficient estimates. However, if surgeons diagnosed veterans with fictitious illnesses when in fact they were perfectly healthy, then this would bias income effects downward because otherwise healthy veterans with high pension incomes would look sick.

In addition to using specific disease outcomes in the analysis, I also group the illnesses into one of the following six categories: respiratory, digestive, infectious, cardiovascular, endocrine and genito-urinary.[44]

[44]Respiratory illnesses include abscess, adhesion, allergy, asthma, atelectasis, bronchiectasis, bronchitis, cavity, edema, effusion, emphysema, empyema, fibrosis, hemoptysis, pleuritis, pneumonia, pneumonitis, pneumothorax, tracheitis, and tuberculosis. Digestive illnesses include constipation, diarrhea, dysentery, dyspepsia, dysphagia, enlarged liver, gallstones, gastroenteritis, malassimilation (malabsorption) and nausea. Infectious illnesses include chancroid, cholera, dengue, diphtheria, gonorrhea, hepatitis, influenza, malaria, meningitis, mumps, orchitis, parotiditis, pertussis, rickettsia, rubeola, salmonella, scarlet fever, septicemia, streptococcus, syphilis, tetanus, typomalaria, and variola. Cardiovascular illnesses include arteriosclerosis, cyanosis, dyspnea, enlarged heart, impaired circulation, murmur, cardiac edema, and palpitation. Endocrine illnesses include diabetes, goiter and enlarged spleen. Genito-urinary illnesses include cystitis, enlarged prostate, nephritis, urethral obstruction, and uremia.

While physicians may have exaggerated the severity of illnesses faced by veterans in an effort to secure higher pensions for veterans, these exaggerations did not lead to increases in pension amounts. According to the *Instructions to Examining Surgeons* a pamphlet circulated to all examining surgeons,[45] physicians were instructed to rate the severity of the illness as opposed to stating opinions as to how much money a veteran deserved based on his illness.[46] Instead, it was the clerks at the pension bureau who evaluated the applications and determined pension amounts. Surgeons' ratings and pension payments are largely uncorrelated. In fact, for many years, it is not possible to link increases in pension payments to exams precisely because pensions were frequently increased as a favor for party loyalty as opposed to just the incidence of an illness. Therefore, veterans had every incentive to report their medical conditions but their pensions depended on a combination of their illnesses and political corruption in their district.

3.1.2. Econometric Framework

In this research, I use a Weibull proportional hazard model to predict the effect of an extra dollar of monthly pension income[47] on the probability of disease onset (or mortality). The dependent variable in each regression is an indicator equal to 1 if a veteran faced a particular condition in year t (or died from a particular condition) and 0 otherwise.

The model assumes that a veteran would eventually suffer from the health condition if he lived long enough. If a veteran died from a particular condition, the indicator variable for that condition will equal 1 in the year of the veteran's

[45] *Instructions to Examining Surgeons* were pamphlets put out by the Pension Bureau and frequently updated to reflect changes in the pension law. Instructions relevant to Civil War veterans are known to have been published in the years 1871, 1877, 1884, 1891, 1895, 1901, 1905, and 1908, and most of these copies can be found at the Regenstein Library at the University of Chicago. There is evidence that other instructions to surgeons may exist between the years 1871 and 1908, however, at the time of this research, additional pamphlets have not been found.

[46] An example can be found in the *Instructions* published in 1884, p. 8: "All disability which cause a lesser degree of disability than that resulting from anchylosis [the stiffening of joints] of the wrist or ankle should be determined by comparison with anchylosis of the wrist or ankle, and stated by fractions of totals, as 1/8, 1/4, 3/8, 1/2, 5/8, 3/4, or 7/8 of total." Therefore, examining surgeons *rated* disability but did not determine the payouts awarded to veterans.

[47] An extra dollar of monthly pension income is approximately a 4% increase in the income of an average farmer who makes $24 a month in 1900.

death. The dataset is expanded to a balanced panel spanning the years 1865 to 1906. If a veteran's death year came before 1907, observations after his death year were dropped from the sample. Since the independent variable, monthly pension income, is not exogenous to health status in all years, the presence of close elections in a pensioner's district is used as exogenous sources of income. However, because the model is non-linear, an instrumental variables approach cannot be used.[48] Instead, I use the control function approach in which the monthly pension income and control variables as well as a cubic of the residual from the first stage is included in the hazard regression. The first-stage takes on the following form:

$$pen_{it} = \gamma_0 + \gamma_1 vote_{it} + \Gamma C_{it} + u_{it} \tag{1}$$

where *pen* = monthly pension income, *vote* = dummy variable equal to 1 if Republican congressional vote share is between 0.3 and 0.7 and otherwise zero, *i* = individual, *t* = year, and *C* = set of demographic and socio-economic controls. Controls include birth year, battle wounds, previous health conditions, military rank, prisoner-of-war status, and county-level farm land value per acre. The associated residual has the following form:

$$\hat{u}_{it} = pen_{it} - \hat{\gamma}_0 - \hat{\gamma}_1 vote_{it} - \hat{\Gamma} C_{it} \tag{2}$$

In the second-stage, I choose

$$\theta = \{\beta, \alpha, \phi\}$$

to maximize the likelihood function

$$\sum_{i=1}^{N} \sum_{b=1873,1893}^{1906} \left\{ d_{it} log[e^{k_{it}\beta} \alpha t^{\alpha-1}] + (1 - d_{it})(-t^{\alpha} e^{k_{it}\beta}) \right\} \tag{3}$$

[48]Since the second-stage is non-linear, E(u‖vote) must equal zero instead of E(u*vote)=0, which is the weaker assumption necessary for two-stage least squares. Combined with the assumption that the first-stage is linear (necessary for the CF approach), the CF approach is more efficient than two-stage least squares. More importantly, two-stage least squares is inconsistent when the model is not linear in the parameters. For a more detailed explanation of the Control Function versus Instrumental Variables Approach, see (Imbens and Wooldridge, 2007).

where

$$k_{it}\beta = \beta_0 pen_{it} + \sum_{j=1}^{N} \beta_j (C_j)_{it} + \phi_1 \hat{u}_{it} + \phi_2 \hat{u}_{it}^2 + \phi_3 \hat{u}_{it}^3 + \epsilon_{it} \tag{4}$$

The term d_{it} is an indicator variable equal to 1 if the veteran is alive and 0 if dead or if t=1907. Veterans who have died do not contribute to the likelihood after their death although the hazard model treats them as at risk for illnesses that they have not yet had.[49]

Since the model is a proportional hazard model, it is possible to interpret the effects of a change in income on the hazard. A negative coefficient indicates that the time until onset of disease increases as income increases, which is equivalent to a negative effect on the hazard or the probability of disease onset.

For the purpose of hypothesis testing, I cluster the standard errors by district and year in the first stage. This is because the unit of observation is the individual in a particular year. However, the vote variable is the same within a district-year. Therefore, it is perfectly correlated across all individuals within a district-year.

The standard errors of the second stage do not take account of the fact that the residual from the first stage, which enters in the second stage, is estimated with error. Because of the difficulty in making the usual correction for this in a non-linear setting, I bootstrap the standard errors. However, bootstrapping is only necessary if the coefficient on the residual is significantly different from zero in the second stage.[50]

3.2. Part II

In the years between 1907 and 1918, the number of exams dropped significantly because the Bureau dispensed pensions based on year of birth.[51] Figure 5 shows the number of exams in each year from 1870 to 1930. It is immediately clear that the largest spike occurred in the 1891-1892 period coinciding with the passage of the Invalid Pensions Act of 1890. After the 1907 law, the number of exams fell

[49] Conditional on the covariates, the true time to failure is independent from the censoring event. Because I code death due to particular disease as a morbidity, this should be valid.

[50] (Imbens and Wooldridge, 2007, p. 9).

[51] It was still possible to collect pensions under the rules of the Invalid Pensions Act of 1890, however, most veterans would receive more income if they applied under the new age-based laws.

rapidly and approached zero in the late 1910s. If a pensioner died in this period, the Pension Bureau received information about the veteran's cause of death and contributing causes of death. In data cleaning, disease indicator variables were set equal to one in the year of death if a veteran died of the disease or the disease was a contributing cause of death.

Using a regression discontinuity approach, I attempt to address the effects that changes in medical treatments and public health interventions may have had on different cohorts. Comparing cohorts that were born only one year apart, I assume that changes in medical treatments and public health interventions had the same effect on the health status of adjacent cohorts.

3.2.1. Identification

The details of the Laws of 1907, 1912, and 1918 can be found in Appendix A. I use the law of 1907 in the regression discontinuity analysis as opposed to all three changes in pension legislation because the law of 1907 provided the largest relative increase in pension income to veterans. Since there are few exams after 1907, I identify income effects on cause of death as opposed to the probability of onset of non-fatal diseases.

3.2.2. Econometric Framework

I compare the cohort born in 1844 to the cohort born in 1843. In 1907, the cohort born in 1844 was age 63 and those born in 1843 were age 64. I compare these cohorts because they were necessarily eligible for a pension increase under the Law of 1907. Assuming that an individual born in 1844 lived the same number of years as an individual born in 1843, the individual born in 1844 would receive more years of pension income under the Law of 1907. Therefore, if increased income decreases the likelihood of mortality from diseases of poverty (such as infectious diseases), then the expectation is that the effect of a pension increase on the mortality rates from diseases of poverty would be negative for the 1844 cohort. With this econometric strategy, the assumption is that, in the absence of income differences, mortality rates for the cohort born in 1843 were the same as for the cohort born in 1844.

I restrict the sample to those born in 1843 and 1844, who lived to be at least 63 years old and thus able to take advantage of the law. The first year in the sample is 1907 and the final year is 1935.[52] I use the following regression discontinuity model:

$$disease_i = \beta_0 + \beta_1 cohort1844_i + \beta_2 C_i + \epsilon_i \quad (5)$$

where *disease* is an indicator variable equal to 1 if the veteran ever had the disease. *cohort*1844 is an indicator variable equal to 1 if the veteran was born in 1844 and zero otherwise. Therefore, the reference group in the sample is veterans born in 1843. No other cohorts are present in the sample. In this specification, the "treatment" is receiving an extra ($12 x 12 months =) $144 of lifetime wealth before age 64 due to the change in the pension system. I test whether, conditional on surviving to late life, an extra $144 of lifetime wealth delays the onset of particular diseases.[53] Controls included in this specification are a veteran's rank in the army, his war wounds and POW status.

4. Data

4.1. Union Army Sample

I study these issues using the Center for Population Economics' Union Army data set, which consists of information about the military experience, post-war health conditions, and socioeconomic status of veterans. The dataset is compiled from three sources: the military, pension, and medical records; surgeons certificates; and census records. The military records contain demographic and socioeconomic information about the soldier at the time of his enlistment. The pension and medical records provide detailed information regarding the veterans experience with the Union Army pension.

Since two-thirds of white[54] men between the ages of 20 and 45 served in the

[52] The last veteran in the sample died in 1935.

[53] Note that because of other laws passed later, the total lifetime effect of the treatment is potentially greater than $144, but only for veterans who survive to 1912 and then to 1918.

[54] Black men were not included in this research because they were largely disenfranchised between 1870 and 1930. Therefore, the exogenous source of variation in pension income - Congressional vote share in a pensioner's district - is not applicable.

Union Army, the more than 2 million men who served were representative of the general population of white men in the North.[55] Of the men who served in the Union Army, records for 35,570 white men were compiled. Regiments in the Union Army were comprised of 10 companies. The Fogel group selected 331 white companies at random and compiled information for each of the men within a company. The data used in this analysis consist of 303 out of the 331 companies. Therefore, the 35,570 recruits span 303 companies.

In this analysis, I use two subsamples of the 35,570 recruits in the dataset. The first subsample, the 1873-sample, consists of 1,750 recruits who survived to 1873 and were already on the pension rolls in that year. The second subsample, the 1893-sample, consists of 13,296 recruits who survived to 1893 and were on the pension rolls by that year.

Table 1 shows summary statistics for both the 1873- and 1893-sample at baseline. For those on the rolls in 1873, 4.4% suffered from respiratory conditions, 6.91% suffered from digestive conditions and 3.43% suffered from a cardiovascular condition in 1873. For those on the rolls in 1893, 7.22% suffered from a respiratory condition, 24.75% suffered from digestive conditions, and 30% suffered from cardiovascular conditions. Veterans of both the 1873- and 1893-sample were likely to be farmers or retired. Few veterans were professionals of type 1 or 2.[56] Veterans from both samples come largely from New York, Pennsylvania and the Midwest. Table 2 presents probit regressions in which I use wartime indicators to predict the likelihood that a veteran would be in the 1873- or 1893-sample in the baseline year. Veterans were 20.7% more likely to be on the pension rolls by 1873 (and thus in the 1873-sample) if they were wounded. 76.51% of veterans in the 1873-sample were wounded as compared with only 34.12% in the 1893-sample. From Table 2, it is clear that veterans on the pension rolls by 1893 were two years younger than those on the rolls by 1873.

The surgeons certificates are of particular importance in this research because they describe the illnesses of veterans. Surgeons certificates were written by physicians, who were appointed by the Pension Bureau, to assess the illnesses faced by veterans.

[55](Costa and Kahn, 2008, p. 2,3).

[56]The Professional (1) category includes manufacturers, educators, attorneys, and other professionals. The Professional (2) category includes clerks, merchants and salesmen.

Since veterans underwent many physical examinations, either to apply for the first time or to apply for an increase, health information is available over time. One applicant could undergo as many as twenty exams. There are a total of 79,238 exams in the data set, and on average, each veteran in the sample had 4.94 exams.[57] The average exam year was 1892 (the median is 1891), coinciding with the passing of the 1890 Act, which awarded pensions for disabilities.

4.2. Historical Congressional Election Data

In order to determine the Republican Congressional vote share of each veteran's district, it was first necessary to determine the district of residence for veterans in each year. Since the Union Army sample contains the state and city of residence as well as the exact street address of veterans from first pension receipt until death, I matched each veteran to his associated Congressional district between 1870 and 1910.[58] Since district boundaries change rapidly during this period, veterans had to be rematched to districts to account for border changes. Even during years in which a veteran remained at the same residence, he could still be counted as being in a new district if boundaries were redrawn.

To account for changes in district lines, I matched each veteran's address to district maps for census years 1870 to 1910.[59] Having matched veterans to their districts in each year, I then collected election returns for each district in the United States between the years 1870 and 1910.[60]

It was necessary to collect this new dataset of Congressional Election returns by district and to create new GIS district maps, as opposed to using the ICPSR's Historical Election Returns Series and GIS county maps from the NHGIS's Historical state and county boundary files (1790-2000),[61] for two reasons. First, while

[57] The median number of exams was 4.

[58] If a veteran moved to a new location in a given year, he appears in the data as being in the destination district for that year.

[59] District boundaries change after each census year. Therefore, district boundaries from 1970 to 1979 can be determined by looking at the boundaries of the 1970 census. District boundaries for the maps were found in Kenneth Martis' *The Historical Atlas of the United States Congressional Districts: 1789 - 1983*, which had never been digitized.

[60] The election returns were compiled from Michael Dubin's book *United States Congressional Elections, 1788 - 1997*.

[61] The National Historical Geographic Information System has historical county boundary files

the ICPSR data set links counties to districts, it is not possible to be certain of a veteran's district simply by determining his county. This is because many counties were split into multiple districts. Therefore, matching a veteran's address to a county, using GIS county maps, and linking the county to an associated district, using the linkages provided in the ICPSR's Historical Election Returns, 1824-1968, is an inaccurate approach.

Second, the ICPSR series contains vote totals by *county* as opposed to district. While counties are matched to districts in this series, it is not possible to compute the Republican vote share for a district by summing Republican votes over the counties in a district (and diving by total votes) because one county could lie in *two* different districts. Therefore, I collected a new series of election returns by district, which are linked to a new set of GIS maps with historical Congressional district boundaries.[62]

4.2.1. County and City-Level Data

In the analysis, I use county-level data from the ICPSR's Historical, Demographic, Economic and Social Data: The United States, 1790-2002. In particular, I use farm values per acre as a proxy for changing wealth levels in the county. Information on the population size of U.S. cities from the U.S. Census Bureau.[63]

5. Results

First-stage results from the specification in Part I are presented in Table 3.[64] For the 1873-sample, the coefficient estimate on the close-vote variable is 1.28 and significant at the 1% level. This means that veterans in the 1873-sample living in districts with close elections received an extra $1.28 of pension income relative

from 1790 to 2000 available at nhgis.org.

[62]The digital GIS maps were created by Carlos Villareal with the support of the All-UC Economic History Dissertation Grant 2010. Figures 1 to 4 show the GIS maps created from census years 1870, 1880, 1890 and 1900.

[63]The U.S. Census Bureau's Population of the 100 Largest Cities and Other Urban Places in the United States: 1790 to 1990 is available at http://www.census.gov/population/www/.

[64]The dependent variable in the second-stage associated with the first-stage presented in the table is an indicator variable =1 if a veteran had a hernia in year t.

to their counterparts in non-close election districts. Veterans in the 1893-sample living in close election districts received an extra 88 cents of pension income relative to their counterparts in non-close election districts. Using both samples, living in one of the hundred most populated cities did not significantly affect pension income.

The tables of hazard regression estimates of disease onset are separated into anatomical groups and regressions with and without the control function are presented for both the 1873- and 1893-sample. Table 4 shows that respiratory conditions are income sensitive using the control function approach to correct for reverse causality.[65] Correcting for reverse causality, an extra $1 of pension income decreases the probability of the onset of a respiratory condition by [1-exp(-.207)=] 18.7% for veterans in the 1893-sample, which is equivalent to a reduction in the hazard rate of 1.68/1000. Estimates of the effect of a $1 increase in pension income on the likelihood of contracting a respiratory illness for the 1873-sample are even larger – the semi-elasticity is -.344, equivalent to a 29.1% reduction in the proportional hazard rate. Table 4 also shows estimates for digestive conditions. For veterans in the 1873-sample, increased income does not significantly affect the onset of conditions in the digestive category, however, for veterans in the 1893-sample, income has large effects. Interestingly, for both the 1873- and 1893-sample, increased income does not prevent diarrheal conditions once correcting for reverse causality. This may be because diarrheal conditions in this period are primarily caused by contaminated water supplies shared by both the rich and poor. Therefore, public heath interventions to chlorinate water supplies were especially beneficial because, in light of these estimates, the incidence of diarrheal conditions could not be warded off by additional income.

Table 5 shows regression estimates for illnesses in either the infectious, cardiovascular or endocrine category. An extra $1 of pension income decreases the likelihood of the onset of an infectious illness by 38% (a decrease of .0015 in the hazard rate) for veterans in the 1893-sample. However, the probability of a veteran in the 1873-sample contracting an infectious illness does not appear to be significantly influenced by increased income. This may be because veterans in

[65] Estimates on the left-hand side of Table 4 show the results when I estimate the hazard model without using the control function approach – use the second-stage of the specification in Part I without the use of the first-stage residual.

the 1873-sample were likely to be in worse health earlier in the lifecycle (and therefore able to receive pensions at an earlier date) relative to veterans in the 1893-sample causing income to have little beneficial effects.

With regard to the onset of cardiovascular conditions, veterans in both the 1873- and 1893-sample appear to have benefitted enormously from increased income. Cardiovascular conditions such as arteriosclerosis and enlarged heart are conditions associated with affluence and seen in higher rates in developed nations. However, individuals who suffered from acute infections, such as rheumatic fever, could sustain valvular damage to the heart. Therefore, inasmuch as income could ward off infectious illnesses, it could also prevent the likelihood of heart disease resulting from acute infections.

Table 5 also shows the effects of income on endocrine diseases. For both the 1873- and 1893-sample, increased income has no effect on diseases in the endocrine category taken together. However, for the 1893-sample, there are negative income effects on the probability of developing diabetes whereas there are no effects for the 1873-sample. This may be because veterans in the 1893-sample receive pensions at older ages relative to the 1873-sample, and there may be negative income effects on the probability of the onset of type-II diabetes (which usually appears at older ages) operating through better nutrition. Logan (2009) shows that calorie expenditure elasticities in developing countries today are significantly lower than calorie elasticity estimates for the U.S. in the late 19th century. Therefore, individuals born at the same time as the Union Army cohort were likely to be significantly underfed relative to the poor today. Given the findings of Logan (2009), increased income most likely operated on health through improvements in nutrition to prevent a range of illnesses from diabetes to infectious conditions.

Table 7 shows the effects of income on the crude death rate (all-cause mortality) and on cause of death. I find that an extra $1 of pension income lowers the hazard rate of death from any cause by .008. I also find large income effects for respiratory, digestive and cardiovascular illnesses. However, I do not find significant income effects for infectious illnesses. There are two possible reasons for this finding. First, diseases in the respiratory and digestive category were mostly infectious illnesses but are not in the infectious category because symptoms of

the illnesses are confined to either the respiratory system or the digestive system. Therefore, the large declines seen in illnesses such as tuberculosis are predicted by my estimates. Second, while income can delay the onset of infectious illness, the results suggest that income cannot prevent the eventual death of a veteran from an infectious illness relative to other illnesses.

Hazard estimates for mortality from endocrine diseases appear to be negatively and significantly affected by increased income. This is plausible because improvements in diet can greatly alter mortality rates of endocrine diseases such as diabetes.

With regard to the regression discontinuity estimates, infectious diseases shown in Table 8 do not seem to be responsive to income. Instead respiratory illnesses and cardiovascular conditions are responsive to income. The negative coefficient on respiratory conditions, for example, means that veterans born in 1844, who received more pension income relative to veterans born in 1843, had a lower probability of dying from respiratory infections.

In Table 8, I include the results of the same regression discontinuity approach but instead compare the likelihood of the onset of illness for the 1846-cohort to the (omitted 1845-cohort). Since neither those in the 1845-cohort nor those in the 1846-cohort "missed out" on income from the enactment of the Law of 1907 (as was the case for the 1843-cohort relative to the 1844-cohort), there should be no difference in the rates of disease onset between the two cohorts. In Table 8, I include the results of the regression discontinuity analysis when I compare the 1845- to 1846-cohort and do not find a difference in the rates of disease onset with the exception of the respiratory category.

6. Robustness Checks

6.1. Threats to Identification

6.1.1. Migration Model

The results of this research hinge on the assumption that sick veterans do not migrate to districts in which Republican Congressional candidates face close elections in order to secure higher pensions. Of veterans that move to new districts,

an average of 10.44%[66] migrate from districts in which Republican vote share was below 30% or above 70% to districts in which Republican Congressional candidates faced close elections. Therefore, veterans who moved chose districts with closer elections. However, to more concretely determine whether *sicker* veterans migrated to more Republican districts, I use a simple Conditional Logit model of Migration. The dependent variable is the probability that a veteran moves to a new district with close elections when the originating district did not have close elections. The independent variable is the incidence of any disease in the year *t-1*. The model has the following form:

$$Prob(move_{it} = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 sick_{i,t-1} + \Gamma C)}} \tag{6}$$

where *sick* is a dummy variable equal to 1 if a veteran has any illness in a given year and *C* are a set of controls. Controls include a quadratic time trend, body mass index, rank in the army, marital status, occupation, retirement status, prisoner-of-war status, and war wounds.[67]

The results presented in Table 9 show that if a veteran was sick with any illness in the previous period, he is 8 percent more likely to move to a close-election district, and the result is significant at the 10%-level. However, upon including the set of controls, the estimate is no longer significant. Therefore, while this was a period of great migration in the United States, Union Army veterans, once they fell sick, did not appear to be moving to districts in which Republicans faced close elections.

6.1.2. Farm Land Values

If Republican Congressional candidates were able to raise income and wealth levels in their districts through means other than increasing the pensions of Union Army veterans, then the identification strategy of this research breaks down. One check on the candidates' abilities to affect the health of their constituents through practices, which increased income or wealth, other than boosting pensions is to determine the effect of close elections on farm land values. Farm land values are

[66] The standard deviation is .306
[67] I cluster by year and district.

a particularly good measure of overall economic prosperity in a veteran's district because the majority of veterans lived in rural areas.

Data on the average value of farm land per acre stratified by county over the years 1870 to 1930 come from the Michael Haines' ICPSR's Historical, Demographic, Economic and Social Data: The United States, 1790 - 2002, Dataset 2896 Part 106. I match each county to its associated district[68] and Republican Congressional vote share. I use the following specification:

$$logfarm_{dt} = \gamma_0 + \gamma_1 vote_{dt} + \Gamma C_{dt} + \epsilon_{dt} \tag{7}$$

where *logfarm* is the log of average farm land value per acre, *vote* is an indicator variable equal to 1 if Republican vote share is between .3 and .7 inclusive, *C* is a set of controls including year fixed effects, district time trends and district fixed effects, *d* denotes the district and *t* denotes time.

There is no significant effect of the closeness of elections for Republican Congressional candidates on farm land values per acre. The coefficient on the close-election indicator variable is -0.006 and is not significant.[69]

6.1.3. Mortality Trends of Veterans and Non-Veterans

To further check whether Republican Congressional candidates were able to enact policies which benefited the health of their constituents besides increasing the pensions of Union Army veterans, I use a separate mortality dataset to see if non-veteran cohorts living in districts with close elections had lower mortality rates relative to those in all other districts.

The mortality data used in this section come from the U.S. Federal Census Mortality Schedules, 1850-1885.[70] The Mortality Schedules contain information on every person who died during the year preceding the census year.[71] The

[68] In cases where one county overlaps two districts, I map the county to the district in which most of its area lies.

[69] There were 163,020 observations, and the t-statistic for Republican Congressional vote share is -1.26.

[70] This data is found on the Ancestry.com website and was compiled by researchers at the Center for Population Economics at the University of Chicago.

[71] For the 1850, 1860, 1870 and 1880 censuses, collection began in June of the census year. Therefore, information on mortality is collected for the twelve months prior to the June collection for each census year.

following information appears in the mortality schedules: Name of deceased, gender, age, race, birth place, cause of death, county and state. I restrict the sample to the post-Civil War census years 1870 and 1880 because they coincide with the years included in the main analysis of the paper. The dataset includes the following states: Arizona (Territory), Arkansas, California, Colorado, District of Columbia, Georgia, Idaho (Territory), Illinois, Iowa, Kansas, Kentucky, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Montana (Territory), Nebraska, Nevada, New Hampshire, New Jersey, North Carolina, Pennsylvania, South Carolina, Texas, Utah (Territory), Vermont, Virginia and Wisconsin.[72]

Since the Mortality Schedule contains only a listing of those who died in each county for a given census year and not the fraction who died out of the total population, it was necessary to match population totals for each county.[73] However, since this dataset only has population totals as opposed to population stratified by age, it was necessary to determine the age structure (each cohorts share of the total population) by county. This was found using 1870 and 1880 IPUMS 1% samples. I then matched counties to district.[74]

I restrict the dataset to white males and form 10-year birth cohorts beginning in 1760 and ending in 1870. I test whether living in a district with close elections affects the overall mortality in the district as well as cause-specific mortality.

Table 10 includes the coefficient estimates on the close-election variable,[75] a dummy variable for the year 1880, and interaction terms (close-election multiplied by cohort) for each cohort. Each 10-year birth cohort represents those who were born during the nine years following the cohort-year label.[76] The majority of those who served in the Civil War were born during the 1830s. From Table 10,

[72]Some states are left out of the analysis because they have not yet been acquired by ancestry.com. These states are Alabama, Connecticut, Delaware, Florida, Indiana, Maryland, Mississippi, Missouri, New Mexico (Territory), New York, North Dakota, Ohio (Seneca County only), Oregon, Rhode Island, South Dakota, West Virginia, Wyoming (Territory).

[73]County-level population was drawn from Michael Haines' Historical, Demographic, Economic, and Social Data: The United States, 1790 - 2002. Dataset: ICPSR 2896. Part 11: 1870 Census (County and State) and Part 15: 1880 Census (County and State)

[74]If a single county lied in two districts, I matched the county to the district in which encompassed the majority of the county's land.

[75]The close election variable is a dummy equal to 1 if Republican Congressional vote share is between 0.3 and 0.7 inclusive.

[76]For example, the 1770-cohort includes all individuals born between 1771 and 1780 inclusive.

it is clear that all cohorts had higher mortality rates and cause-specific mortality rates in 1880 relative to 1870. This is apparent from the positive and significant coefficient on the 1880 dummy variable. In order to determine whether living in a district with close Congressional elections affects mortality, it is necessary to add the coefficient on the close-election variable with the coefficient on the interaction term of the cohort of interest. For example, relative to the omitted 1860-cohort, living in a district with close elections caused a -0.03% [0.0000+(-.0003)=-.0003] decrease in the mortality rate of the 1830-cohort. However, this result is not significant. When testing the joint significance of the coefficient of the close-election indicator variable with the Interaction term for the 1830-cohort, the F-statistic is 0.24. The estimates on the close-election variable are jointly significant with the 1790-cohort, 1800-cohort and 1810-cohort interaction terms for the Total Mortality, Respiratory and Infectious disease categories. The estimates on the close-election variable are jointly significant with the 1800-cohort interaction term for the Cardiovascular disease category, and the close-election estimate is not jointly significant with any of the cohort interaction terms in the Digestive category.

While effects are significant for older cohorts, they are positive and small. For example, living in a district with close elections decreases the overall mortality rate for the 1800-cohort by .3% [-.0000+(-.0030)=-.0030], which is the largest significant effect for all cohorts across all categories (columns). Therefore, close elections do not affect health outcomes for the Union Army cohort or any individuals born after 1820. For cohorts born before 1820, the effects are slight causing the main results of this research to be biased downward.

7. Conclusion and Discussion

In this research, I explore the impact of income on adult health at the end of the 19th and early 20th century. In order to circumvent reverse causality - the scenario in which health influences income - I use two sources of exogenous variation in pension income: the presence of close elections for Republican candidates of a pensioner's Congressional district and changes in pension legislation. I find large effects and conclude that increases in income, in the absence of public

health interventions or medical advancements, profoundly influenced the health trajectories of cohorts born in the mid-nineteenth century for the better.

The results of this research shed light on current debates regarding the health benefits of cash transfers to adults living in developing nations in which the socioeconomic gradient in health is large, as was the case in the U.S. a century ago. Entitlement programs providing cash transfers, of particular interest today, are the South African pensions and Mexico's Oportunidades system. Case (2004) uses data on the South African pension system to determine the effect of income on health status, but is unable to make specific assessments regarding the health of recipients because health status is self-reported in the sample. Investigations of income's effect on health using data from the Oportunidades program suffer from the same problem as health status is similarly self-reported.[77] For regions in which individuals suffer from high rates of infectious illnesses, the results of this research suggest that cash transfers have large benefits. In light of the results, it appears that the tradeoffs between providing cash transfers to adults in developing countries as opposed to public health interventions is narrower than previously thought.

The results of this research are also pertinent to discussions of the relationship between income and retirement, as income may act on retirement through health. First, the design of pension systems in countries with wide SES gradients in health must account for positive income effects on longevity. Second, since income affects current health status and expected longevity, individual decisions regarding labor force participation and retirement are ambiguous and would be an interesting avenue for further research.

[77] Lia et al. (2008).

8. Appendices

8.1. Appendix A: Age-based Laws

Law of 1907

Age	Income per month ($)
Over 62	12
Over 70	15
Over 75	20

Law of 1912

	Monthly Pension Income ($) given Length of Service						
Age	90 days	6 months	1 year	1.5 years	2 years	2.5 years	3 years
Over 62	13	13.5	14	14.5	15	15.5	16
Over 66	15	15.5	16	16.5	17	18	19
Over 70	18	19	20	21.5	23	24	25
Over 75	21	22.5	24	27	30	30	30

Law of 1918

	Monthly Pension Income ($) given Length of Service						
Age	90 days	6 months	1 year	1.5 years	2 years	2.5 years	3 years
Under 72	30	30	30	30	30	30	30
72 and over	30	32	35	38	40	40	40

References

[1] Almond, Douglas (2006). "Is the 1918 Influenza Pandemic Over? Long Term Effects of *In Utero* Influenza Exposure in the Post-1940 U.S. Population." *Journal of Political Economy,* 114(4), 672-711.

[2] Balan-Cohen, Andreea (2007). "Healthy, Wealthy, and Wise? The Impact of the Old Age Assistance Program on Elderly Mortality in the United States." SSRN: http://ssrn.com/abstract=1115333.

[3] Case, Anne (2004). "Does Money Protect Health Status? Evidence from South African Pensions" in David Wise, ed., *Perspectives on the Economics of Aging*. Chicago: University of Chicago Press for NBER, 247-286.

[4] Costa, Dora L (1995). "Pensions and Retirement: Evidence from Union Army Veterans." *The Quarterly Journal of Economics*, 110(2), 297-319.

[5] Costa, Dora L (1997). "Displacing the Family: Union Army Pensions and Elderly Living Arrangements." *The Journal of Political Economy,* 105(6), 1269-1292.

[6] Costa, Dora L, Lorens A. Helmchen, and Sven Wilson (2006). *Race, infection, and arteriosclerosis in the past*, Proceedings of the National Academy of Sciences of the United States of America. http://www.pnas.org/content/104/33/13219.full.pdf+html

[7] Costa, Dora L., Matthew E. Kahn (2008). *Heroes and Cowards: The Social Face of War* Princeton: Princeton University Press.

[8] Cutler, David, Angus Deaton, Adriana Lleras-Muney (2006). "The Determinants of Mortality." *Journal of Economic Perspectives,* 20(3), 97-120.

[9] Cutler, David, and Grant Miller (2005). "The Role of Public Health Improvements in Health Advances: The Twentieth-Century United States." *Demography,* 42(1), 1-22.

[10] Dow, William and David H. Rehkopf (2010). "Socioeconomic gradients in health in international and historical context." *Annals of the New York Academy of Sciences,* 1186, 24-36.

[11] Dubin, Michael (1998). *United States Congressional Elections, 1788 - 1997.* Jefferson: McFarland & Company Inc.

[12] Dyer, Frederick (1959). *A Compendium of the War Rebellion*, Vol. 1. New York: Thomas Yoseloff, 11.

[13] Ferrie, Joseph P., Werner Troesken (2005). "Water and Chicago's Mortality Transition, 1850-1925." *Explorations in Economic History,* 45(1), 1-16.

[14] Fogel, Robert (2004). *The Escape from Hunger and Premature Death*, 1700 - 2100. Cambridge: Cambridge University Press.

[15] Glasson, William H (1918). *Federal Military Pension in the United States.* New York: Oxford University Press.

[16] Haines, Michael R (2001). "The Urban Mortality Transition in the United States, 1800 - 1940." *NBER Working Paper Series on Historical Factors in Long Run Growth.* No. 134.

[17] Imbens, Guido and Jeffrey M. Wooldridge (2007). "Control Functions and Related Methods." *NBER Lecture Notes 6, Summer '07*, 1-27.

[18] Jayachandran, Seema, Adriana Lleras-Muney, and Kimberly V. Smith (2010). "Modern Medicine and the Twentieth Century Decline in Mortality: Evidence on the Impact of Sulfa Drugs." *American Economic Journal: Applied Economics*, 2(2): 11846.

[19] Kaufman, Martin. *American Medical Education: The Formative Years, 1765 - 1910.* Westport: Greenwood Press.

[20] Linares, Claudia (2001). "The Civil War Pension Law." *CPE Working Paper,* 2001-6.

[21] Logan, Trevon (2009). "The Transformation of Hunger: The Demand for Calories Past and Present." *The Journal of Economic History.* 69: 388-408.

[22] Martis, Kenneth. *The Historical Atlas of the United States Congressional Districts: 1789 - 1983.* New York: The Free Press, 1982.

[23] McKinlay, J. B. and S. M. McKinlay (1977). "The Questionable Contribution of Medical Measures to the Decline of Mortality in the U.S. in the 20th Century." *The Milbank Memorial Fund Quarterly. Health and Society,* 55(3), 405-428.

[24] Polkinhorn, R. O. (1886). *The Campaign Book of the Democratic Party, 1886.* Washington: Office of the Librarian of Congress.

[25] Preston, Samuel H. and Michael R. Haines (1991). *Fatal Years: Child Mortality in Late-nineteenth Century America.* Princeton: Princeton University Press.

[26] National Democratic Committee (1888). *Republican Abuses at the Pension Bureau.* New York: Brentanos.

[27] Rosenberg, Charles E (1987). *The Care of Strangers: The Rise of America's Hospital System.* New York: Basic Books.

[28] Skocpol, Theda (1992). *Protecting Soldiers and Mothers.* Cambridge: The Belknap Press of Harvard University Press.

[29] Smith, James (2005). Unraveling the SES-Health Connection. *Population and Development Review*, Special Issue (February).

[30] Snyder, Stephen E., and William N. Evans (2006). "The Effect of Income on Mortality: Evidence from the Social Security Notch." *Review of Economics and Statistics,* 88, 482-495.

[31] U.S. Census Bureau (1960). *Historical Statistics of the United States, Colonial Times to 1957.* Washington D.C.: U.S. Census Bureau.

[32] U.S. Pension Bureau (1882). *Instructions to Examining Surgeons for Pensions.* Washington: Department of the Interior.

Table 1: Summary Statistics for Union Army Veterans

	Mean (%) in Baseline Year	
	On rolls in 1873	On rolls in 1893
Disease Conditions		
Respiratory	4.40	7.22
Endocrine	.46	5.64
Genito-urinary	.40	3.56
Digestive	6.91	24.75
Cardiovascular	3.43	30.00
Infectious	1.94	5.06
Occupation Type		
Farmer	35.60	36.82
Professional (1)	2.22	3.03
Professional (2)	5.66	6.19
Artisan	14.74	13.03
Service	3.71	4.61
Manual Labor	9.37	11.44
Retired	24.17	22.50
Married	72.06	78.44
State		
Illinois	12.02	8.01
New York	18.57	10.17
Ohio	13.69	14.67
Pennsylvania	10.41	8.77
Michigan	4.72	6.34
Indiana	4.37	5.50
All Other	36.22	46.54
No. of Veterans	1750	13,296

Table 2: Probit Regression - Predicting Veteran's Entry onto Pension Rolls

	Date of Entry onto the Pension Rolls			
	1873		1893	
	Coefficient	Mean (%)	Coefficient	Mean (%)
War Injury/Illness	.207***	76.51	.044***	34.12
	(37.00)		(10.16)	
POW	.031***	13.14	.013*	8.76
	(4.16)		(-16.42)	
Private	.007	71.82	.087***	74.70
	(0.18)		(2.46)	
Sergeant	.014	10.29	.036	8.06
	(0.34)		(1.49)	
Lieutenant	.015	2.29	.024	1.84
	(0.34)		(0.87)	
Musician	.003	.97	.042*	1.45
	(0.08)		(1.82)	
Birth Year	-.003***	1836	-.006***	1838
	(-9.88)		(-16.42)	
No. of Veterans on rolls	1750		13296	
Total no. on veterans	16013		14442	

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

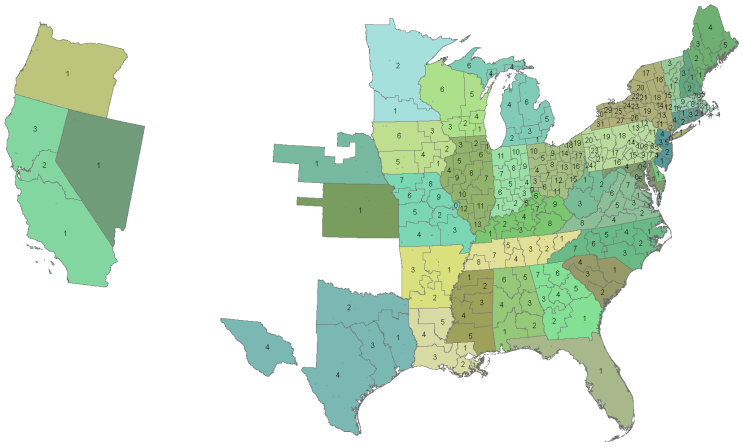

Figure 1: Congressional District Map for Census Year 1870

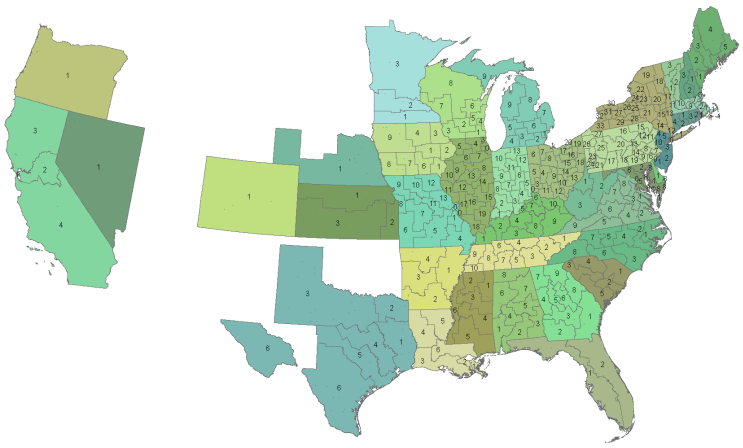

Figure 2: Congressional District Map for Census Year 1880

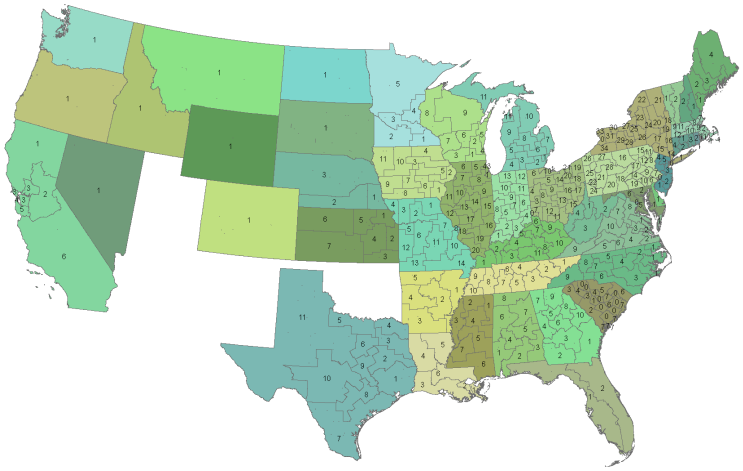

Figure 3: Congressional District Map for Census Year 1890

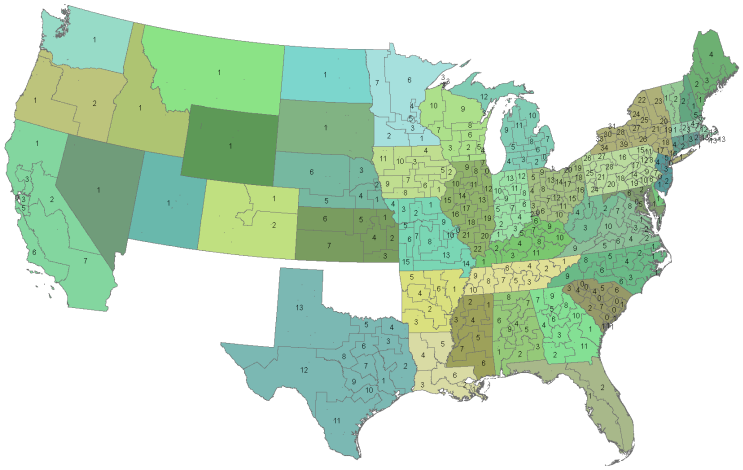

Figure 4: Congressional District Map for Census Year 1900

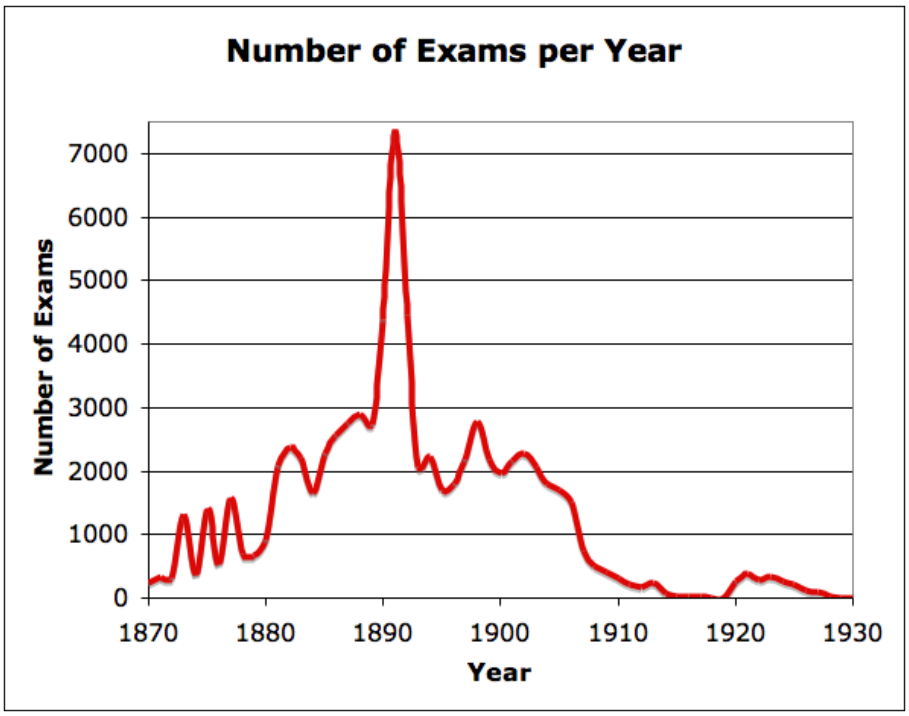

Figure 5: Number of Exams per Year

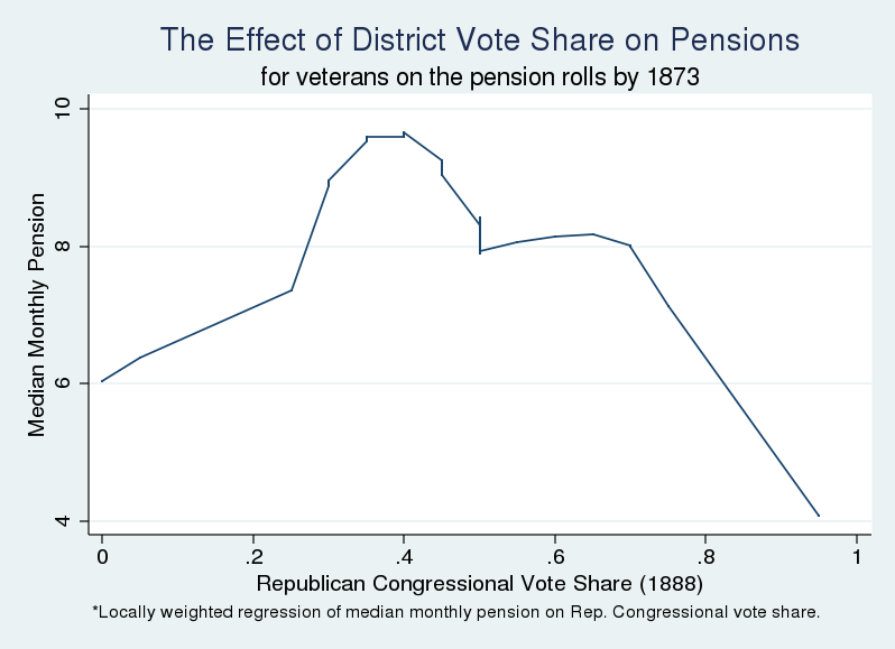

Figure 6: District Vote Share and Pensions for 1873-sample

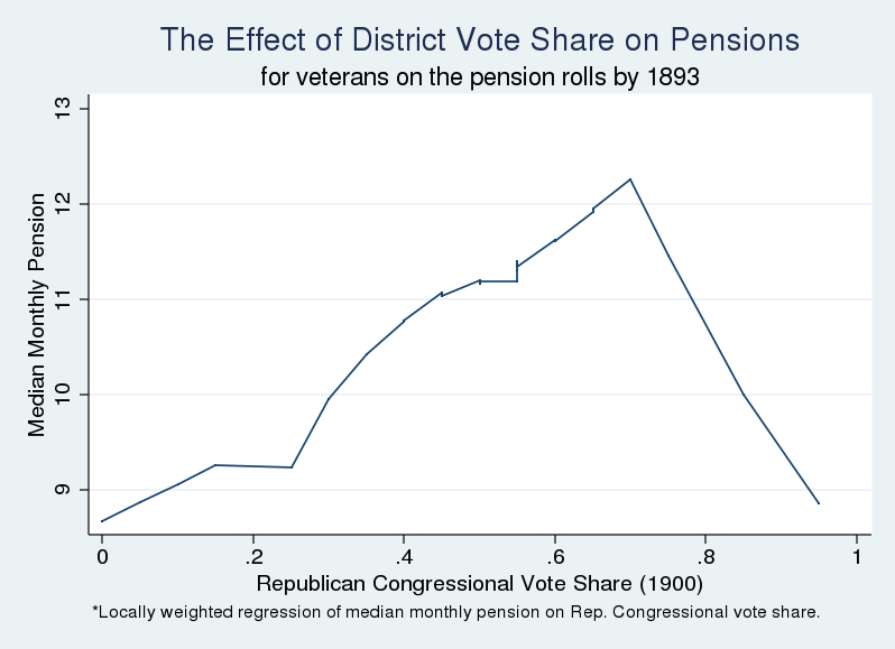

Figure 7: District Vote Share and Pensions for 1893-sample

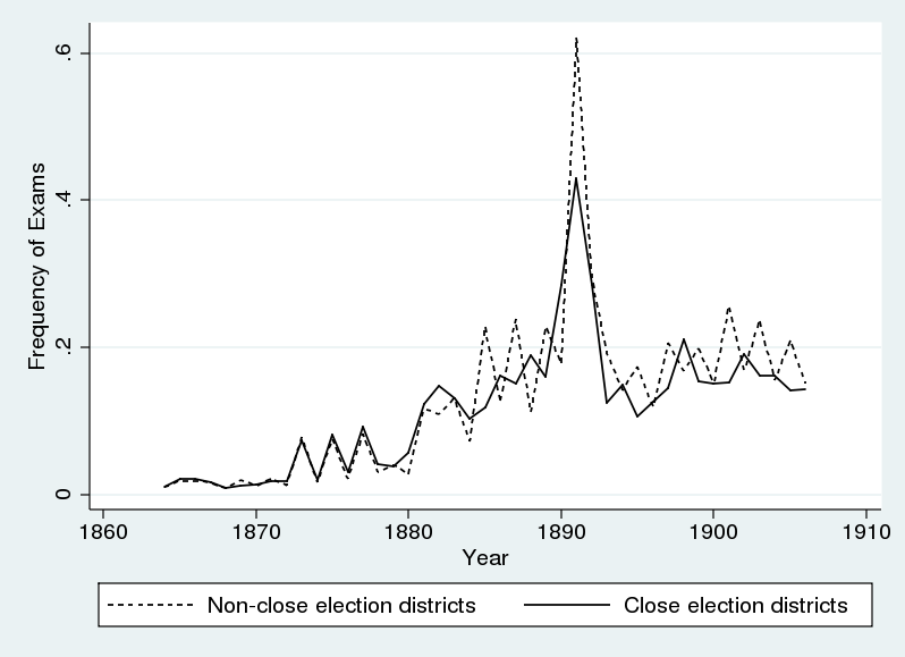

Figure 8: Frequency of Exams per year for all veterans

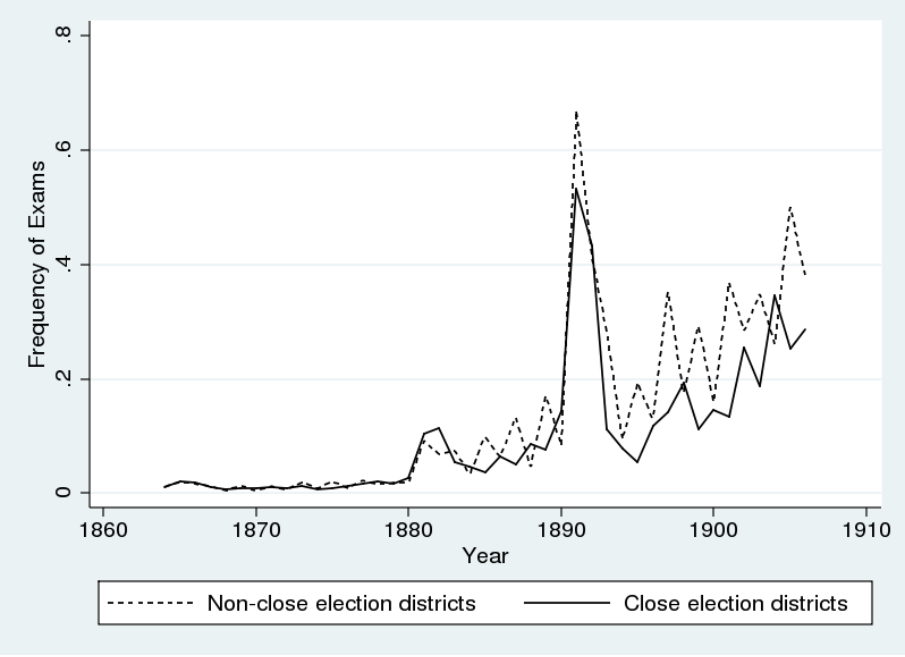

Figure 9: Frequency of First Exams per year for those not yet on rolls

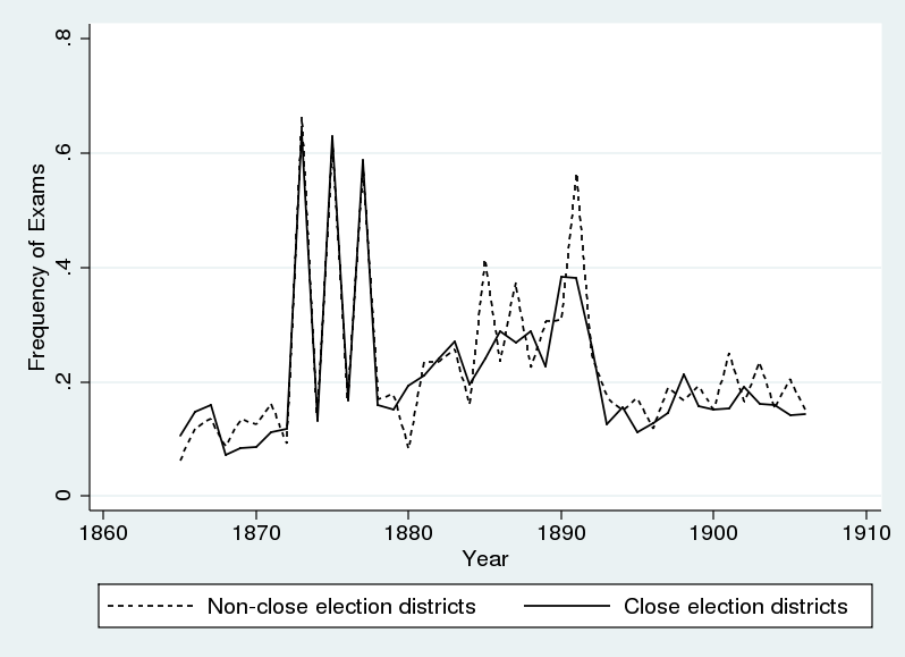

Figure 10: Frequency of Exams per year for those already on the rolls

Table 3: First Stage Results

	Monthly Pension ($)	
Date of entry onto Pension Rolls:	1873	1893
Vote (=1 if 0.3≤ Republican Vote Share ≤0.7)	1.28***	.88***
	(9.44)	(9.06)
Time Trend	.45***	.24***
	(78.80)	(27.50)
Birth Year	-.05***	-.18***
	(-7.81)	(-44.97)
Top 100 City	-.24	.26
	(-0.24)	(0.53)
Farm Land Value (per acre)	.00***	.00***
	(-5.23)	(-14.18)
Mean pension ($)	11.13	11.92
No. of Veterans	1671	11698

Note: First stage results when second-stage dependent variable of interest is a dummy variable =1 if a veteran had a hernia in the period. *t* statistics in parentheses. Monthly pension income in 1907 dollars. Controls: Rank in the army, prisoner-of-war status, war wounds and dummies for previous illnesses. * p¡0.05, ** p¡0.01, *** p¡0.001. Clustered by year and district.

Table 4: Hazard Regression Estimates of the Onset of Respiratory & Digestive Conditions

Dependent Variable: Monthly Pension Amount						
	No fix for reverse causality		Correcting for reverse causality			
Date on rolls:	1873	1893	1873	Hazard Rate	1893	Hazard Rate
Respiratory	.003	-.002	-.344***	.006	-.207**	.009
	(.007)	(.004)	(.138)		(.098)	
	[1659]	[11548]	[1659]		[11548]	
Bronchitis	-.007	-.003	.100	.002	-.065	.005
	(.010)	(.005)	(.262)		(.134)	
	[1717]	[12192]	[1717]		[12192]	
Pneumonia	.016	-.003	-.566**	.001	-.210*	.002
	(.010)	(.008)	(.283)		(.119)	
	[1894]	[12855]	[1894]		[12855]	
Digestive	-.018***	-.028***	-.031	.008	-.199**	.015
	(.007)	(.004)	(.150)		(.087)	
	[1603]	[9023]	[1603]		[9023]	
Diarrhea	-.020**	-.017***	-.194	.005	.055	.008
	(.009)	(.005)	(.166)		(.121)	
	[1618]	[9884]	[1618]		[9884]	
Enlarged Liver	-.018***	-.005	-.511***	.006	-.207**	.011
	(.007)	(.004)	(.139)		(.091)	
	[1719]	[10856]	[1719]		[10856]	

Note: Standard errors in parentheses. No. of veterans in square brackets. $^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$
Controls: Top 100 city (in population size), time trend, cubic of first-stage residual, birth year, county-level average farm value per acre, rank in the army, prisoner-of-war status, war wounds and previous illnesses. Clustered by year and district.

Table 5: Hazard Regression Estimates of the Onset of Infectious, Cardiovascular, and Endocrine

	Dependent Variable: Monthly Pension Amount					
	No correction for reverse causality		Correcting for reverse causality			
Date of Entry onto Pension rolls:	1873	1893	1873	Hazard Rate	1893	Hazard Rate
Infectious Illnesses	-.013	-.024***	-.275	.003	-.478***	.004
	(.010)	(.007)	(.201)		(.125)	
	[1693]	[11829]	[1693]		[11829]	
Cardiovascular	-.009**	-.017***	-.150*	.022	-.285***	.049
	(.004)	(.002)	(.082)		(.050)	
	[1657]	[8152]	[1657]		[8152]	
Arteriosclerosis	-.017	-.001	-.592***	.002	-.505***	.006
	(.011)	(.004)	(.174)		(.106)	
	[1736]	[12880]	[1736]		[12880]	
Dyspnea	-.021***	.002	-.089	.011	-.231***	.034
	(.005)	(.002)	(.116)		(.052)	
	[1715]	[11827]	[1715]		[11827]	
Enlarged Heart	-.003	-.008	-.051	.013	-.272***	.029
	(.004)	(.003)	(.114)		(.059)	
	[1708]	[9946]	[1708]		[9946]	
Endocrine Illnesses	-.003	.005	-.255	.004	-.102	.008
	(.008)	(.003)	(.189)		(.108)	
	[1729]	[11725]	[1729]		[11725]	
Diabetes	.019	.008	-.486	.001	-.449**	.002
	(.012)	(.006)	(.376)		(.194)	
	[1734]	[12884]	[1734]		[12884]	

Note: Standard errors in parentheses. No. of veterans in square brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Controls: Top 100 city (in population size), time trend, cubic of first-stage residual, birth year, county-level average farm value per acre, rank in the army, prisoner-of-war status, war wounds and previous illnesses. Clustered by year and district.

Table 6: Hazard Regression Estimates of the Onset of Hernia and Genito-urinary Conditions

	Coefficient on Monthly Pension Amount					
	No correction for reverse causality		Correcting for reverse causality			
Date of Entry onto Pension rolls:	1873	1893	1873	Hazard Rate	1893	Hazard Rate
Genito-urinary Illnesses	-.028***	-.022***	.042	.003	-.241***	.009
	(.010)	(.005)	(.196)		(.093)	
	1729	12366	1729		12366	
Cystitis	-.027	-.014**	.036	.001	-.418***	.003
	(.017)	(.007)	(.336)		(.150)	
	1733	12750	1733		12750	
Hernia	-.028***	-.021***	-.410***	.004	-.556***	.005
	(.010)	(.006)	(.147)		(.114)	
	1671	11698	1671		11698	

Note: Standard errors in parentheses. No. of veterans: 17,238. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Controls: Top 100 city (in population size), time trend, cubic of first-stage residual, birth year, county-level average farm value per acre, rank in the army, prisoner-of-war status, war wounds and previous illnesses. Clustered by year and district.

Table 7: Hazard Estimates for Mortality

	Coeff. on Monthly Pension		Coeff. on Monthly Pension			
	No correction for reverse causality		Correcting for reverse causality			
Date of Entry on rolls:	1873	1893	1873	Hazard Rate	1893	Hazard Rate
All-cause Mortality	.014***	.010***	-.327***	.018	-.342***	.028
	(.003)	(.001)	(.071)		(.048)	
Respiratory Illnesses	.021***	.014***	-.420***	.003	-.377***	.005
	(.006)	(.003)	(.186)		(.113)	
Infectious Illnesses	.022	.008	-.513	.001	-.264	.002
	(.015)	(.005)	(.390)		(.195)	
Digestive Illnesses	.015**	.0143	-.459**	.002	-.333***	.007
	(.007)	(.002)	(.219)		(.101)	
Cardiovascular Illnesses	.009	.009***	-.281*	.005	-.382***	.013
	(.005)	(.001)	(.155)		(.072)	
Endocrine Illnesses	.019	.019***	-.720**	.001	-.430**	.002
	(.013)	(.003)	(.345)		(.181)	
No. of veterans	1736	13011	1736		13011	

Note: Standard errors in parentheses. No. of vets: 17,238. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Controls: Top 100 city (in population size), time trend, cubic of first-stage residual, birth year, county-level average farm value per acre, rank in the army, prisoner-of-war status, war wounds and previous illnesses. Clustered by year and district.

Table 8: Regression Discontinuity - Law of 1907

	1844-Cohort	1846-Cohort		1844-Cohort	1846-Cohort
Respiratory	-.043***	-.028*	Endocrine	.002	-.003
	(-3.04)	(-1.76)		(-0.30)	(-0.34)
	[1566]	[1221]		[1499]	[1199]
Asthma	-.008*	.004	Diabetes	-.003	.006
	(-1.66)	(0.99)		(-0.87)	(1.25)
	[1825]	[1424]		[1826]	[1427]
Bronchitis	-.013	-.012	Enlarged Spleen	.006	-.007
	(-1.45)	(-1.34)		(1.22)	(-1.39)
	[1691]	[1333]		[1641]	[1240]
Pleuritis	-.002	-.016	Genito-urinary	-.009	.001
	(-1.05)	(-0.53)		(-0.81)	(0.21)
	[1836]	[1273]		[1675]	[1440]
Pneumonia	-.018**	-.013	Cystitis	-.004	.005
	(-2.11)	(-1.25)		(0.49)	(.054)
	[1840]	[1447]		[1794]	[1394]
Tuberculosis	-.007	.004	Enlarged Prostate	-.017	.004
	(-1.48)	(0.70)		(-1.28)	(0.27)
	[1833]	[1445]		[1743]	[1333]
Digestive	.001	-.006	Nephritis	.008	-.014
	(0.08)	(-0.50)		(0.90)	(-1.33)
	[1125]	[851]		[1864]	[1468]
Diarrhea	-.002	.000	Infectious	-.002	-.009
	(-0.40)	(0.03)		(-0.35)	(-1.41)
	[1347]	[1036]		[1649]	[1245]
Dysentery	-.001	-.002	Cholera	.001	-.001
	(-0.64)	(-0.80)		(1.11)	(-0.90)
	[1864]	[1469]		[1882]	[1478]
Enlarged Liver	-.026***	-.003	Cardiovascular	-.029	.021
	(-3.00)	(-0.41)		(-0.88)	(0.59)
	[1335]	[1086]		[698]	[492]
Gastroenteritis	.004*	-.002	Arteriosclerosis	-.009	.008
	(1.55)	(-.039)		(-0.51)	(0.40)
	[1851]	[1433]		[1766]	[1376]
Malassimilation	-.003	-.004	Dyspnea	-.050***	-.001
	(-0.69)	(-0.90)		(-2.58)	(-0.07)
	[1744]	[1334]		[1091]	847
Nausea	.001	.003	Enlarged Heart	-.035**	-.020
	(0.91)	(0.77)		(-1.94)	(-1.07)
	[1848]	[1448]		[1079]	[784]

Note: z statistics in parentheses. No. of veterans in square brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Controls include the veteran's rank in the army, his war wounds and POW status.

Table 9: Logit Model of Migration

Dep. Var.: Prob. of moving to district in which elections are close for Republicans				
Lagged Sickness (any disease)	.080*	-.032	.020	-.065
	(1.70)	(-0.93)	(0.37)	(-1.42)
Time Trend	-.032***	-.011	-.051***	-.013
	(3.56)	(-1.06)	(-2.97)	(-1.28)
Square of Time Trend	.000***	.000*	.001***	.000***
	(4.50)	(1.81)	(4.39)	(3.41)
Only those who move	NO	NO	YES	YES
Controls	NO	YES	NO	YES
$Number of Observations$	651,822			

Controls include BMI, rank, marital status, occupation, retirement status, POW status and war wounds.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Mortality by County: 1870 and 1880

	Total Mortality	Respiratory	Digestive	Infectious	Cardiovascular
Close Election	-.0000	-.0000	.0000	.0001***	-.0001
	(-0.20)	(-0.27)	(0.97)	(3.67)	(-1.14)
Year = 1880	.0025***	.0012***	.0001***	.0002***	.0004***
	(13.98)	(12.78)	(7.37)	(16.40)	(7.54)
Interaction (Cohort =1770)	-.0022	.-0010*	.0000	-.0001*	-.0000
	(-1.21)	(-1.00)	(0.87)	(-1.35)	(-0.10)
Interaction (Cohort = 1780)	-.0025	-.0010	.0001	-.0003	-.0005
	(-1.09)	(-0.81)	(0.24)	(-1.31)	(-0.85)
Interaction (Cohort = 1790)	.0023*	.0018***	.0001	.0001	.0002
	(1.71)	(2.53)	(0.41)	(0.71)	(0.37)
Interaction (Cohort = 1800)	.0030***	.0016***	-.0000	.0001**	.0008***
	(3.05)	(2.43)	(-0.30)	(2.23)	(3.13)
Interaction (Cohort = 1810)	.0013**	.0008***	.0001	.0001	-.0003**
	(2.74)	(2.72)	(0.80)	(1.11)	(2.00)
Interaction (Cohort = 1820)	.0004	.0003	.0000	-.0000	-.0000
	(1.49)	(1.12)	(1.20)	(-0.96)	(-0.14)
Interaction (Cohort = 1830)	-.0003	-.0002	-.0001	-.0001**	-.0000
	(-1.40)	(-0.87)	(-0.20)	(-2.33)	(-0.78)
Interaction (Cohort = 1840)	.0001	-.0000	-.0000	-.0001**	.0001
	(0.46)	(-0.11)	(-0.51)	(-2.04)	(1.21)
Interaction (Cohort = 1850)	-.0003*	-.0003*	.0000	-.0001***	.0001**
	(-1.89)	(-1.86)	(0.67)	(-2.60)	(2.50)
N	12768	12768	12768	12768	12768

t statistics in parentheses. Controls: Cohort dummies for 1770 - 1850. Omitted cohort is 1860.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Clustered by year and district.