The First Industrial Pension: Aging and Retirement in the Early 20th Century

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Abstract

In 1900 the Pennsylvania Railroad, which was then the largest private employer in the U.S., imposed the first in the nation mandatory retirement on all its long-term employees who were age 70 or over. The Pennsylvania Railroad pension became a model for other railroads and industrial companies, but its unexpected impact on the railroad finances led to government intervention in the Railroad Retirement Acts, which created a model for the Social Security system.

Using the records of 20,000 workers who retired in the first twenty years of the Pennsylvania Railroad program, we describe how its diverse workforce changed as they aged. In particular, we use data on early retirements to examine how workers responded to economic and non-economic incentives to retire. We find that workers were quite sensitive to the benefits offered by the pension, but their decisions were also shaped by working conditions, like the long hours and irregular schedules faced by those who worked aboard the trains.

PRELIMINARY RESULTS
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Introduction

At the end of the nineteenth century, very few workers in the U.S. could expect to retire with a pension. Large employers and unions had developed various "relief plans" for workers that focused on sickness insurance, funeral expenses, and disability benefits. Some plans included a pension provision, which was linked to contributions to the relief fund. Old age pensions in the U.S. lagged behind European countries, like Germany where there was a pension for all industrial workers. Discussions of government sponsored old age pensions in the U.S. was derailed by the politics of pensions for Union Army veterans.

In 1900 the Pennsylvania Railroad, which was then the largest private employer in the U.S., introduced a new old age pension for all its workers. The amount of the pension was based on recent earnings and length of service, but it was non-contributory and fully funded by the railroad. All employees were required to retire at age 70, and workers in poor health could request retirement as early as age 65. Railroad leadership expected the new pension to more than pay for itself by replacing retirees with younger, more efficient, and less costly workers. The Pennsylvania Railroad pension rapidly became a model for other railroads and industrial companies. However, when railroads faced the combined impacts of competition from automobiles, an ageing workforce, and the Great Depression, these pensions became unsustainable. Railroads and their unions won government-supported pensions in the Railroad Retirement Acts, which created a model for the Social Security system.

We describe the first twenty years of the Pennsylvania Railroad program and how its diverse workforce changed as they aged. Since mandatory retirement was introduced without any warning, the first year of the pension gives us a snapshot of men who were still working for the railroad after age 70. Some of these men had moved down the occupational ladder to less physically demanding and less remunerative jobs, like watchman. Others adapted by working part-time. A third group was protected by their skills and by unions that insisted on rights for seniority. However, we find that the most elite workers in this group, locomotive engineers and conductors, sometimes retired by age 70 before 1900 and often requested early retirement under the new pension.

We also use data on early retirements to examine how workers responded to economic and non-economic incentives to retire. We find that workers were extremely sensitive to the benefits offered by the pension, but their decisions were also shaped by working conditions, like the long hours and irregular schedules faced by those who worked aboard the trains.

The Pennsylvania Railroad Pension

The PRR pension was not the first benefit that the company offered to its employees. Waves of violent strikes in the last quarter of the nineteenth century and the rise of trade unions convinced railroads to adopt new approaches to their employees (Licht, 1983, pp. 262-264). The industry had transitioned from a spot labor market to one of long-term employment and seniority. Railroad executives were sensitive to the need to

win the loyalty and goodwill of their large and dispersed workforce. One way to accomplish this was the establishment of "relief" departments or associations which provided accident, sickness and death benefits. Most of these plans were "voluntary" and required a monthly contribution. Some plans restricted membership by age or health. The Baltimore and Ohio Railroad was the first company to add a pension benefit for the members of their relief organization 1885. The original plan was described as for:

> superannuating such members of this association as may become incapacitated through infirmities or old age for earning a livelihood, and for making provision for the support of such disabled members of the association as, having received a year's sick allowance, are not entitled to further benefits form the relief fund, yet remain totally unable to earn a livelihood. (Baltimore and Ohio Railroad Company Minute Book - President and Directors Meeting, October 8, 1884 reprinted in Higgins (1974))

This plan allowed workers who had been members of the relief association for four years and worked for the railroad for ten years to retire on a pension that was determined by the worker's class of membership in the relief association (Higgins, 1974). However, participation was not significant. From 1885 to 1900 it averaged less than 200 pensioners in any year from a line that had over 8,000 employees.

The PRR had established a Voluntary Relief Department in 1886. It provided the same types of service as the B&O, and worker contributions to the PRR Voluntary Relief Department and its benefits were scaled according to earnings (Riebenack, 1905, pp. 60-72). By 1900 the PRR Voluntary Relief Department also had a superannuation plan that would "return to them, monthly, during active retirement period, a portion of the interest on the surplus, based on their relative contributions." It was recognized, however, that "the accrued interest on Relief Fund money, ..., was inadequate to furnish to retired employes, members of the fund, an income sufficient for their maintenance without other financial aid" (Riebenack, 1905, p. 179) .

For several years up to 1900, the PRR was considering a much larger and innovative pension that included mandatory retirement and covered all workers. In addition to the usual motive of removing the dangerous, superannuated worker, the primary purpose mentioned was "to move him out for 'payroll relief', and to open channels of promotion which would otherwise be blocked" (Williamson, 1988). This pension program was established on January 1, 1900, in the PRR Lines East of Pittsburgh and a year later for the Lines West of Pittsburgh. Retirement was mandatory at age 70, and voluntary retirement for incapacitation was available from age 65 for those with 30 years of service. Pension allowances were based on earnings and length of service: one percent of average monthly earnings in the ten years before retirement for every year of service. Unlike the Relief Department, pensions were paid entirely by the company without worker contributions (Riebenack, 1905, pp. 141-146).

This plan was revolutionary and gave birth to the modern industrial pension. Between 1890 and 1899, about 20,000 railroad employees in the U.S. were covered by pensions, which was only 2.5 percent of a workforce approaching one million. It is not known how many had retired during that time, but the number must have been small. In 1900, the PRR retired over 1,300 workers from its Eastern Lines. The number of railroad workers covered by pensions jumped from 24,295 in 1899 to 251,008 in 1901, 23.4 percent of all railroad employees (Latimer, 1932a, p. 1:26). Other railroads immediately contacted the PRR to get information on how to create their own pensions. By 1905 eleven other railroads copied the PRR and 35% of railroad employees were covered by a pension plan. By 1929, there were 397 industrial pensions covering 3.7 million employees (Latimer, 1932a, pp. 1: 478-483).

The PRR pension was motivated by the economic interests of the company and not by the welfare of its workers (Gratton, 1990). The company had accepted demands of trade unions, such as the Brotherhood of Locomotive Engineers, that awarded higher wages and more desirable positions on the basis of seniority. Seniority rules increased the disparity in wages between older and younger workers and reduced the company's ability to remove less productive workers. Since workers would lose their pension rights if they left the company, the pension would reduce turnover and discourage labor unrest. Thus, the pension system was viewed as a way to cut costs and increase efficiency. Graebner (1980, pp. 184-188) shows that economic considerations also dominated early discussions of the Social Security system. Congress and the Roosevelt administration emphasized economic efficiency and the importance of retirement for reducing unemployment for younger workers.

PRR Pension Data

Data were collected from dossiers created for the PRR Pension which include names, average earnings before retirement, years of service, and dates of birth, retirement, and death (Pennsylvania Railroad, 1900-1920). We have data on 10,045 workers who retired between January 1900 and October 1920 in the Eastern Lines of the railroad. The Annual Reports of the Pension Board providing these data were discontinued in 1920 when governance of the pensions of the Eastern and Western Lines was merged. The number of observations in our tables varies, because of missing data on occupations and dates.

Figure 1 shows the number of retirements by year broken down by type of retirement. There were three ways that a man could retire. First, retirement was mandatory at age 70. More than 1,300 workers retired in 1900 when the age limit of 70 years was imposed. Second, employees could request early retirement because of poor health starting at age 65 if they had at least 30 years of service to the PRR. Early retirements at the employee's request grew from about a third before 1905 to more than half after 1910. This reflected increased willingness of the Pension Board to accept requests for early retirement initiated by employees. The growth in early retirements surprised the railroad management: "Scattered comments suggest that the PRR executives assumed

that older workers wanted to remain on their jobs as long as possible" (Gratton, 1990, p. 655). Third, a small percentage (4%) of workers retired early (between ages 65 and 70) at the request of their supervisors. As we will see, these men were often in poor health and were already working part time.

Although the pension records do not identify workers by sex or race, we know that they were overwhelmingly male and white. Pensions were denied to the railroad's African American and female workers by excluding the Dining and Restaurant Service from the pension. In the minutes of the Board of Officers of the Pension Board, Vice President Thayer supported this decision by saying that

> 90% of those in the Dining Car Service are colored persons, who, on account of their migratory habits, do not appreciate the value of pension advantages, and that prospect of pension is of no value to the Company in retaining service of such employes. (Riebenack, 1907).

A 1908 table showing numbers of workers by race and sex in the Dining and Restaurant Service shows that African Americans were dominant among chefs, cooks, pantrymen, and train porters. Women, who were mostly white, were found as cooks and dishwashers (Pennsylvania Railroad, 1908). Dining service jobs like cook do not appear in the pension data. There are 28 porters in the pensions, but we do not know how many of them were non-white. Four retirees reported as "matrons" were presumably female. We used first names to identify about sixty women included in the pension records and exclude them from the analysis described here.

Occupations and Careers

The pension records describe the occupations of all men over age 70 in 1900, when they were forced to retire under the new pension. It is clear that some men were at the apex of their careers while others had moved down the occupational ladder at older ages, a pattern described by Ransom and Sutch (1986). For example, almost 12% of all retirees are listed as "watchmen," triple the percentage of all workers in these jobs reported by Riebenack (1905, p. 13).

Census data from 1900 strongly suggest that watchmen began in other occupations. We selected male workers in the railroad industry living in six states (Delaware, Indiana, Maryland, New Jersey, New York, and Pennsylvania) included in the PRR East pensions from the full count U.S. census of 1900 data provided by IPUMS (Ruggles et al., 2021). The IPUMS team assigned occupations to the industry codes developed by the Census Bureau for the 1950 census, in which railroads are coded 506. In addition, we searched for reported occupations that included text strings "RR " or " RR" to capture railroad workers not recognized by the industry codes. We use the IPUMS "OCC1950" occupational categories to look at specific occupations.

Figure 2 compares the age distributions of two occupation categories including watchmen to the ages of laborers and switchmen. Laborers and switchmen were predominantly young men, and less than a third of men in these occupations were over age 40. In contrast, more than half of watchmen were over age 50. The rapid decrease in watchmen around age 70 is at least partly due to the PRR pension program, which began before the census was taken. Although we cannot trace men shifting among jobs, these patterns suggest that jobs like watchman were destinations for older workers who had done hard physical labor when they were young.

We can see evidence of other career paths in Table 1, which shows average ages of men in occupation categories with at least one hundred men in the 1900 census sample. For example, locomotive firemen and brakemen were young, average ages 30.1 and 31.9 respectively, but the average locomotive engineer was 40.9 years old. Similarly, clerical workers (average age 31.1) and bookkeepers (32.9) could have become cashiers (37.1), ticket/station/express agents (38.0), and accountants/auditors (39.1). Among men in the skilled trades, some occupations peaked early, like boilermakers (33.6), painters (34.5), and machinists (35.4), while other careers lasted longer, like carpenters (40.8) and blacksmiths (41.0). Describing the period before 1880, Licht (1983, p. 150) tells us: "The normal pattern, however, was laborer at twenty, brakeman at twenty-two, freight conductor at twenty-six, and passenger conductor at thirty-six."

Executives and supervisors repeatedly expressed their desire to support men who had given decades of loyal service to the railroad, and it was believed that workers were often employed after they had lost the ability to do their jobs (Licht, 1983, p. 212). Indeed, the pension program was a way to reward these loyal employees while opening jobs to younger, more productive workers (Gratton, 1990). For example, a 1903 letter from a superintendent to the president of the Cleveland Akron & Columbus Railway proposed restricting the assignments of two enginemen (aged 61 and 60), who had been in that job since 1869 and 1873 respectively.

> Both of these men are so old that they are not giving satisfactory service on our through passenger runs, especially the night runs, and should be placed on trains where the work is easier and the responsibilities not so great…
>
> If Rhinehart and Ingham are put on these runs at the rate of pay made $4.00 a trip, it would be a pension position and would put the company, as I have said, to the expense of $34., a month, or $408., a year over and above what it costs at present. At the same time, in view of their age, good records and terms of service, I think we owe them something, especially when you consider it is not likely they will be in a position to run at all for any great number of years, but since it involves a gratuitous increase in our expenses I do not care to make the arrangement without its being understood by yourself and having authority for the same.
> (Thornton, 1903)

In this case the workers retained their job titles, but they were moved to less demanding and lower paid tasks. Thus, it is likely that some men moved down the occupational ladder at older ages, while others retained their jobs with reduced responsibilities.

Earnings Before Retirement

Table 2 shows the number of retirees and their average monthly earnings during the ten years before retirement by occupational categories. Pre-retirement earnings have been adjusted to 1900 dollars by a consumer price index (Williamson & Officer, 2024) to account for inflation during this period. The highest paid retiree was a first vice president, whose average monthly earnings in the ten years before retirement were $2,555.55. This was more than 45 times the average monthly earnings for all retirees of $56.55. We identify locomotive engineers, conductors, brakemen, and firemen separately, because they play an important role in our findings below. It is noteworthy that locomotive engineers ($85.61) and conductors ($74.22) were more highly paid than supervisors ($73.18) and many white-collar workers, like clerks and agents ($65.32). The skilled trades (machinists, blacksmiths, carpenters, painters) earned around $50 per month, and unskilled laborers averaged only $34 per month.

How well were 1900 railroad workers paid relative to today? To put earnings in 1900 in perspective, we compute their relative worth in 2023 prices and wages. Consider the pay of locomotive engineers. As shown in Table 2, their average annual wage in 1900 was $1,027. What is the relative value of this 1900 wage in 2023? Table 2 gives two answers. One is the "real wage" in 2023 estimated by an inflation calculator based on the Consumer Price Index (CPI). Adjusting the 1900 annual wage of locomotive engineers for changes in the CPI produces an estimate of $38,455. That is about $20 per hour or the wage of a clerk at McDonalds. According to the BLS the median annual wage of an engineer in 2023 is $74,770 or double this amount (U.S. Bureau of Labor Statistics, 2023). This implies that engineers earned an unskilled wage in 1900 and over a century later were more skilled, earning a middle-class income. This is not what happened.

A better way to compute the relative worth of the wages of locomotive engineers is to compute "relative labor earnings" in 2023. This is done by taking the ratio of their earnings to the national average of earnings in 1900 and then applying that ratio to the average earnings today. For example, locomotive engineers earned 213 percent of average earnings in 1900, and multiplying that percentage by average earnings in 2023 ($57,998 (U.S. Bureau of Labor Statistics, 2024)) yields relative labor earnings of $123,356. Although this estimate is 70% more than the average engineer today, it is a realistic number. First, average earnings in the pension records are the earnings of locomotive engineers who retired with more than forty years of seniority. Further, they were working for the largest employer in the country. These were not average engineers. The average salary today is for an engineer who has been working for far fewer years

Commented [LC1]: How does that compare with what's in MeasuringWorth for unskilled/production workers?

Commented [LC2]: Given the way this turns out, is it really necessary? The points about how well these guys were paid can be made without trying to tie them to 2023 values.

and works for a less prestigious employer. More importantly, driving a locomotive in 1900 was a dangerous, highly skilled occupation that was respected by other railroad workers and society in general. Today, locomotive engineers are just one of hundreds of skilled professions, one of those where computerization has made the job less dangerous and substitutes for some of the skill required by older engineers. For additional discussion on the different ways to compute the relative worth of compensation in the past see (Williamson & Cain, 2024).

Part-time Work and Early Retirement

The pension records also indicate that many workers responded to aging by working less time. The terms of the PRR pension created a strong incentive for those working less than full time to retire early. Since the amount of the pension was based on average earnings for the ten years before retirement, employees who missed work or slipped into less remunerative jobs risked reducing the size of their pensions. Although pensions increased by one percent for every year of service, working less than ninety percent of full time would reduce the ten-year average used to compute the pension by more than one percent.

We have clear evidence that some retirees were working less than full time as a result of a change in the calculation of pensions that went into effect in 1906. Starting in that year the Pension Board based pensions on the actual earnings of workers in the ten years before retirement rather than the expected earnings for full-time workers in the same occupation (Pennsylvania Railroad, 1910-1912). For three years (1906-1908) the retirement records included both actual and expected full-time earnings for each retiree.

Table 3 examines retirement behavior by the ratio between actual and expected full-time earnings among those who retired from 1906 to 1908. More than 60% of workers who retired at age 70 earned more than 95% of their expected full-time earnings before retirement compared to only 38% of workers who requested early retirement. Less than 8% of workers who retired at age 70 were below 75% of their expected full-time earnings compared to 26% of workers who requested early retirement. Workers whose earnings were slipping had a strong incentive to retire as early as possible.

The results shown in Table 4 show a strong association between part-time work and early retirement, especially for retirements initiated by a supervisor. Table 4 uses an indicator of part-time employment for all retirees comparing their earnings to the median earnings in 21 occupational groups, which we apply to pensions from 1901 to 1920. As we show below, men forced into retirement by their supervisors were in worse health than those who requested early retirement themselves. The categories used in Table 4 are wider than those in Table 3, because our measure of expected earnings is less precise. Table 4 excludes retirees with professional and executive occupations, because of the very wide range of earnings in that group.

Early Retirement by Occupation

Table 5 looks at early retirement by skill level and years of service. Recall that a worker's pension was calculated by multiplying average earnings in the ten years preceding retirement by one percent for every year of service. Table 5 shows that the highest paid workers had also worked for the PRR for the longest time, so their pensions were more than 40% of their pre-retirement earnings.

Table 5 also shows that the relationship between pre-retirement income, skill, and early retirement was not simple. Overall, 46 percent of workers took early retirement. Early retirement was less common for highly paid professionals and executives and for low wage unskilled workers. However, 80 percent of locomotive engineers, conductors, brakemen, and firemen retired early. Engineers and conductors were well paid, but brakemen and firemen earned slightly less than the average for all retirees. The most obvious difference between these four occupations and other PRR employees is that they traveled with the trains.

Commented [LPC3]: Say something about how this worked. Did the same engineer travel from, say, Chicago to New York? I assume not. I assume they went from Chicago to some point several hours away, then drove a train back to Chicago the following day (or something like that). You need to offer some explanation for the additional cost of "traveled with the trains."

The retirement records also suggest that workers who travelled with the trains were more likely to retire before age 70 before 1900. We computed ages in 1900 of all PRR retirees who would have been age 50 or older in 1900. Among all PRR retirees, 15.2 percent were older than 70 in 1900, but only 5 percent of engineers, 3 percent of conductors, and 2.1 percent of brakemen and firemen were older than 70 in 1900. We do not have direct evidence of the reasons these workers sought early retirement, but Licht (1983, p. 226) reports: "Railroad work, however, did prove disruptive of normal family life. Men frequently were on the road for long periods of time and away from home." We also note that these four occupations had powerful trade unions that succeeded in negotiating strict seniority rules benefiting older workers. The brotherhoods of locomotive engineers and conductors did create their own pension plans in 1912 and 1917 respectively (Latimer, 1932b, pp. 27-28), but these programs were too late to have an effect on the patterns discussed here. Thus, PRR workers whose trade unions protected them from age discrimination were more likely to retire early even before the pension started.

Early Retirement, Health, and Mortality

The role of poor health in early retirement shows up clearly when we examine the mortality of retirees. Figure 3 shows Kaplan-Meier survival curves by type of retirement for men who retired before age 70. We use the Kaplan-Meier technique, because it takes into account life histories that are censored, such as retirees who died after our records end in 1920. The poor health of men whose supervisors requested their retirement shows up clearly in Figure 3. Less than 60 percent of these retirees would have survived to age 70, and less than 20 percent would have lived to age 80. In contrast, about 75 percent of employees who requested early retirement themselves would have survived to age 70 and slightly more than 20 percent would have survived to age 80.

In Figure 4, we compare the survival of early retirees to employees who retired at age 70. The survival curves in Figure 4 begin at age 70, because we do not know how many men died before reaching the mandatory retirement age. We see again that workers who retired at the request of their supervisors survived fewer years than those who requested early retirement themselves or worked until age 70. The estimated median age at death for workers who retired at the request of supervisors was 75.5 compared to 76.9 for those who retired early at their own request and 77.9 for those who retired at age 70.

PRR employees who requested early retirement were healthier than men forced to retire by their supervisors but not as healthy as those who worked until age 70. Failing health was an important motivation for early retirement, and the pension program enabled retirement for many workers who otherwise would have remained in the labor force. (See Bound and Waidman (1992, pp. 1417-1418) on interpreting behavioral responses to disability insurance.)

A Model of Early Retirement

In this section we use an econometric model to examine the roles of income, pension benefits, health, and occupation in the decision to retire early. Although the previous sections showed that each of these factors was correlated with early retirement, they are also correlated with each other. This section asks whether the relationships described above persist when other variables are controlled.

Following Haveman and Wolfe (1984), we model PRR retirement decisions as a choice between working and taking early retirement due to poor health. In the PRR pension system, all workers were required to retire at age 70, but they could request retirement as early as age 65 if they had completed 30 years of service to the company. We assume that the retirement decision is made at the earliest age that the worker qualified for retirement. Workers who were not eligible for early retirement are excluded from this analysis.

The utility of working until mandatory retirement can be written as

$$U_{70} = U_{70}(Y_{70}, H_{70}) \qquad (1)$$

Y_{70} is the present value of income assuming retirement at age 70, and H_{70} is hours worked between the age of eligibility for early retirement and age 70.

The utility of retiring at the earliest age of eligibility is

$$U_E = U_E(Y_E, 0) \qquad (2)$$

Y_E is the present value of income assuming retirement at the age of eligibility, and no hours are worked after this age.

The decision function is

$$I^* = U_{70}(Y_{70}, H_{70}) - U_E(Y_E, 0) \qquad (3)$$

The worker will retire early if I* is less than zero.

For estimation, I* is approximated with

$$I^* \approx \alpha Y_{70} - \beta Y_E + \gamma X + \varepsilon \qquad (4)$$

where X is a vector of individual characteristics affecting the utility function and ε is a random error term with a mean of zero.

The PRR pension program had a simple formula for calculating benefits, which allows us to estimate the present values of income for both early and mandatory retirement. The pension was equal to average earnings over the previous ten years ($\bar{Y}$) multiplied by one percent for every year of service (S_i). The pension records provide both average earnings and years of service at the time of retirement. By assuming that each individual's average earnings were constant between ages 65 and 70, we can compute the present values of expected income from retiring at age 65 (Y_{65}) and from working until mandatory retirement at age 70 (Y_{70}).

Commented [LPC4]: Explain why this is a reasonable assumption. Under what circumstances could a worker expect annual earnings to increase or decrease between 65 and 70? This may not be clear to young readers used to annual cost of living raises.

Commented [GA5R4]: We are adjusting for inflation, so the issue is whether individual wages were rising between ages 65 and 70. Does that need justification?

The PRR formula for pensions poses a problem for statistical analysis. Both Y_{65} and Y_{70} depend upon the same two variables, average earnings and years of service. Consequently, they are perfectly collinear, which makes estimates from including both of them in a regression model unreliable. Rather than using the present values of expected incomes, we use the two variables that determine them. The roles of these variables in the difference between income from retirement at age 70 and age 65 can be broken down into three factors:

$$Y_{70} - Y_{65} = 5\bar{Y}D_0^4 - 5\frac{S_{65}}{100}\bar{Y}D_0^4 + e_{70}\frac{5}{100}\bar{Y}D_5^{e_{70}} \qquad (5)$$

in which D_t^{t+n} represents discounting to future income from years t to $t+n$ and e_{70} is expectation of life at age 70.

The three parts of Equation 5 are

$5\bar{Y}D_0^4$: the present value of income from working between age 65 and 70,

$5\frac{S_{65}}{100}\bar{Y}D_0^4$: the present value of receiving a PRR pension between 65 and 70,

$e_{70}\frac{5}{100}\bar{Y}D_5^{e_{70}}$: the present value of receiving a higher pension at age 70 because of five more years of service.

In our statistical analysis we include direct measures of average earnings ($\bar{Y}$) and years of service (S_{65}). Average earnings play a role in all three terms in Equation 5, but it's greatest contribution should be to the first term, earnings from working between age 65 and 70. For this reason, we expect higher average earnings to reduce the likelihood that an employee would retire early.

Years of service (S_{65}) only affects the second term in Equation 5, which is the first five years of pension income for those who retire at age 65. We expect men who qualified for higher pensions to be more likely to retire early.

The third term in Equation 5 is the difference in pension income after age 70 for those who work until age 70 compared to those who retire at age 65. Since working until age 70 adds five years of service, pension income after age 70 increases by five percent. However, this term is also affected by two subjective factors. The present value of pension income after age 70 depends upon how long an employee expected to live after age 70 (e_{70}) and how much he discounted the value of income more than five years in the future ($D_5^{e_{70}}$). Both of these factors would have been affected by his health at age 65, because healthy men could expect to live longer after age 70. We measure health in our regression models with years lived between ages 70 and 75 and measures of part-time work discussed above.

Since we only observe average earnings at the time of retirement, our calculations use the same value of $\bar{Y}$ for earnings at age 65 and 70. Values of average earnings have been adjusted to 1900 values using a consumer price index (Williamson & Officer, 2024). As we saw above, some men were apparently working part time, and we use a ratio of observed to expected earnings to correct for part-time work in the regression analysis.

We estimate models with and without a variable for levels and types of skill to capture work-related differences in behaviors. This variable has separate categories for men working on board the trains discussed above: locomotive engineers, conductors, brakemen, and firemen.

Most models of this sort include income from other sources, such as investments and the earnings of other family members. Although this information is not available for the PRR retirees, we believe that other sources of income were highly correlated with the earnings of retirees. Better paid workers (e.g., engineers, conductors, foremen, and white-collar workers) may have had savings accounts and owned their own homes. Since labor force participation of married women was very low at the beginning of the 20th century (Goldin, 1990, p. 17), we believe that income from wives was not substantial. Incomes from investments and the wages of children were probably positively correlated with income. In a companion paper (Alter & Williamson, 2024) we show that living with unmarried children was more common among wealthier PRR retirees, which we attribute to differences in ages at marriage of children.

Results

We estimate the model described above with logistic regression on a dependent variable set to one if the employee retired at age 65 or 66 and zero if he retired at age 70. Tables 7 and 8 report models estimated on two subsamples. Table 7 is based on all available cases after the restrictions described below are applied. Table 8 applies the same

Commented [LC6]: You earlier made a point about the type of job (e.g., travel with the trains). How are you including job type in your analysis?

restrictions to men who retired in the years 1906 to 1908, when the pension records include both actual and expected earnings.

Although we start with more than nine thousand retirees, the sub-sample used in the regressions is greatly reduced to avoid selection effects. Since we are interested in early retirement, we select employees who qualified for early retirement by having 30 years of service at age 65. We only include men who survived to age 70, because we do not observe deaths before age 70 of men who retired at that age. We exclude men who retired early at the request of a supervisor and men who retired in 1900, when mandatory retirement was introduced. To measure health, we use years lived between ages 70 and 75, which excludes men who would not have reached age 75 in 1920. (See Anderson and Burkhauser (1985) for a similar use of subsequent mortality as an indicator of health.) In addition, we estimate regressions separately for men who retired between 1906 and 1908, when a measure of part time work is available. Means for variables in the regression models are in Table 6. Computations were performed using Stata MP version 18 (StataCorp., 2023).

Regression results in Tables 7 and 8 are reported as odds ratios. Variables that increase the odds of retiring at age 65 have odds ratios greater than 1.0. Odds ratios below 1.0 decrease the odds of early retirement. We can illustrate the interpretation of odds ratios with the estimated odds ratio for average earnings in Model 1 in Table 7, 0.993. In the sample used for this model, 43% of men retired at ages 65 or 66, which is an odds of 0.759 (= 0.43/(1 – 0.43)). The mean of the monthly earnings variable is $63.02 with a standard deviation of $37.55. A one standard deviation increase in monthly earnings would result in an odds ratio of 0.765 = ($0.993^{37.55}$), because the regression is estimated on the logarithm of the odds ratio. This implies odds of early retirement of 0.580 (= $0.759 \cdot 0.765$), which means that only 36.7% (= $100 \left(\frac{0.580}{(1+ 0.580)}\right)$) of employees who earned $100.57 would take early retirement. In other words, workers who earned $100.57 were six percent less likely to take early retirement than an average worker who earned $63.02.

Model 1 in Table 7 includes three variables that approximate terms in Equation 5: average monthly earnings in the ten years before retirement ($\bar{Y}$), years of service at age 65 (S_{65}), and years lived between ages 70 and 75 (e_{70}). The estimated odds ratios of these variables are all statistically significant and in the expected directions. As we showed above, men with higher average earnings were less likely to retire early. More years of service, which increased the amount of the pension, decreased early retirement. The odds ratio of 1.048 for years of service at age 65 implies that 5.2 more years of service (i.e., one standard deviation change and a 5.2 percent higher pension) increased early retirement from 43% to 49%.

Better health, as measured by years lived between ages 70 and 75, reduces early retirement in all models. A 1.4-year increase in years lived between 70 and 75 predicts

that the proportion who retired early would have decreased from 43% to 40%. When we estimate the same model with the 1906-1908 data (Model 5 in Table 8), the results are very close to Model 1. These results should be considered a lower-bound estimate of the effect of health on early retirement. Since we exclude men that died between 65 and 70, who were also more likely to be in poor health at age 65, we have selected men with less certain knowledge of their future health.

In Models 2 (Table 7) and 6 (Table 8) we add a variable identifying men who were working part-time before retirement. We showed above (Table 4) a clear tendency toward early retirement among men with low values for the ratio of earnings to the median earnings of their occupation group, but this effect does not appear in the regression model (Model 2). However, the more accurate estimate of part-time work in the 1906-1908 data (Model 6) shows that part-time work was an extremely strong predictor of early retirement. The odds ratio for men who earned less than half of expected earnings is 11.4, which predicts that 90 percent of these men would retire early after controlling for the other variables in the model.

Differences among nine groups of occupations are examined in Models 3 (Table 7) and 7 (Table 8). Skilled workers are the reference group in these models. The regression results confirm most of the descriptive analysis in Table 5. Even when we control for average earnings, years of service, and mortality after age 70, locomotive engineers and conductors were much more likely to retire early than other workers. Brakeman and firemen, who also travelled aboard the trains, were also more likely to retire early than skilled workers, but those differences are not statistic significant. Most other groups were less likely to retire early than skilled workers, but only the difference between unskilled and skilled workers is statistically significant.

When we look at Models 4 (Table 7) and 8 (Table 8), which include all five explanatory variables, we find that results for 1906-1908 are almost exactly the same as those for 1901-1915. Including measures of part-time work and differences among occupations have very small effects on the odds ratios for our key economic variables: average monthly earnings in the ten years before retirement ($\bar{Y}$), years of service at age 65 (S_{65}), and years lived between ages 70 and 75 (e_{70}).

The elasticities of early retirement with respect to years of service derived from Models 4 and 8 are 0.87 and 1.04 respectively.[1] Since PRR pension benefits were a linear function of years of service, this should be a good approximation of the elasticity of non-participation in the labor force with respect to pension benefits. We can compare our estimates to the large literature on Social Security disability benefits, which began in

[1] This elasticity was estimated using the Stata 'margins , eyex()' command. For comparability with other studies, the elasticity of this model was also estimated with a probit regression which returned the same value, 0.909. Most other studies use probit regression to resolve econometric issues, such as censoring. We prefer the Logit regression, because odds ratios are easier to interpret than coefficients from a probit regression.

1957. Bound and Burkhauser (1999) review more than a dozen of these studies, and they suggest that the most plausible estimates of the elasticity of non-participation in the labor force are in the 0.2 to 0.3 range. Our much higher estimates for 1900-1915 imply that workers were much more responsive to pension benefits in the early twentieth century. Similar estimates by Costa (1995) using the Union Army pensions and Pesner (2024) using Railroad Retirement Act pensions in the 1930s also support this conclusion.

Conclusion

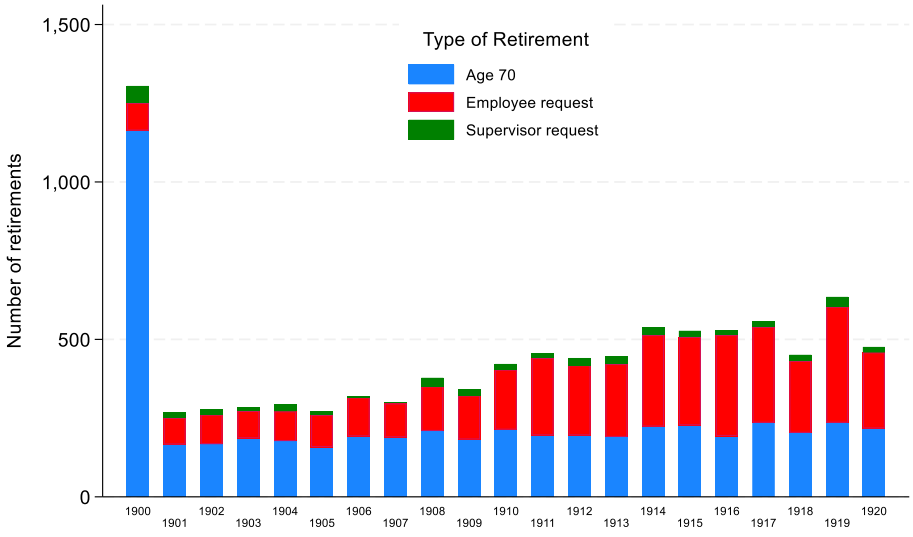
The innovative 1900 PRR pension quickly became the model for pensions offered by most railroads increasing the number of workers covered from 24 to 490 thousand in five years (Latimer, 1932a, pp. 1: 26-27). Many other industries soon followed the same model. The PRR pension was intended to increase worker loyalty, reduce turnover, and discourage strikes. But above all, it was seen as a way to reduce costs by replacing high-wage older workers with cheaper and more productive younger workers. By 1930, it was clear that non-contributory pensions entirely under the employer's control were unsustainable. The railroad's workforce was aging, pensioners were living longer than expected (Alter, 1995), and the economy was collapsing into the Great Depression. The failure of railroad pensions resulted in intervention by the Federal Government. Under the Railroad Retirement Acts, the U.S. government took over past and future pension obligations to railroad workers, and the railroad retirement system became a test for the future Social Security system.

Our analysis of PRR pensions from 1900 to 1920 suggests that older workers were eager to withdraw from the labor force. By age 65, many workers had already slipped down the occupational ladder to less demanding and less rewarding jobs, like watchman. Others worked part-time with the support of supervisors and managers. After 1910 more than half of PRR workers retired before age 70 with the permission of their supervisors. Our econometric model of early retirement shows much greater responsiveness to the amount of the pension offered at age 65 among PRR workers than among workers eligible for the Social Security disability benefits half a century later. The PRR experience supports the decisions to allow retirement at age 65 without the justification of poor health in the Railroad Retirement Acts and Social Security.

Our most surprising finding was the strong preference for early retirement among locomotive engineers, conductors, and other workers who travelled with the trains. The census of 1900 suggests that engineers and conductors were retiring before age 70 even before the pension was introduced. Since engineers and conductors were well paid, we cannot attribute their decisions to lack of economic incentives to keep working until age 70. Moreover, they belonged to powerful trade unions that strongly enforced seniority rights with the cooperation of their employer. Their choices seem to have been motivated by the hardships of working on trains. This should remind us of the

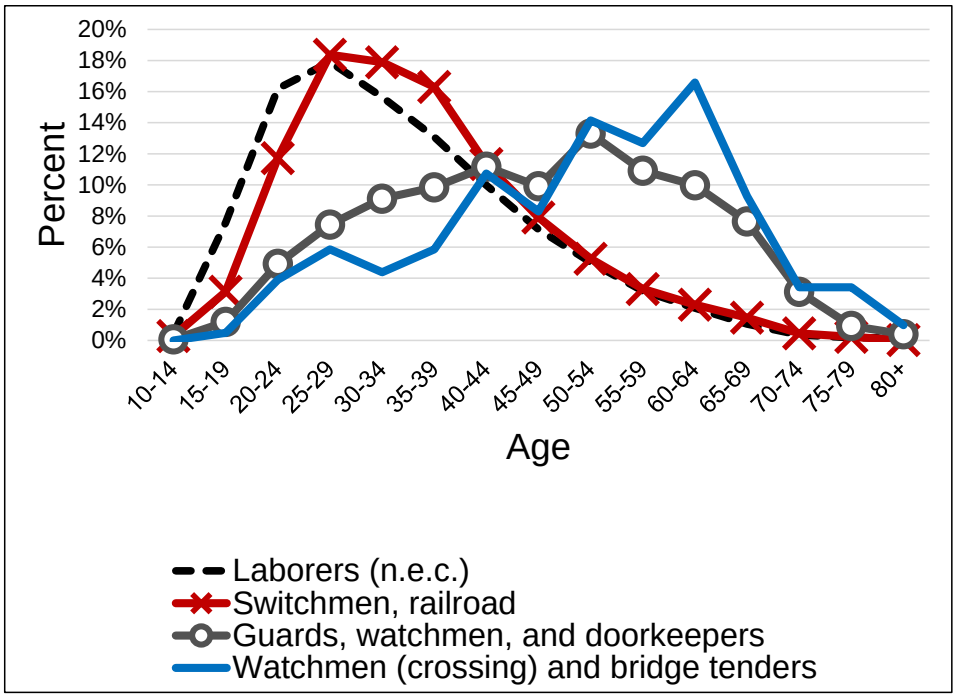
importance of working conditions on retirement decisions (Hayward, Hardy, & Grady, 1989).

Figure 1. Number of Retirements by Type and Year, Pennsylvania Railroad Pensions, East Lines, 1900-1920



Source: PRR Pensions ??

Figure 2. Percent of Workers in Selected Occupations by Age, PRR Eastern Line States, 1900



Source: US census ??

Figure 3. Survival Curves by Type of Early Retirement, PRR Pensions, 1900-1920

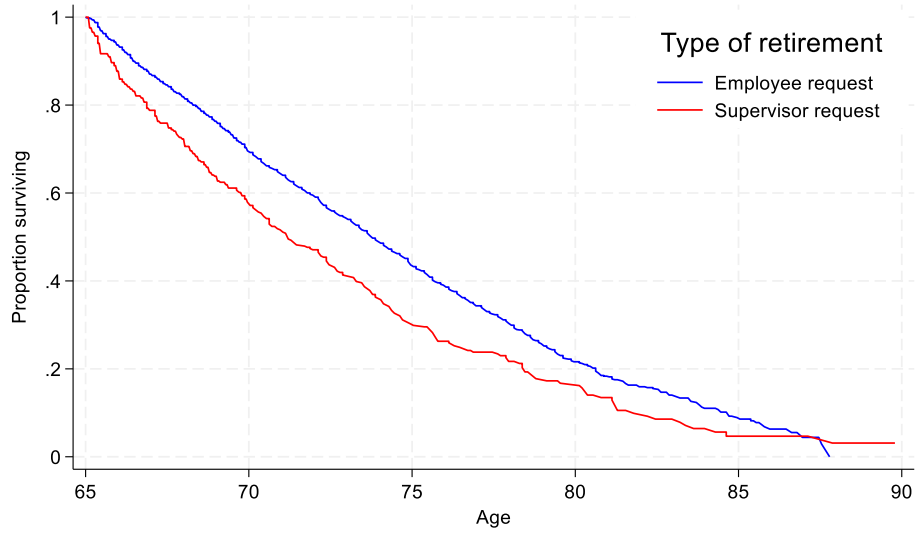


Figure 4. Survival Curves from Age 70 by Retirement Type, PRR Pensions, 1900-1920

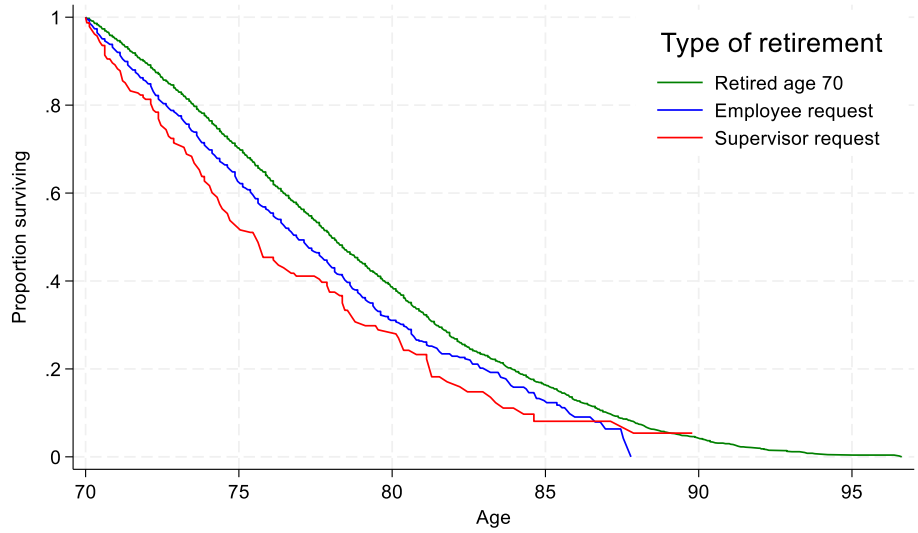


Table 1. Mean Age of Railroad Workers in Selected Occupation Groups, 1900 Census for PRR East States

Occupation groups	Mean age	Number
Watchmen (crossing) and bridge tenders	51.4	205
Guards, watchmen, and doorkeepers	46.9	1,503
Blacksmiths	41.0	524
Locomotive engineers	40.9	15,075
Carpenters	40.8	1,529
Managers, officials, and proprietors (n.e.c.)	40.7	2,925
Policemen and detectives	40.5	131
Foremen (n.e.c.)	40.4	4,649
Inspectors (n.e.c.)	39.1	3,604
Accountants and auditors	39.1	119
Baggagemen, transportation	39.0	2,314
Ticket, station, and express agents	38.0	5,394
Cashiers	37.1	150
Express messengers and railway mail clerks	36.8	535
Switchmen, railroad	35.9	3,957
Mechanics and repairmen, railroad and car shop	35.9	546
Conductors, railroad	35.6	19,279
Machinists	35.4	1,113
Operative and kindred workers (n.e.c.)	35.3	6,171
Porters	34.7	1,038
Painters, construction and maintenance	34.5	242
Laborers (n.e.c.)	34.0	42,817
Boilermakers	33.6	116
Oilers and greaser, except auto	33.1	100
Bookkeepers	32.9	227
Brakemen, railroad	31.9	25,957
Clerical and kindred workers (n.e.c.)	31.1	13,521
Locomotive firemen	30.1	11,758
Telegraph operators	29.2	466
Messengers and office boys	24.8	326

"n.e.c" = "not elsewhere classified"
Source: US Census 1900

Table 2. Average Earnings Adjusted to 1900 and to 2023 by Skill Level, PRR Pensions, Eastern Lines, 1900-1920

	Number	Average monthly earnings adjusted to 1900	Average yearly earnings adjusted to 1900	Average "Real Wage" Adjusted to 2023 by CPI**	Ratio of the "Real Wage" in 2023 to the average annual wage	Ratio of average annual wage to national average wage in 1900	Ratio of average annual wage to national average in 1900 times the national average in 2023
Professional/Executive	72	$366.43	$4,397	$164,599	284%	910%	$528,006
Supervisor	1,482	$73.18	$878	$32,871	57%	182%	$105,443
Clerk/Agent	961	$65.32	$784	$29,343	51%	162%	$94,127
Skilled	1,743	$50.81	$610	$22,823	39%	126%	$73,211
Semi-skilled	1,039	$40.89	$491	$18,368	32%	102%	$58,922
Unskilled	2,709	$34.41	$413	$15,459	27%	86%	$49,589
Locomotive engineer	777	$85.61	$1,027	$38,455	66%	213%	$123,356
Conductor	532	$74.22	$891	$33,341	57%	184%	$106,951
Brakeman/Fireman	139	$51.51	$618	$23,139	40%	128%	$74,225
All PRR	**9,454**	**$56.59**	**$679**	**$25,422**	**44%**	**141%**	**$81,549**
Average national annual wage			$483*	$164,599			$57,998***

Sources: PRR

* Carter et al. (2021, Series Ba4282)

** Williamson and Officer (2024). Adjusted by the ratio of CPI in 2023 to CPI in 1900 : 304.78/8.14 = 37.43

*** U.S. Bureau of Labor Statistics (2024)

Table 3. Percent of Retirees by Retirement Type and Ratio of Actual to Full-Time Earnings, Pennsylvania Railroad Pensions, 1906-1908

Ratio of actual to full-time earnings	Type of retirement: Age 70	Employee request	Supervisor request	Total	Number
<50%	1.6	5.0	4.0	2.9	27
50-75%	6.0	19.9	20.0	11.5	107
75-95%	31.0	37.7	36.0	33.6	313
95-105%	51.2	26.9	40.0	42.0	391
>105%	10.3	10.5	0.0	10.1	94
Total	100.0	100.0	100.0	100.0	932
<50%	33.3	63.0	3.7	100.0	27
50-75%	31.8	63.6	4.7	100.0	107
75-95%	55.9	41.2	2.9	100.0	313
95-105%	73.9	23.5	2.6	100.0	391
>105%	61.7	38.3	0.0	100.0	94
Total	60.6	36.7	2.7	100.0	932

Source:

Table 4. Percent of Retirees by Retirement Type and Ratio of Earnings to Median Earnings by Occupation, Pennsylvania Railroad Pensions, 1901-1920

Ratio of actual to full-time earnings	Type of retirement: Age 70	Employee request	Supervisor request	Total	Number
<30%	36.0	47.1	16.9	100.0	172
30-59%	47.2	46.7	6.1	100.0	887
>60%	48.5	48.0	3.5	100.0	7,017
Total	48.1	47.8	4.0	100.0	8,076

Source:

Table 5, Percent Retired Early, Average Years of Service, and Average Age when Hired by Skill Level, PRR Pensions, Eastern Lines, 1900-1920

	Percent retired early	Average years of service	Average age when hired	Number
Professional/Executive	25.0	41.6	27.5	72
Supervisor	46.0	40.7	28.1	1,482
Clerk/Agent	40.0	38.1	31.0	961
Skilled	40.0	35.3	34.1	1,743
Semi-skilled	45.6	35.9	33.1	1,039
Unskilled	34.0	33.3	36.4	2,709
Locomotive engineer	80.4	43.3	23.7	777
Conductor	82.5	42.0	24.8	532
Brakeman/Fireman	79.9	39.7	27.3	139
Total	46.0	37.1	31.9	9,454

Source:

Table 6. Number of Observations, Mean (Standard Deviation), and Distribution of Variables for Logistic Regression Models

	Table 7 Models 1-4	Table 8 Models 5-8
Number of observations	2,149	533
Proportion retiring early	0.43	0.44
Mean of average monthly earnings in the ten years before retirement (1900 dollars)	63.02 (37.55)	64.62 (60.03)
Mean of years of service at age	38.59 (5.16)	38.15 (5.27)
Mean of years lived ages 70 to 75	4.2 (1.41)	4.3 (1.32)
Skill level (percent)		
Prof/Exec		1.9
Supervisor	21.3	19.5
Clerk/Agent	11.5	10.1
Skilled	17.7	20.1
Semi-skilled	10.6	12.6
Unskilled	22.8	19.9
Engineer	9.9	9.4
Conductor	4.9	4.3
Brakeman/Fireman	1.2	2.3
Total	100.0	100.0
Ratio of earnings to group median (percent)		
<30%	1.1	
30-59%	5.1	
60+%	93.8	
Total	100.0	
Ratio of earnings to expected earnings (percent)		
<50%		1.3
50-75%		9.8
75-95%		31.0
95-105%		47.3
>105%		10.7
Total		100.0

Table 7. Odds Ratios from Logistic Regressions Models of Retirement by Employee Request at Age 65

	Model 1		Model 2		Model 3		Model 4	
Average monthly earnings (1900 dollars)	0.993	**	0.993	**	0.989	**	0.988	**
Years of service at age 65	1.048	**	1.048	**	1.041	**	1.041	**
Years lived ages 70 to 75	0.920	**	0.920	**	0.911	**	0.912	**
Skill levels								
Prof/Exec								
Supervisor					0.781		0.804	
Clerk/Agent					0.710		0.730	
Skilled					1.000	ref.	1.000	ref.
Semi-skilled					0.996		0.989	
Unskilled					0.726	*	0.717	*
Engineer					2.441	**	2.605	**
Conductor					2.963	**	3.124	**
Brakeman/Fireman					1.349		1.391	
Ratio of earnings to group median								
<30%			0.844				0.435	
30-59%			1.257				0.989	
60+%			1.000	ref.			1.000	ref.
Intercept	0.270	**	0.266	**	0.471	*	0.499	
Number of observations	2,149		2,149		2,149		2,149	
Log likelihood	-1441.93		-1441.18		-1398.88		-1397.20	
Model DF	3		5		10		12	
χ^2	54.67		56.17		140.76		144.13	
Model test p-value	0.00		0.00		0.00		0.00	

** p<.01, * p<.05

Source:

Table 8. Odds Ratios from Logistic Regressions Models of Retirement by Employee Request at Age 65

	Model 5		Model 6		Model 7		Model 8	
Average monthly earnings (1900 dollars)	0.986	**	0.993	*	0.978	**	0.988	*
Years of service at age 65	1.061	**	1.059	**	1.054	**	1.050	*
Years lived ages 70 to 75	0.916		0.913		0.921		0.911	
Skill levels								
Prof/Exec					1.281		1.900	
Supervisor					0.825		1.439	
Clerk/Agent					0.972		1.937	
Skilled					1.000	ref.	1.000	ref.
Semi-skilled					0.996		1.430	
Unskilled					0.645		1.267	
Engineer					4.166	**	3.714	**
Conductor					4.736	**	4.557	**
Brakeman/Fireman					1.167		2.930	
Ratio of earnings to expected earnings								
<50%			11.400	*			8.031	
50-75%			8.556	**			7.948	**
75-95%			2.980	**			2.948	**
95-105%			1.000	ref.			1.000	ref.
>105%			3.001	**			3.208	**
Intercept	0.272		0.099	**	0.498		0.117	*
Number of observations	533		533		533		533	
Log likelihood	-348.65		-321.35		-332.11		-312.82	
Model DF	3		7		11		15	
χ^2	33.15		87.76		66.23		104.80	
Model test p-value	0.00		0.00		0.00		0.00	

** p<.01, * p<.05

Source:

Appendix Table 1. Number of Observations, Means, and Distributions of Variables for Logistic Regression Models

	Models 1-4	Models 5-8	Model A1	Model A2	Model A3	Model A4	Model A5	Model A6
Number of observations	2,149	533	5,642	5,664	5,673	5,586	614	2,187
Proportion retiring early	0.43	0.44	0.65	0.65	0.65	0.65	0.51	0.43
Average monthly earnings (1900 $s)	63.02	64.62	62.58					
Years of service at age	38.59	38.15		39.69				
Skill level								
Prof/Exec		1.9			1.0			
Supervisor	21.3	19.5			18.6			
Clerk/Agent	11.5	10.1			11.2			
Skilled	17.7	20.1			16.3			
Semi-skilled	10.6	12.6			10.4			
Unskilled	22.8	19.9			19.7			
Engineer	9.9	9.4			12.2			
Conductor	4.9	4.3			8.4			
Brakeman/Fireman	1.2	2.3			2.0			
Total	100.0	100.0			100.0			
Ratio of earnings to group median								
<30%	1.1					1.7		
30-59%	5.1					9.8		
60+%	93.8					88.5		
Total	100.0					100.0		
Ratio of earnings to expected earnings								
<50%		1.3					2.4	
50-75%		9.8					11.7	
75-95%		31.0					31.8	
95-105%		47.3					44.1	
>105%		10.7					9.9	
Total		100.0					100.0	
Years lived ages 70 to 75	4.2	4.3						4.2

Table A2. Odds Ratios from Logistic Regression Models of Retirement by Employee Request at Age 65

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Average monthly earnings (1900 $s)	0.997	**										
Years of service at age 65			1.059	**								
Skill levels												
Prof/Exec					0.242	**						
Supervisor					0.662	**						
Clerk/Agent					0.623	**						
Skilled					1.000	ref.						
Semi-skilled					1.027							
Unskilled					0.801	*						
Engineer					3.192	**						
Conductor					3.473	**						
Brakeman/Fireman					4.408	**						
Ratio of earnings to group median												
<30%							1.936	**				
30-59%							1.300	**				
60+%							1.000	ref.				
Ratio of earnings to expected earnings												
<50%									30.116	**		
50-75%									11.929	**		
75-95%									3.442	**		
95-105%									1.000	ref.		
>105%									2.535	**		
Years lived ages 70 to 75											0.924	**
Intercept	2.187	**	0.193	**	1.798	**	1.795	**	0.465	**	1.044	
Number of observations	5,642		5,664		5,673		5,586		614		2,187	
Log likelihood	-3652.49		-3607.95		-3471.15		-3608.65		-375.79		-1489.71	
Model DF	1		1		8		2		4		1	
χ^2	23.21		130.19		422.58		14.62		99.29		6.88	
Model test p-value	0.00		0.00		0.00		0.00		0.00		0.01	

** p<.01, * p<.05

Source:

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