Technological Changes and Employment of Older Manufacturing Workers in Early-Twentieth-Century America

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Abstract

This study explores how broadly-defined technological changes (including organizational and managerial transformations as well as innovations in production methods) in the U.S. manufacturing industries affected the probabilities of long-term unemployment and of retirement of older male workers in the early-twentieth-century United States. For this purpose, industry-level statistics reported in the 1899 and 1909 manufacturing census were linked to the IPUMS of the 1910 census, and to a longitudinal sample of Union Army veterans. The results suggest that the rapid technological changes had both favorable and adverse impacts on the employment of older workers. On one hand, technological progress improved the employment prospect of older workers by enhancing labor productivity and by formalizing the workplace management. On the other hand, emergence of large corporations and technological shifts toward more capital- and technology-intensive productions made it increasingly difficult for older workers to remain in the labor market, perhaps by increasing the requirements for physical strength, mental agility, and ability to acquire new skills. It is likely that the overall impact of technological changes on the employment of older workers during the industrial era was negative.

1. Introduction

The labor force participation rate (LFPR, hereafter) of men 65 and older in the United States has dramatically fallen over the last 120 years, from nearly 80% in 1880 to less than 20% today (Moen 1987, Costa 1998). Early retirement, defined as leaving the labor market permanently before reaching age 65, is much more common today than it was decades ago (Gruber and Wise 1999). Such a sharp decline in the labor market activity of the elderly male population is regarded as one of the most significant labor market changes in America in the past century.

Many economists have attributed the decline in the involvement of older males in the labor market to the factors that influence labor supply decisions of older persons. In particular, a great deal of attention has been paid to the retirement effect of the implementation and expansion of social insurance programs such as Social Security. A large number of empirical studies, based on both time-series and cross-sectional evidence, have suggested that the availability of Social Security and Disability Insurance has been the major cause of the long-term decline in the labor force participation among older men since the rise of the welfare state in the 1930s.

It has been suggested that the Old Age Assistance (OAA) was the main underlying force behind the sharp decline in the LFPR of older men during the 1930s (Gratton 1988, Parsons 1991). Many have attributed the fall in the LFPR of older males from the 1960s to the increase in real Social Security benefits (Boskin 1977, Parsons 1980, Hurd and Boskin 1984). Recent comparative studies have concluded that measures of work disincentives arising from old-age pension programs were strongly related to the size of labor-market activity of older males around the world (Gruber and Wise 1999, 2004).

Although there is considerable disagreement in the literature as to the magnitude and direction of the effect of Social Security on labor supply (Krueger and Meyer 2002), it is hard to deny that Social Security still remains probably the single most important explanation for the long-term decline in the LFPR of older males in the United States. Other than Social Security, the major determinants of retirement that the existing literature suggests are mostly supply-side factors such as health status (McGarry 2002), health insurance (Gruber and Madrian 1995), and wealth (Gustman and Steinmeier 2002).

Even if the retirement effects of the supply-side factors introduced above are indeed strong, it is still surprising that the potential impact of changes in the demand side of the labor market has been largely ignored. Notable exceptions are studies by Hurd (1996) and Hurd and McGarry (1993), who found that a job's flexibility and financial aspects were important determinants of retirement decisions. The features of the workplace, such as production technology, managerial practices, work organization, employment relations, and labor market conditions, may affect retirement decisions.

For instance, increasing the speed and the intensity of work could force aged workers out of the labor market either by decreasing their relative productivity or by raising the cost of their labor supply. A decline in job flexibility, often resulting from modifications of work organization and workplace management, could make it difficult for aged workers make gradual adjustments in response to the influences of aging. The growing importance of formal education and on-the-job training due to rapid technological changes could make employers hesitate to hire aged workers, because of the obsolescence of their skill sets and lower returns to training. Some of the adverse impacts of industrial changes on the labor-market status of older workers could have been mediated by deterioration in health caused by the newly emerging work environment. Over the last 120 years, the United States has experienced dramatic transformations in industrial structure, corporate organization, and production and managerial technologies. It is likely that such structural shifts in the demand side of the U. S. labor market had considerable impact on the labor force participation of older workers.

The present study focuses on the half century prior to Social Security, especially the first decade of the twentieth century. The pre-Social Security era provides a unique empirical ground for examining the impacts of demand-side changes on retirement. During that period, the U.S. economy went through the so-called "Second Industrial Revolution," characterized by the growth of large modern firms, the rise of new products, power sources, and technologies, and the radical transformation of the industrial structure (Chandler 1977, 1990). It was during this period that scientific knowledge began to be systematically applied to industrial technology, the mass-production system spread, and methods of scientific management were introduced into workplaces. The technological changes of this period were arguably the most critical in all of modern times in terms of the magnitude of the long-run impact on productivity and human well-being—even more important than the "First Industrial Revolution" or the Information Technology revolution in recent decades (Gordon

2000).

It should also be noted that there were no major social insurance programs for the elderly prior to 1935. The Union Army pension, once considered the largest public income transfer program before the establishment of Social Security, was not a major factor in decreasing the LFPR of the older male population at large in the early twentieth century (Lee 1998a). Because of the tremendous changes in the industrial environment and the absence of significant old-age security programs, the demand-side factors probably had much stronger effects on the retirement decisions of aged workers in the late nineteenth and early twentieth centuries than they do today. Indeed, the LFPR of older men rapidly fell between 1880 and 1940, accounting for about half of the overall decline in the LFPR of men 65 and older since 1880. As will be surveyed below, many contemporaries believed that aged workers were being forced out of the work force, victimized by the consequences of industrialization, such as the increased intensity of production, greater need for formal education, new managerial practices, and the rise of age discrimination (Squier 1912, Epstein 1928, Graebner 1980).

Only a few studies have quantitatively investigated the impact of the spread and deepening of industrialization on the labor-market status of older men in the early and twentieth centuries, in spite of the abundant contemporary narratives about unemployment, poverty, and dependence of the elderly caused by the consequences of the industrial changes. This study hopes to fill this gap in the literature by providing more direct quantitative evidence as to how changing technology, along with individual characteristics, affected labor force participation and unemployment of older men. This study will provide some indirect evidence as to how much of the long-term decline in the LFPR of older men is attributable to Social Security by explaining why older men began to leave the labor force earlier than before during the pre-Social Security era. This paper is also expected to shed some new lights on the issue of how the on-going technological changes, such as the advances in IT technology (Friedberg 2001), and shifts in the corporate structure and work organization will change the labor market activity of older workers.

2. Old Labor in the Industrial Era: A Survey

Recent empirical studies on employment of older workers prior to the Social Security era have focused mostly on supply-side factors, such as the rise in retirement incomes. Costa (1998) suggested that 90% of the decline in the LFPR of older males between 1900 and 1930 could be attributed to secularly rising incomes, based on the estimated elasticity of labor force nonparticipation with respect to Union Army pensions in 1910. Carter and Sutch (1996), interpreting the occupational difference in the hazard of leaving the labor force at older age between 1900 and 1910, maintained that many men in early twentieth century America planned their retirement based on wealth accumulation. In support of this view, Gratton (1996) reported that earnings of aged workers substantially increased between 1890 and 1950 both in absolute terms and relative to the earnings of younger employees.

This revisionist view of work and retirement of older males in the past sharply differs from the rather pessimistic portrait of the elderly suggested by the conventional explanations of the decline in the labor market activity of older workers in the industrial era. Until recently, it was widely believed that the decline in the relative size of the agricultural labor force had produced a decrease in the labor market involvement of older men, because the flexibility of farming allowed farmers to stay in the labor force longer in comparison with those employed in non-agricultural occupations (Durand 1948, Long 1958, Bancroft 1958).

According to this traditional view, industrial workers were subject to a greater probability of job loss and forced retirement due to unfavorable work conditions for aged workers, such as longer hours, less flexibility, and greater intensity of work. It has also been suggested that industrialization brought greater disadvantages in employment associated with aging, such as more serious age discrimination and greater importance of job-specific skills that inhibited the hiring and training of older workers (Squier 1912, Epstein 1928, Graebner 1980, Haber 1983).

Previous studies provide some empirical evidence suggesting that the influence of changing demand-side factors on the labor market status of the older workers was indeed strong, as pointed out by the traditional view. Lee (1998b) reported that long-term unemployment of older male workers in 1900 greatly reduced their chances of remaining in the labor force by 1910. Lee (2002) found that farmers were less likely to retire than nonfarmers prior to 1940, and estimated that the decrease in the labor force employed in farming accounted for more than 20% of the decline in the LFPR of men 60 and older between 1880 and 1940. This study also suggested that the decline in the labor-market activity of aged men who were employed in non-farm occupations accounts for a larger fraction of the total decline of the LFPR of older males during the same period.

Lee (2005) showed that men who had better occupations in terms of economic and work conditions were less likely to retire than were those with poorer jobs in the early twentieth century by comparing the hazard of retirement across more narrowly defined occupational categories. Based on the pattern of shifts in the occupational structure that occurred between 1880 and 1940, this study also suggested that industrialization brought a growth of the sectors in which the pressure toward departure from employment at old ages was relatively strong. Lee (2004) found that older males who were out of the labor force were much poorer than active workers of a similar age, and that the support of children was no longer an important means of old-age security after the end of the nineteenth century. These results tend to support the conventional belief that the rise of the welfare state was a response to the emerging social problems in the era of industrialization.

These studies demonstrate how the labor-market status of older workers in the era of industrialization varied across different occupations or industries. They also suggest how the sectoral shift affected the extent of pressure toward leaving the labor force over time. However, the forces that produced the observed disparities in the labor-market experiences of older workers employed in different industries remain unknown. More significantly, very little is known about the causes of within-sector decline in the labor-market activity which accounts for a larger fraction of the decrease in the LFPR of older men than the effect of the sectoral shift. According to the conventional view, as noted above, the rapid technological changes and employment of new managerial practices were perhaps the major underlying forces. Unfortunately, there is no quantitative evidence regarding these explanations.

I hope to fill this gap in the literature by exploring the effects of demand-side factors represented by various industrial characteristics, such as establishment size, hours of work, measures of production technology, and employment structure (these factors will be referred to as broadly-defined technology), on the probabilities of long-term unemployment and retirement of older manufacturing workers in the early twentieth century. Studies of long-term unemployment and retirement of older male workers in the early twentieth century based on the micro data are abundant (Margo 1993, Costa 1998, Lee 1998, 1999, 2005). However, to my knowledge, this study is the first to examine the roles played by industry-specific characteristics, together with personal characteristics.

3. Conceptual Framework

I use the probabilities of long-term unemployment and of non-participation at older age as measures of labor market status of aged workers in the early twentieth century. The rationale for using these measures will be discussed below in detailed. I demonstrate here how these measures of labor market status are affected by changes in broadly-defined technology (including various industry-specific characteristics of production technology, work organization, managerial practices, and so on) denoted as *T*.

According to standard search model of unemployment, the length of job search of an unemployed worker would depend on the relative size of his/her reservation wage (denoted W_R) and the wage offered to him in the market (W). I assume that market wage W is determined by the worker's human capital (represented by a vector of personal characteristics, denoted X), the average labor productivity of the industry (denoted A) that is a function of T [$A(T)$], and industry-specific conditions of labor and product market in which the worker is employed (Z). Market wage offered in a particular industry is given as:

(1) $$W = W[X, Z, A(T)]$$

The size of an older worker's reservation wage is determined by his or her economic status (such as demand for and provision of non-labor incomes, represented by personal characteristics X) and preference for work (Θ). A person's preference work is determined by various personal characteristics, such as age, health, and family structure. I also hypothesize that the preference for worker is influenced by the prevailing technology, denoted by T. The reservation wage can be written as:

(2) $$W_R = W_R[X, \theta(X, T)]$$

This specification is based on the contemporary observations that it became increasingly costly for older workers to keep working as the speed and intensity of work as well as requirements for skills increased, produced by technological changes, beyond their physical and mental capacities.

The probability of long-term unemployment (denoted P_U) depends on the difference between W_R and W, as presented by the following equation:

$$(3) \qquad P_U = P_U[W_R\{X, \theta(X,T)\} - W\{X, Z, A(T)\}]$$

In this model, a change in T will affect P_U through two different pathways, namely, by changing preference for work (Θ) and by changing the size of labor productivity of the industry (A), as presented by the following equation:

$$(4) \qquad \frac{\partial P_U}{\partial T} = \frac{\partial P_U}{\partial W_R}\frac{\partial W_R}{\partial \theta}\frac{\partial \theta}{\partial T} - \frac{\partial P_U}{\partial W}\frac{\partial W}{\partial A}\frac{\partial A}{\partial T}$$

These two types of effects will be referred to as, respectively, "preference effect" and "productivity effect." Even if narrowly defined in the model, the preference effect could actually capture the impacts of technological changes through various avenues, other than changes in the average labor productivity of a given industry. For instance, employers could discriminate against older workers more actively, as newly introduced technologies make older workers unproductive compared to young employees, while improving the overall productivity of the industry. In this case, a decline in the employment of older workers, although produced by a change in relative productivity, would be identified as preference effect.

Suppose the measures of T are included in a reduced-form regression model, such as the equation given below:

$$(5) \qquad P_U = f(X, Z, T, \varepsilon)$$

Then, the result of a regression, based on equation (5), will provide an estimated coefficients for T in which the two terms in equation (4) are mixed. If a change in technology increases labor productivity, but diminishes the preference for work, the estimated total effect of T on P_U should be smaller than its partial effect on P_U through changing Θ, because the two countervailing effects cancel out.

My empirical strategy, employed below, is to focus on the effect of a technological change on the preference for work (or value of not working), by employing the following regression model.

(6) $$P_U = \alpha + \beta X + \gamma Z + \kappa A + \lambda T + \varepsilon$$

Since a measure of industry-specific labor productivity (*A*) are included in the regression, the coefficient for *T* (λ) represents only the preference effect, holding any changes in wages caused by the change in *T* constant.

The above model of unemployment can be applied to a study of the impact of technological change on retirement with very little modifications. Similar to the case of job search, individuals compare the value of retirement (that is determined by non-labor incomes and preference for work) and market wages offered to them. Thus, I will use below virtually the same specification and method in analyzing both the probabilities of long-term unemployment and retirement.

4. Data

To study how technological changes affect the labor-market activity of older workers, it would be ideal to use a firm-level data set that contains information on both the technological characteristics of and employment status of workers employed in each workplace. Unfortunately, no such data are available for the period this study looks at.

In this study, I circumvent this data limitation by matching samples of population censuses (providing information on labor-market status of individuals) to published manufacturing censuses (offering average statistics on various technological and managerial characteristics of each industry), as will be explained below. Of course, it is not completely satisfactory to rely on industry-level analyses, ignoring differences across firms within each industry. However, if industries are classified narrowly, as in the present study, the between-industry variations in technological characteristics are likely to capture a large fraction of the overall variations across firms. A more practical justification is that company-level data, containing information on both individual and firm characteristics, are difficult to obtain even today.

4.1. Published Manufacturing Censuses of 1899 and 1909

Measures of industry-specific technological characteristics are constructed from the published manufacturing censuses of 1899 and 1909. These volumes provide various average statistics for each manufacturing industry. These statistics include: the number of establishments, the percentage of a particular type of ownership (e.g. the shares of corporations and partnerships), the number of employees by age, sex, and type of work, the size of capital investments, the value of products, the amount of expenses on each type of input, the size of energy used by source, the amount of wages paid out, and the prevailing hours of work, among others. The method of industry classifications, as well as the content and definition of statistics differ between census years. The 1899 manufacturing census classifies the whole manufacturing sector into about 350 industries; the 1909 manufacturing census includes about 260 industries. I made industry-level data sets using these sources.

To match these original industry-level data sets to micro samples of population censuses, I reclassify the industries reported in the manufacturing censuses, according to the industry coding scheme of the 1950 population census.[2] The 1950 census classifies industries more broadly than do the published manufacturing censuses. In the 1909 manufacturing census, for example, "clothing, horse," "clothing, men's buttonholes," "clothing, men's, including shirts," "clothing, women's," and "corsets" are all separate industries, whereas the 1950 population census classifies all these industries into a single category, namely, "apparel and accessories." Accordingly, I combine multiple industries in the manufacturing census, classified as the same industry in the 1950 population census, into a same industry. The methods of reclassifications of industries for 1909 manufacturing censuses are reported in Appendix Tables.[3]

Where several industries in the manufacturing census are merged into a broader industrial category, a particular variable for the combined industrial category should be recalculated based on either the sum (in case of the total amount or number) or the weighted

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[2] I determine the classification of each specific industry based on the full list of industries and their codes included in the 1950 population census (U.S. Bureau of the Census 1950).

[3] The methods of industry reclassifications for the 1899 manufacturing census are not reported here, but can be obtained from the author upon request.

average (in case of the mean or percentage) of the variable for the industries included in the category. For the weight to be assigned to each industry in calculating the weighted average, I used the number of wage earners because the major purpose of this study is to examine the labor-market experiences of employees. As a consequence of the merging process, the original 260-industry data set, drawn from the 1909 manufacturing census, was reduced to a new data set, including 56 (more broadly classified) manufacturing industries. Similarly, the original 350-industry data set, drawn from the 1899 manufacturing census, was changed into a data set that includes 60 industries.

4.2. IPUMS of the 1910 Census

To study how technological characteristics of an industry affected the probability of long-term unemployment of the workers in the industry, I match the variables pertaining to each industry, constructed the published 1909 manufacturing census, to the Integrated Public Use Micro Samples (IIPUMS) of the 1910 census (Ruggles and Sobek 1998). The 1910 census is the first to report information on both industry and the length of unemployment of individuals. The empirical analyses given below are based on a sample of 4,549 male manufacturing workers aged 45 and older. The sample is further limited to persons who were employed in the 56 manufacturing industries covered by the matched data set.

4.3. Longitudinal Sample of Union Army Veterans

A longitudinal sample is needed for studying the probability of retirement. For this purpose, I match a sample of white Union Army veterans who have been linked to the 1900 and 1910 censuses, as well as military, pension, and surgeons' medical records, to the industry-level data sets collected from the published 1899 and 1909 manufacturing censuses. Considering the age distribution of individuals included in the data (the mean age of the veterans in 1900 was about 58), the Union Army sample linked to the 1900 and 1910 population censuses are suitable for examining the determining factors of retirement.

A difficulty confronted in using this sample is that the 1900 population census does not provide information on industry in which a given person was employed. However, the occupational descriptions recorded in the census enable me to identify the industry for a majority of individuals.[4] Exploiting this information, I determined three-digit 1950 industry codes for 6,699 veterans out of 8,469 men who were linked to the 1900 census and for whom non-missing occupational titles were given. Of the veterans whose industry was identified, 793 men (or 12%) were employed in a manufacturing industry. This sample was further restricted to the men who were linked to the 1910 census and who were gainfully employed in 1900.

5. Measuring Industry-Specific Technological and Managerial Characteristics

Among many industrial statistics reported in the manufacturing censuses, I select several variables that are likely to be related to the employment conditions affecting the labor-force participation decisions of older workers. In particular, I attempt to choose variables that reflect hours, intensity, and flexibility of work and the magnitude of demand for old workers in the particular industry.

More straightforward candidates for such measures are industry-specific labor market condition, firm size, input mix, labor productivity, use of electricity, and hours of work. First, I include the percentage of male workers aged 25 to 44 who were unemployed for 24 weeks or longer (% Young Unemployed) as an indicator of industry-specific labor-market conditions. Inclusion of this variable will allow me to identify the inter-industry differences in labor-market disadvantages associated with aging, rather than the differences in the extent of seasonality and general labor market conditions.

For each category of the characteristics of each industry, I consider in the empirical analysis multiple measures one by one. As measures of firm size, for example, I consider the value of product, the number of employees, and the value of capital per establishment. As measures of labor productivity, I employ the value of product and wages per worker. The expenditure on non-labor inputs (such as materials and fuels) as percentage of the total costs is used as a measure of input mix. Electrification is regarded as a sign of reorganization of production, adoption of scientific management, and new technology (Devine 1983). To take into account the impact of utilizing electric power, I include in the analysis the total horse

[4] To take some examples, there are occupational titles such as “paper manufacturers,” “works and cigar maker,” “brakeman for railroad company,” “hat factory,” “in boot factory,” and “works for boot factory,” from which an industrial classification can be inferred.

power driven by electricity per production worker. To see the effect of a longer work day, I consider the average hours of work and the percentage of workers employed in an establishment in which the prevailing hours of work was 60 and over.

I also consider the following indirect measures of production technology and management. First, I consider the percentage of female workers as a proxy variable of requirements for physical strength and other types of human capital. Goldin (1990, p. 81) reported that the manufacturing industries circa 1900 were heavily segregated along the gender lines and that many of the male-intensive industries required substantial amounts of strength or more trainings. Thus, industries that were female intensive or mixed could have been more favorable for the employment of older male workers.

This conjecture seems to be consistent with the manners that the proportion of female workers is correlated with some indexes of work requirements.[5] The percentage of female workers is negatively correlated with wages per worker [correlation coefficient, (denoted ρ, hereafter) = -0.571, p-value (p) < 0.0001), the capital-labor ratio (ρ = -0.241, p < 0.0001), the value of product per worker (ρ = -0.209, p = 0.0007), and the percentage of workers employed in an establishment in which the prevailing hours of work was 72 and over (ρ = -0.0625, p = 0.3129). On the other hand, it is positively correlated with the percentage of child workers (ρ = 0.640, p < 0.0001).[6]

Second, I include the number of superintendents and managers (referred to as managers, hereafter) per production worker as a proxy variable of work organization and managerial practices. Until the early twentieth century, the overall operation of work-floor in manufacturing units, including decisions on employment, wage, and work-organization, was largely controlled by foremen (Jacoby 1985). According to the Marxist account, companies increased the employment of managers and superintendents in an effort to curb the power of, so-called, “craft control,” during the late nineteenth and early twentieth centuries (Lazonick

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[5] These correlations are computed using the industry-level data (including 260 industries) collected from the 1909 manufacturing census.

[6] If female workers were inferior to male workers in the early-twentieth-century manufacturing industries, a higher proportion of women might indicates a tighter labor market condition that led employers turned to less preferred job candidates. However, this conjecture is not supported by the patterns of correlation between industry variables. The percentage of female workers is weakly but positively correlated with the long-term unemployment rate of younger workers (p-value = 0.2567), and uncorrelated with the percentage of older workers, another type of marginal workers (p-value = 0.5755).

1990). Thus, the fraction of managers could be related to the development of more formal management of workplace.

Again, the patterns that this variable is correlated to some measures of the stability of employment relationship support this expectation. The number of managers per worker is negatively correlated with the long-term unemployment rate of older workers ($\rho = -0.329$, $p = 0.0333$) and the long-term unemployment rate of younger workers ($\rho = -0.226$, $p = 0.1307$). On the other hand, this index is positively correlated to the percentage of older workers (45 and older). It is likely that the formalization of workplace management began in more advanced and productive industries. If this was the case, manager-worker ratio should be positively correlated with measures of technological and managerial development. Indeed, this was the case. It is positively and statistically significantly correlated with capital-labor ratio, electric power use per worker, percentage of expenditure on non-labor inputs, and the value of product per worker.[7]

Finally, I consider the number of clerks per production worker as a measure of production technology and demand for white-collar workers. It is widely acknowledge that technology and skilled labor are complements in production. Since most of white-collar workers employed in manufacturing in the early twentieth century should be skilled workers, a higher relative number of clerks could be regarded as an index of technological progress. A look at how the number of clerks per work was correlated with measures of production technology suggests so. It was positively correlated with the capital-labor ratio ($\rho = 0.285$, $p < .0001$), electric power use per worker ($\rho = 0.128$, $p = 0.0389$), the percentage of expenditure on non-labor inputs ($\rho = 0.226$, $p = 0.0002$), and the average wages ($\rho = 0.134$, $p = 0.0301$).[8] Since clerks in the early nineteenth century should have been recruits from a pool of younger and more educated persons, compared to production workers, and older workers were on average less educated, a higher fraction of clerks may indicate as well a lower demand for older workers.

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[7] The results for the long-term unemployment rate and for the share of older workers are obtained from analyzing the industry-level data set (including 56 industries) matched to the 1910 population census, because information on the age composition of employees and unemployment can be drawn only from the population census.

[8] These correlations are computed using the industry-level data (including 260 industries) collected from the 1909 manufacturing census.

6. Long-Term Unemployment in the Early Twentieth Century

In this study, I use the probabilities of long-term unemployment and of non-participation as measures of difficulty of remaining in the labor market at older age. Since long-term unemployment is not an entirely straightforward index of labor market status of older workers than retirement, I will have to offer some explanations for what caused it, how it was related to retirement, and how its incidence differed across manufacturing industries in the era of industrialization.

Long duration of unemployment has been cited as one of the major indicatives of fragile labor market status of older workers in the early twentieth century. Previous studies have suggested that though older workers were less likely to be unemployed than younger workers, they had greater difficulty locating new jobs once laid off (Keyssar 1986, Margo 1993). Contemporaries also noted that old age was one of the most serious obstacles to finding employment and that it was extremely difficult for a semi-skilled worker over 40 or 50, once unemployed, to obtain a job as good as his previous one (Slichter 1917, 155).

The causes of lost days reported in various surveys of industrial workers at the turn of the century reveal that unemployment in the era of industrialization was predominantly involuntary for both young and old workers.[9] Deteriorated physical strength and health, obsolete skills and knowledge, and lack of formal education compared with younger cohorts are some of the potential factors that may have limited employment opportunities for aged workers.[10] In addition, formal or informal discrimination against aged workers in hiring could also have made it difficult for them to find a new job. In the early twentieth century, many firms, especially large corporations, adopted a policy of not hiring anyone over some

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[9] According to the surveys conducted by the Bureau of Labor Statistics in the late nineteenth century, the primary cause of lost times was lay-offs. For instance, nearly 70% of industrial workers ages 55 and over who experienced loss of working time in 1889 reported lay-off as the cause. Sickness and accidents were other major causes of lost days (Carter, Ransom, Sutch, and Zhao 1993a). A similar pattern is found for the cause of lost days among aged farm laborers in Michigan in 1894 (Carter, Ransom, Sutch, and Zhao 1993b).

[10] According to the Cost of Living Investigation by the Federal Bureau of Labor reported that sickness of workers accounted for about 23% of the causes of loss of working times by 12,000 wage earners' families (Lauck and Sydenstricker 1917, 113). Ransom and Sutch (1995) found that the days lost due to illness sharply increased with age after fifty-five among both farm and industrial workers. With regard to the roles of education and skills, Gratton (1986) has suggested that clerks in turn-of-the-century Boston were predominantly young men because younger cohorts had more education and were more likely to be native born and to speak English well without accents.

stated maximum age, the limit being 45 years or sometime even lower (Durand 1948, 114-116, Long 1958, 116-171).

Long-term unemployment, often defined as being unemployed for six months or longer during a given year, has also been acknowledged as a major reason for leaving the labor force of older males in the early twentieth century. Margo (1993) reported, based on his analysis of the PUMS of the 1900 census, that long-term unemployment among the elderly was an intermediate step toward nonparticipation. Using a longitudinal data linked to both 1900 and 1910 censuses, Lee (1998) found that aged men who were unemployed six months or more in 1900 were more likely to be out of gainful employment ten years later, holding other individual characteristics constant. Lee (2005) also found that older workers were more likely to leave their job between 1900 and 1910 if initially employed in occupations where the relative incidence of long-term unemployment was higher. In lights of these results, a greater probability of long-term unemployment among older workers in the early twentieth century may be regarded as an indicative of a greater pressure toward leaving the labor force.

Long-term unemployment was a significant labor market experience of older male workers in the early twentieth century. In 1900, more than 8% of men 55 and older were unemployed for six months or longer. The incidence of long-term unemployment among older workers substantially declined by 1910, but still remained as high as nearly 3%.[11] Long-term unemployment was much more common among older workers than younger persons. Margo (1993) and Ransom and Sutch (1986) reported that the odds of being unemployed six months or more in 1900 increased with age holding other individual characteristics constant. The incidence of long-term unemployment among men 55 and older was 2.5 times greater than the same measure for those 25 to 44 in 1900. Though the ratio fell substantially during the following decade, it was still as great as 1.75 in 1910.[12]

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[11] The observed decrease in the percentage of persons who experienced long-term unemployment may have been in part produced by the change in the definition of unemployment. Instructions for the 1880 through 1900 censuses directed enumerators to record the number of months of unemployment for all persons, regardless of reasons for not being at work. In the 1910 census, on the other hand, enumerators were instructed to record the number of weeks a person was out of work and wanted work only for employees, not the self-employed or employers (Moen 1994b). Therefore, unemployment measures of 1900 may contain some period of voluntary unemployment, while those of 1910 would reflect only the extent of enforced loss of a job.

[12] The disadvantage of the old is not attributable to the difference in occupational composition between age groups because older workers were more likely than young workers to be in occupations in which the incidence of long-term unemployment was relatively low (Lee 2005).

The incidence of long-term unemployment of older workers differed greatly across various occupations, reflecting sectoral differences in the degree of seasonality in demand for labor, the state of labor market prospect, and the extent of disadvantage in employment associated with aging. The percentage of workers who went through long-term unemployment was considerably higher in more seasonal occupations such as craftsmen in construction, farm laborers, and operatives in textile and in metal and mining industries (Lee 2005).[13] The relative incidence of long-term unemployment of older workers as compared to the young in the same occupation, a measure in which the influence of the industry-specific labor market condition is controlled, was relatively great among craftsmen, operatives, and salesmen (Lee 2005). According to some qualitative sources, these occupations are characterized by relatively severe labor-market disadvantages associated with aging.[14]

Table 1 presents the percentage of manufacturing workers in the 1910 IPUMS of the 1910 census who were unemployed for 24 weeks or more during the 1910 census year, separately for prime-age (25 to 44) and older employees (45 and older). The rate of long-term unemployment is not given for age-industry categories that include less than 20 persons. The age-industry cells in which 20 to 29 persons were present are marked by underlines.

The result shows that the incidence of long-term unemployment considerably differed across industries even within the manufacturing sector. The incidence of long-term unemployment was particularly high for various metal industries such as "Blast furnaces steel workers, and rolling mills (8.3%)," "Other primary iron and steel industries (8.1%), "Fabricated steel products (4.5%), and "Not specified metal industries (7.1%), and for "Railroad and miscellaneous transportation equipment (6.8%)."

Other industries in which older workers were subject to a greater risk of long-term

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[13] Some examples of industries in which production activities were heavily affected by weather, supply of water power, or other seasonal cycles include farming, ocean transportation, construction, and iron manufacturing. In some cases, such as food, textile, and shoe manufacturing industries, seasonality in demand for labor was generated by seasonal variations in the supply of law materials or demand for the finished products. For the industrial pattern of seasonality in demand for labor, see Lauck and Sydenstricker (1917, 137-152), Kuznets (1933), Lebergott (1964, 168-172), and Engerman and Goldin (1994, 111-116).

[14] Greabner (1980) noted that between 1900 and 1930 older salesmen were victimized by changing definitions and requirement of their occupation, being criticized for their inability to adopt the method of modern corporation or to adapt to a changing economic and technological environment (1980, 45-46). It was well documented among contemporaries that operatives in transportation were subject to a great hazard and intensity (Squier 1912, 109).

unemployment include miscellaneous wood products (5.8%), furniture and fixtures (3.9%), printing, publishing, and allied industries (4.0%), and leather products except footwear (3.9%). For many of these industries, the disadvantage associated with aging, indicated by the ratio of the incidence of long-term unemployment of older workers to that of young workers was greater than in other industries. In miscellaneous wood products, other primary iron and steel industries, and fabricated steel products, in particular, the proportion of the long-term unemployed among the old was more than twice as high as the long-term unemployment rate for younger workers.

7. Technology and Employment of Older Workers: Regression Results

7.1. Regression Analyses for Long-Term Unemployment

Based on the regression model, presented in equation (5), I perform logistic regressions to analyze the probability of long-term unemployment. Men aged 45 and older are included in the analysis based on the contemporary accounts that many industrial workers in the early twentieth century began to face various disadvantages in employment associated with aging from their mid-forties.

The 1910 population census does not report the weeks of unemployment for a fraction of individuals. Among the 4,549 men in the sample for whom the information for all independent variables is given, 3,769 persons provide weeks of unemployment. Accordingly, I perform regression analyses both for the full sample and for the sub-sample with complete information on the weeks of unemployment.[15] The results of the regressions of the probability of long-term unemployment based on the two samples are very similar. I present the result based on the sample of men with information on weeks of unemployment.

As variables pertaining to personal characteristics (denoted *X* in equation 5), I include in the analysis age, race, nativity, marital status, household headship, illiteracy,

[15] To use the full sample, I assume that individuals who did not report the weeks of unemployment were not the long-term unemployed. According to the result of an analysis the pattern of transition in labor-market status between 1900 and 1910, older men with no information on the months of unemployment in 1900 were more similar to persons who did not experience unemployment than to the long-term unemployed (Lee 1996). Therefore, it is likely that the majority of persons with no information on the weeks of unemployment were not the long-term unemployed.

family size, home ownership, city size, region, and occupation.[16] Variables on region and the population size of the place of location are added to consider differences in labor market conditions by location. As a proxy variable for industry-specific labor-market market conditions (*Z* in equation 5), I employ the percentage of the long-term unemployed among workers aged 25 to 44 (% Young Unemployed).

As noted in section 5, multiple measures are constructed and considered one by one for each of category of industrial characteristics. By comparing the results based on many different specifications, I selected a single measure for each category of which effect on dependent variables is the most powerful. I present the results that were obtained based on the set of selected industry variables. For example, the log of the value of product per work (Productivity) is used as the measure of labor productivity (*A* in equation 5). Other selected industry variables include the log of the value of product per establishment (Firm size), the expenditure on non-labor inputs as percentage of the total input costs (% Non-labor input), electric power per worker measured in horse power (Electric power), the percentage of workers employed in an establishment in which the prevailing hours of work was 60 and over (% Hours 60 and over), the percent of female workers (% Female workers), the number of managers and superintendents per 100 workers (% Managers), and the number of clerks per 100 workers (% Clerks).

Column 1 of Table 2 presents the result of regression that examines the effects of individual and industrial characteristics on the probability of being unemployed for 24 weeks or more. Let me first summarize the estimated effects of individual characteristics on the probability of long-term unemployment. The risk of long-term unemployment increased with age, as reported by Ransom and Sutch (1986) and Margo (1993). Non-white workers were significantly less likely to be unemployed for 24 weeks or more than whites. Family size was negatively related to the probability of long-term unemployment, though it missed statistical significance by a small margin. The effects of race and family size could reflect a lower level of reservation wages of non-whites and workers having a large families arising from their greater economic needs.

[16] Age is included in the regression, implicitly assuming a linear relationship between age and the probability of long-term unemployment. This specification approximates the actual link between age and long-term unemployment well for men aged 45 and older. I also use alternative specifications such as dummy variable for each of five-year age intervals and polynomials of age. The estimated coefficients of other variables are not sensitive to the choice of specification of age variable.

Dwellers in a large city, especially those who lived in a city with 500,000 or more residents, were subject to a greater risk of long-term unemployment than individuals who lived in a place of which population was under 50,000. The probability of long-term unemployment among older men was significantly higher in the region of West than in other regions. White-collar workers were less likely to be unemployed for a prolonged period than blue-collar workers.

The results for the industry variables, the major focus of this study, suggest that a few variables pertaining to technological and managerial features did exert a strong effect on the odds of long-term unemployment of older male manufacturing workers. As expected, the extent of hardship in the industry-specific labor market condition, measured by the percentage of the long-term unemployed among men 25 to 44 (Young unemployment), was positively related to the probability of long-term unemployment of older workers. The measure of firm size does not have any significant effect on the probability of long-term unemployment.

Variables pertaining to production technology also had strong effects on the probability of long-term unemployment. As expected in the model explained above, the measure of labor productivity was negatively associated with the probability of long-term unemployment. The percentage of expenses on non-labor inputs was positively related with the probability of long-term unemployment. Electric power per worker had no effect at all. The prevalence of longer hours of work (measured by % Hours 60 and over) was positively associated with the odds of long-term unemployment. On the other hand, the percentage of female workers had a negative effect on the risk of long-term unemployment. Lastly, the number of white-collar employee as percentage of the number of production workers had significant effects on the probability of long-term unemployment. The number of managers relative to the number of production workers was negatively associated with the probability of long-term unemployment. In contrast, the number of clerks per wage workers had a strong positive effect on the probability of long-term unemployment.

In addition to this baseline regression, I performed similar additional regressions in which the probabilities of being unemployed for 16 weeks or more and of one week or more are used as dependent variables (columns 2 and 3 of Table 2). A comparison of these results tells that the effects of industry variables are more powerful in general for the first than for the second and third regressions. In contrast, occupational differences in the probability of unemployment are greater for the second and third regressions than the first one. This suggests that inter-industry differences in technological and managerial characteristics largely affects the degree of difficulty of finding a new job when unemployed rather than the risk of losing one's job.

I also conducted similar regressions separately for the two sub-samples: relatively older (ages 55 and older) and middle-age (ages 45 to 54) manufacturing workers. The results of the two regressions, presented in Table 3, look similar in general. However, the effects of industry variables on the probability of long-term unemployment are somewhat larger in magnitude and more significant for older workers than for middle-age persons. In particular, the effects of the percentage of non-labor inputs and the percentage of clerks are much stronger for older men than younger workers. This suggests that technological changes should have more severely hurt the labor-market prospect of older workers than that of younger ones. On the other hand, a younger worker's chances of suffering long-term unemployment were more strongly influenced by personal characteristics such as age, race, and family size than an older worker's.

7.2. Regression Analyses for Retirement

Employing a similar regression model presented in equation 5 (only replacing P_U with P_L, denoting the probability of retirement), and using a sample of 316 Union Army veterans who were active manufacturing workers in 1900, I investigate how technological characteristics affected the probability of leaving the labor market between 1900 and 1910. A major change in the regression model is that the log of Union Army pensions is added. A number of studies have reported Union Army pensions greatly increased the probability of retirement of veterans (Costa 1998, Lee 1998, 2005). Since the amount of pensions was determined based on health status as well as age and military experiences, this variable can be regarded as an index of both non-labor incomes and health.

The dummy variable on race is eliminated because the sample is composed of white veterans. Taking into account the small sample size and its geographic concentration in the Northeast and Mid West, the dummy variables pertaining to the city size, region, and occupation are reconstructed in ways to represent broader categories of individuals. For industry variables, I use the average of the 1899 and 1909 values, if possible, to reflect the work conditions that the veterans were exposed to during the entire decade under study. For the variables on the hours of work, managers, and clerks, not available from the 1899 manufacturing census, the 1909 values are used.[17]

Because of the small sample size, I was able to perform regressions only for the full sample and the sample of men aged 55 and older (N=230). The sample of relatively younger veterans, aged 45 to 54 (N=86), is too small to run a separate regression with. The results of these two regressions are reported in Table 4. It should be remembered that many of the younger persons who were not gainfully employed in 1910 were not actually retired anyway. To study the determinants of retirement (defined as permanent departure from the labor market), therefore, it is more meaningful to look at the sample of men aged 55 and older.

The estimated coefficients for industry variables reported in Table 4 are remarkably similar to those obtained from long-term unemployment regressions, although statistically significant variables are somewhat different. The prevalence of long hours of work tended to push out older workers from the labor market, as it increased their risks of experiencing long-term unemployment. The percentages of female workers and the number of managers per production workers had significant negative effects on the probability of retirement. On the other hand, the effects of the relative size of non-labor input costs and the number of clerks per production worker are not statistically significant, although their signs are the same as in the case of long-term unemployment regressions.

The effects of firm size and electric power are most notably different between the analyses of retirement and long-term unemployment. The probability of retirement was higher for workers employed in industries with large-scale establishments. It is rather surprising that older men working in industries that used more electric power were less likely to leave the labor market. There two variables had no significant effects on the probability of long-term unemployment.

7.3. Productivity Effect versus Preference Effect

According to the simple model, introduced above, each of industry variables should have affected the probabilities of long-term unemployment and retirement through two different pathways, namely, by changing preference for work (preference effect) and by changing the size of labor productivity of the industry (production effect), as demonstrated

[17] It is unlikely that hours of work in manufacturing industries changed much between 1899 and 1909 during which nine per day was the prevailing hours in many industries (Whaples 1990).

by equation (4). Since a measure of labor productivity is included, the estimated regression coefficients reported above represent only the preference effect.

To estimate the total effects of industry variables, I performed short regressions, excluding the measure of labor productivity. The results of these regressions are presented in Table 5. Other independent variables, employed in the above regressions, were also included in the regression analyses, but their results are not reported in the table. For an easier comparison of the preference and productivity effects, I summarize the regression results of the long and short regressions, and calculate the differences between the two (see Table 6). According to the model, employed here, this third term represents the productivity effect.

The results show that the signs of the productivity and preference effects are opposite for almost all industry variables. This suggests that a technology introduced to increase productivity tended to deteriorate the employment conditions of older workers. To take some examples, an increase in the relative size of non-labor input costs would boost the employment of older workers by enhancing labor productivity on one hand, but would push aged workers out of the labor market, on the other hand, perhaps by making work more demanding or by substituting non-labor inputs for labor. A technological shift, represented by an increase in the number of clerks per production workers, would bring similar consequences.

Shorter prevailing hours, physically less demanding work, and more formalized workplace management (represented by, respectively, % 60 hours or longer, % female workers, and % managers) would make work conditions more favorable for older workers, but these positive effects were partially offset by their negative effects on labor productivity. Again, it was unexpected that the measure of electrification had a strong negative effect on the probability of retirement. According to the result of Table 6, it largely represents a strong and negative preference effect.

Another notable regularity observed from Table 6 is that the magnitude of the preference effect is larger than that of the productivity effect for most of the industry variables. In case of the regression for retirement, in particular, the total effect is largely determined by the preference effect, except for the percentage of non-labor input costs. For long-term unemployment, too, the size of preference effect is much larger in absolute magnitude than that of productivity effect, except for firm size and the relative size of non-labor input costs. This suggests that changing work conditions were perhaps more important pathway, compared to changing productivity, that technological changes affected the employment of older workers.

8. Implications for the Decline of LFPR of Older Males prior to the Social Security Era

The U.S. manufacturing industries went through tremendous transformations in production technology, work-organization, and managerial practices in the late nineteenth and early twentieth centuries. Table 7 offers only a partial picture of these technological transformations from 1889 to 1919 by providing selected average statistics of the whole manufacturing sector, many of which were considered in the empirical analyses conducted above.

As widely known, the average scale of establishment (measured by the values of production and capital per establishment) and the labor productivity (measured by the value of product per worker) rapidly increased over these 40 years. The ratio of non-labor inputs to labor inputs (measured by the ratio of expenses on materials to wages), use of power, and the relative importance of electricity as percentage of the total power also show increasing trends. Though provided only for 1909 and 1910, the number of managers per worker and the number of clerks per worker increased appear to be increasing over the early twentieth century.[18] Only the percentage of female workers remained stable over the period under investigation.

The results this paper, in conjunction with the patterns of industrial transformations that were under way during the late nineteenth and early twentieth centuries, suggest that technological changes in manufacturing industries should have had considerably strong impacts on the labor-market status of older workers. Moreover, my study suggests that the technological changes that took place during the industrial era had both favorable and adverse effects on the employment of older workers.

On one hand, changes in production technology and managerial practices tended to improve the employment prospect of older workers by increasing labor productivity and stabilizing the employment relations. The regression results show that aged workers employed an industries that boasted a high labor productivity were less likely to be

[18] In the 1899 and 1929 manufacturing censuses, the number of managers and clerks are reported in a combined category, making it difficult to calculate their numbers separately.

unemployed for a prolonged period of time than those working for a low-productivity industry, perhaps thanks to stronger demand for labor and higher wages. A higher ratio of managers to production workers was associated with lower probabilities of long-term unemployment and retirement of older manufacturing workers. As mentioned above, this result suggests that the formalization of work-organization and the decline of craft control may have stabilized the employment of older workers. Though not reported here, it is well documented that the prevailing hours of work decreased over the early twentieth century, especially after 1909 (Whaples 1990). Diminished hours of work, other things being equal, should have mitigated the difficulty of remaining in the workforce at older age.

On the other hand, technological changes should have made it increasingly difficult for older workers to remain in the workplace, perhaps by increasing the requirement for physical strength, mental agility, and ability to learn new skills. The regression results provide that the average size of establishments, the percentage of expenses on non-labor inputs, and the number of clerks per production workers were all positively related to the probabilities of long-term unemployment and of retirement. As noted above, a higher clerk-worker ratio might indicate a higher level of technology. Thus, my study suggests that emergence of large corporations and technological changes toward more capital- and technology intensive productions in the late nineteenth and early twentieth centuries should have deteriorated the employment conditions of older workers.

The regression results show that the percentage of female workers is the single most powerful determinant of the probabilities of long-term unemployment and retirement. Its effect is consistently strong for all specifications and sample selections. As noted above, a higher fraction of female workers in a particular industry could indicate greater requirements for physical strength and other types of human capital that women might lack. Thus, the regression results tell that older workers employed in a more physically-demanding and skill-intensive industry were more likely to leave the labor market.

The stable ratio of female to male workers in the manufacturing from 1899 to 1929, at first glance, seems to tell that overall demands for physical and mental human capitals remained unchanged over time. However, it should be noted that the female labor force participation rate increased over the early twentieth century, and that the rise in the labor-market activity of women during the period were largely caused by supply-side changes, such as decline in social trauma associated with women's paid work (Goldin 1990). Since the proportion of female labor failed to increase in the manufacturing, whereas the overall labor-market activity of females rose, the observed time trend in the percentage of female workers in manufacturing industries cannot simply be regarded as evidence against deterioration in the employment conditions for older workers.

9. Conclusions

This study has explored how technological, organizational, and managerial changes in the U.S. manufacturing industries affected the probabilities of long-term unemployment and retirement of older male workers in the early-twentieth-century United States. For this purpose, industry-level statistics reported in the 1899 and 1909 manufacturing census were linked to IPUMS of the 1910 census, and to a longitudinal sample of Union Army veterans, based on the common industry codes.

I found that a number of variables representing industry-specific technological characteristics had strong effects on the employment of older workers. Larger establishment size, greater fraction of non-labor inputs, higher prevalence of longer working hours, and more clerks per production workers were positively associated with the probabilities of long-term unemployment and retirement. On the other hand, the magnitude of labor productivity, the percentage of female workers, and the number of managers per production worker were negatively related to the risk of being out of work for a long period or permanently.

In this study, I hypothesize that each of industry variables affected the probabilities of long-term unemployment and retirement through two different pathways, namely, by changing preference for work (preference effect) and by changing labor productivity of the industry (productivity effect). The signs of productivity and preference effects were opposite for almost all variables pertaining to technological characteristics, meaning that technologies introduced to increase productivity tended to deteriorate the employment conditions of older workers. The magnitude of preference effect was larger than that of productivity effect for most of the technology variables. This suggests that changes in work conditions were perhaps more important pathway, compared to changes in productivity, that technological changes affected the employment of older workers.

My study suggests that the rapid technological, organizational, and managerial transformations in the late nineteenth and early twentieth centuries had both favorable and adverse impacts on the employment of older workers. On one hand, technological progress improved the employment prospect of older workers by increasing labor productivity and formalizing the employment relations. On the other hand, emergence of large corporations and technological changes toward more capital- and technology intensive productions made it increasingly difficult for older workers to remain in the labor market, perhaps by increasing the requirement for physical strength, mental agility, and ability to acquire new skills.

Though highly speculative for the present, the overall impact of technological changes on the employment of older workers during the industrial era is likely to be negative. The majority of industrial characteristics considered in this study changed in the direction to diminish the preference for work of older workers. Positive effects of technological changes through improving productivity do not seem to be large enough to offset those adverse effects. In this sense, my study tends to support the conventional, and more pessimistic, view of the labor market status of older industrial workers in the late nineteenth and early twentieth centuries.

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Table 1
Incidence of Long-term Unemployment by Industry in 1910

Industry	Number	% Workers aged 45+	% Long-Term Unemployed, aged 25-44	% Long-Term Unemployed, aged 45+
Logging	776	25.13	2.64	1.03
Sawmills, planing mills, and mill work	1716	19.29	0.88	4.23
Miscellaneous wood products	352	29.55	2.60	5.77
Furniture and fixtures	507	23.47	2.58	2.52
Glass and glass products	277	18.77	5.07	3.85
Cement, concrete, gypsum, and plaster products	244	22.13	3.39	1.85
Structural clay products	465	17.42	2.76	0.00
Pottery and related prods	76	28.95	2.78	0.00
Miscellaneous nonmetallic mineral and stone products	236	25.00	2.16	3.39
Blast furnaces, steel workers, and rolling mills	1515	19.08	6.2	8.30
Other primary iron and steel industries	857	17.39	3.91	8.05
Primary nonferrous industries	335	18.81	2.16	1.59
Fabricated steel products	867	23.3	1.57	4.46
Not specified metal industries	324	17.28	5.68	7.14
Agricultural machinery and tractors	214	36.92	2.13	1.27
Office and store machines	69	21.74	3.13	0.00
Miscellaneous machinery	1077	23.03	2.68	2.42
Electrical machinery, equipment, and supplies	332	14.76	3.41	4.08
Motor vehicles and motor vehicle equipment	415	13.98	1.28	1.72
Ship and boat building and repairing	290	26.55	3.77	0.00
Railroad and miscellaneous transportation equipment	709	22.85	6.33	6.79
Professional equipment	34	23.53	5.00	
Photographic equipment and supplies	14	28.57		
Watches, clocks, and clockwork-operated devices	57	35.09	3.33	5.00
Miscellaneous manufacturing industries	560	26.07	1.90	3.42
Meat products	382	23.56	0.99	2.22
Dairy products	243	15.64	1.43	0.00
Canning and preserving fruits, vegetables, and sea foods	57	29.82	3.57	
Crain-mill products	229	36.68	0.00	0.00
Bakery products	260	16.54	0.73	6.98
Confectionery and related products	174	19.54	0.00	2.94
Beverage industries	411	31.39	0.97	0.78
Miscellaneous food preparations and kindred products	208	24.04	2.06	2.00
Not specified food industries	13	38.46		
Tobacco manufactures	478	27.41	1.30	1.53
Knitting mills	107	20.56	2.33	4.55
Dyeing and finishing textiles, except knit goods	91	25.27	0.00	8.70
Carpets, rugs, and other floor coverings	101	26.73	4.65	3.70
Yarn, thread, and fabric	1227	23.63	1.52	3.45
Miscellaneous textile mill products	101	20.79	2.50	0.00
Apparel and accessories	940	20.43	4.61	2.60

Miscellaneous fabricated textile products	55	14.55	4.17	
Pulp, paper, and paper-board mills	284	20.07	1.27	1.75
Paperboard containers and boxes	23	26.09		
Miscellaneous paper and pulp products	31	22.58		
Printing, publishing, and allied industries	2430	20.74	2.79	3.97
Drugs and medicines	35	22.86		
Paints, varnishes, and related products	81	23.46	4.17	
Miscellaneous chemicals and allied products	281	25.62	0.65	1.39
Petroleum refining	105	21.90	0.00	0.00
Miscellaneous petroleum and coal products	1	1. 00		
Rubber products	164	17.68	2.33	0.00
Leather: tanned, curried, and finished	306	21.57	5.81	1.52
Footwear, except rubber	569	24.96	3.10	2.82
Leather products, except footwear	147	35.37	1.52	3.85

Source: IPUMS of the 1910 Census.
Note: Estimates of long-term unemployment rate are not given for age-industry cells including less than 20 persons; cells including 20 to 29 persons are marked by underlines.

Table 2
Logistic Regressions: Correlates of the Probability of Long-Term Unemployment among Older Male Workers in 1910

	Mean	(1) Unemployed for 24 weeks or longer		(2) Unemployed for 16 weeks or longer		(3) Unemployed for one week or longer	
		$\partial P/\partial x$	P-value	$\partial P/\partial x$	P-value	$\partial P/\partial x$	P-value
Individual Variables							
Age	53.524	**0.050**	<.0001	**0.026**	0.0032	0.012	0.0429
Nonwhite	0.049	**-0.979**	0.0153	**-0.739**	0.0034	-0.296	0.1031
Foreign	0.438	0.114	0.5595	0.134	0.3957	0.007	0.9418
Married	0.804	-0.106	0.6495	-0.241	0.1215	-0.131	0.2726
Head of household	0.819	0.301	0.3195	0.223	0.3296	-0.031	0.8112
Illiterate	0.075	0.259	0.4600	**0.638**	0.0283	**0.345**	0.0495
Family size	4.206	-0.061	0.1132	-0.045	0.1320	0.025	0.1777
Residence Owned	0.407	-0.168	0.3115	-0.090	0.5132	**-0.142**	0.0865
City size							
Under 2,500	0.219	NI	NI	NI	NI	NI	NI
2,500-49,999	0.305	-0.101	0.6990	**-0.297**	0.0848	-0.071	0.5425
50,000-499,999	0.243	0.490	0.1365	-0.053	0.0739	-0.118	0.3342
500,000 and over	0.233	**1.248**	0.0040	**0.585**	0.0305	**0.346**	0.0301
Region							
Northeast	0.509	NI	NI	NI	NI	NI	NI
Midwest	0.312	-0.198	0.2829	-0.149	0.3215	-0.107	0.2591
South	0.126	0.422	0.2365	0.210	0.4312	-0.082	0.5749
West	0.053	**1.209**	0.0193	**0.982**	0.0135	**0.551**	0.0192
Occupation							
White collar I	0.059	-0.512	0.1757	**-0.544**	0.0979	**-0.728**	<.0001
White collar II	0.052	**-0.665**	0.0708	**-0.632**	0.0574	**-0.805**	<.0001
Craftsmen	0.310	NI	NI	NI	NI	NI	NI
Operatives	0.344	0.044	0.8383	**0.518**	0.0152	**0.450**	0.0004
Service	0.027	-0.166	0.7375	0.130	0.7853	-0.287	0.2638
Manual labor	0.208	0.335	0.2166	**0.926**	0.0006	**0.683**	<.0001
Industry Variables							
% Young Unemployed	2.709	**0.172**	0.0239	**0.200**	0.0004	**0.119**	0.0005
Firm size: Log(Q)	11.516	-0.039	0.7517	-0.067	0.4949	-0.071	0.2285
Productivity: Log(Q/L)	7.900	**-0.899**	0.0036	**-0.663**	0.0418	0.009	0.9745
% Non-labor input	76.515	**0.095**	0.0175	0.028	0.2835	-0.015	0.2717
Electric power: E/ L	0.850	-0.176	0.4232	-0.059	0.7509	-0.097	0.3604
% Hours 60 and over	9.886	**0.024**	0.0470	0.012	0.2132	**0.017**	0.0015
% Female workers	15.891	**-0.032**	0.0008	**-0.015**	0.0354	0.002	0.6753
% Managers	1.898	**-0.560**	0.0049	**-0.467**	0.0048	**-0.221**	0.0215
% Clerks	8.559	**0.155**	0.0007	**0.092**	0.0041	0.021	0.2001
Number of observations		3769		3769		3769	
-2 Log L w/o covariates		1317.876		1892.056		3888.758	
-2 Log L with covariates:		1206.352		1755.332		3666.221	
Likelihood Ratio		111.5239(p= 0.0002)		136.725(p<0.0001)		222.5366(p<0.0001)	

Source: IPUMS of the 1910 census linked to the published 1909 manufacturing census.
Note: The dependent variable for each regression is one if the person was unemployed for 24 weeks or longer during the year prior to the enumeration of the 1910 census, and zero, otherwise. The sample is limited to individuals for whom the number of weeks unemployed is reported. Statistically significant variables are given in bold numbers.

Table 3
Logistic Regressions: Correlates of the Probability of Long-Term Unemployment among Older Male Workers in 1910 by Age

	(1) Older Workers (ages 55 and older)			(2) Younger Workers (ages 45 to 54)		
	Mean	∂P/∂*x*	P-value	Mean	∂P/∂*x*	P-value
Individual Variables						
Age	61.327	**0.055**	0.0083	48.937	**0.076**	0.0790
Nonwhite	0.043	-0.999	0.9785	0.053	**-0.872**	0.0523
Foreign	0.455	0.216	0.4622	0.428	0.063	0.8196
Married	0.779	0.028	0.9366	0.819	-0.221	0.4867
Head of household	0.835	0.188	0.6513	0.810	0.372	0.4015
Illiterate	0.072	-0.112	0.8149	0.077	0.587	0.2648
Family size	3.810	-0.013	0.8267	4.443	**-0.101**	0.0604
Residence Owned	0.443	-0.264	0.2365	0.386	-0.112	0.6494
City size						
Under 2,500	0.214	NI	NI	0.224	NI	NI
2,500-49,999	0.318	-0.132	0.7295	0.297	0.029	0.9392
50,000-499,999	0.228	0.811	0.1278	0.252	0.346	0.4384
500,000 and over	0.240	**1.200**	0.0605	0.228	**1.484**	0.0182
Region						
Northeast	0.544	NI	NI	0.489	NI	NI
Midwest	0.284	-0.027	0.9267	0.328	-0.352	0.1480
South	0.131	-0.166	0.7227	0.122	**1.122**	0.0491
West	0.041	**2.000**	0.0245	0.060	0.721	0.2660
Occupation						
White collar I	0.054	-0.371	0.5442	0.062	-0.544	0.2955
White collar II	0.058	-0.789	0.1344	0.049	-0.500	0.3566
Craftsmen	0.316	NI	NI	NI	NI	NI
Operatives	0.318	0.323	0.3654	0.359	-0.253	0.5742
Service	0.049	-0.410	0.4887	0.013	1.121	0.3418
Manual labor	0.205	**0.923**	0.0457	0.210	-0.012	0.9731
Industry Variables						
% Young Unemployed	2.661	0.000	0.9974	2.737	**0.324**	0.0038
Firm size: Log(Q)	11.476	-0.067	0.6885	11.541	-0.015	0.9380
Productivity: Log(Q/L)	7.882	**-0.919**	0.0219	7.914	**-0.875**	0.0722
% Non-labor input	76.277	**0.110**	0.0631	76.707	0.086	0.1372
Electric power: E/ L	0.817	-0.097	0.7719	0.870	-0.167	0.5987
% Hours 60 and over	9.440	0.028	0.1130	10.164	0.017	0.3543
% Female workers	16.131	**-0.030**	0.0253	15.768	**-0.034**	0.0174
% Managers	1.919	**-0.572**	0.0202	1.892	-0.543	0.1035
% Clerks	8.569	**0.190**	0.0020	8.578	0.113	0.1129
Number of observations	1394			2375		
-2 Log L w/o covariates	618.168			686.313		
-2 Log L with covariates:	556.485			621.498		
Likelihood Ratio	61.683 (p = 0.0002)			64.814 (p < 0.0001)		

Source: IPUMS of the 1910 census linked to the published 1909 manufacturing census.
Note: The dependent variable for each regression is one if the person was unemployed for 24 weeks or longer during the year prior to the enumeration of the 1910 census, and zero, otherwise. The sample is limited to individuals for whom the number of weeks unemployed is reported. Statistically significant variables are given in bold numbers.

Table 4
Logistic Regressions: Correlates of the Probability of Retirement among Older Veterans between 1900 and 1910

	(1) All veterans			(2) Older veterans (ages 55 and older)		
	Mean	∂P/∂*x*	P-value	Mean	∂P/∂*x*	P-value
Individual Variables						
Age	57.996	**0.120**	<0.0001	60.191	**0.132**	0.0006
Foreign	0.225	-0.265	0.3674	0.222	**-0.512**	0.0755
Married	0.877	**-0.577**	0.0881	0.852	-0.506	0.2072
Head of household	0.899	0.415	0.5465	0.887	0.011	0.9867
Illiterate	0.019	0.163	0.8755	0.017	0.429	0.7369
Family size	3.547	**0.162**	0.0397	3.309	0.117	0.2143
Residence Owned	0.525	-0.303	0.2218	0.548	0.051	0.8884
Reside in urban areas	0.329	-0.132	0.6542	0.309	-0.140	0.6827
Region						
Northeast	0.500	NI	NI	0.491	NI	NI
Midwest/ South/West	0.500	0.002	0.9942	0.509	0.081	0.8138
Occupation						
Unskilled	0.316	NI	NI	0.274	NI	NI
Skilled	0.573	-0.303	0.2542	0.609	-0.360	0.2227
White collar	0.111	-0.073	0.8796	0.117	-0.292	0.5595
Log of UA pension	1.735	**0.339**	0.0412	1.762	0.233	0.2059
Industry Variables						
Firm size: Log(Q)	11.544	**0.412**	0.0672	11.547	**0.471**	0.0882
Productivity: Log(Q/L)	7.984	-0.480	0.3803	7.969	-0.376	0.5749
% Non-labor input	78.846	0.011	0.7972	78.544	0.015	0.7469
Electric power per worker	0.402	-0.442	0.4421	0.403	**-0.867**	0.0368
% Hours 60 and over	10.077	0.015	0.3887	10.261	**0.042**	0.0376
% Female workers	15.077	**-0.041**	0.0014	15.637	**-0.045**	0.0023
% Managers	2.068	-0.231	0.4242	2.064	**-0.541**	0.0563
% Clerks	9.410	0.018	0.7633	9.209	0.094	0.2269
Number of observations	316			230		
-2 Log L w/o covariates	405.873			305.075		
-2 Log L with covariates:	351.060			266.913		
Likelihood Ratio	54.8129 (p < 0.0001)			38.1620 (p = 0.0085)		

Source: Longitudinal sample of Union Army veterans linked to 1900 and 1910 censuses, and published 1899 and 1909 manufacturing censuses.

Note: The dependent variable for each regression is one if the person was not gainfully employed when the 1910 census was enumerated, and zero, otherwise. The sample is limited to individuals for who were gainfully employed in 1900. The average of the 1899 and 1909 values are used for the following industry variables: product per establishment, product per worker, % non-labor input, electric power per worker, and % female workers; The value for 1909 is used for the following industry variables: % hours 60 and over, % managers, and % clerks. Statistically significant variables are given in bold numbers.

Table 5
Logistic Regressions with Omitting Labor Productivity Measure

	(1) Probability of Long-Term Unemployment (Men aged 45 and older)			(2) Probability of Retirement (Men aged 55 and older)		
	Mean	∂P/∂*x*	P-value	Mean	∂P/∂*x*	P-value
Industry Variables						
Firm size: Log(Q)	11.516	-0.119	0.2916	11.547	0.415	0.1067
% Non-labor input	76.515	-0.011	0.4720	78.544	-0.007	0.7819
Electric power per worker	0.850	-0.082	0.7054	0.403	**-0.870**	0.0352
% Hours 60 and over	9.886	**0.022**	0.0579	10.261	**0.039**	0.0447
% Female workers	15.891	**-0.012**	0.0660	15.637	**-0.042**	0.0021
% Managers	1.898	**-0.488**	0.0032	2.064	**-0.546**	0.0540
% Clerks	8.559	**0.074**	0.0177	9.209	0.087	0.2557
Number of observations	3769			230		
-2 Log L w/o covariates	1317.876			305.075		
-2 Log L with covariates:	1217.182			267.229		
Likelihood Ratio	100.694 (p < 0.0001)			37.846 (p = 0.0062)		

Source: (1) IPUMS of the 1910 census linked to the published 1909 manufacturing census; (2) Longitudinal sample of Union Army veterans linked to 1900 and 1910 censuses, and published 1899 and 1909 manufacturing censuses.
Note: 1. Regression (1): The dependent variable is one if the person was unemployed for 24 weeks or longer during the year prior to the enumeration of the 1910 census, and zero, otherwise. The sample is limited to individuals for whom the number of weeks unemployed is reported. All independent variables used in the regressions reported in Table 2 are included, but the results for individual variables are omitted from this table.

2. Regression (2): The dependent variable is one if the person was not gainfully employed when the 1910 census was enumerated, and zero, otherwise. The sample is limited to individuals for who were gainfully employed in 1900. The average of the 1899 and 1909 values are used for the following industry variables: product per establishment, product per worker, % non-labor input, electric power per worker, and % female workers; The value for 1909 is used for the following industry variables: % hours 60 and over, % managers, and % clerks. All independent variables used in the regressions reported in Table 4 are included, but the results for individual variables are omitted from this table.

Statistically significant variables are given in bold numbers.

Table 6
Comparison of "Preference Effect" and "Productivity Effect"

	Long-Term Unemployment			Retirement		
	(1) Total	(2) Preference	(3) Productivity	(4) Total	(5) Preference	(6) Productivity
Firm size: Log(Q)	-0.119	-0.039	-0.080	0.415	**0.471**	-0.056
% Non-labor input	-0.001	**0.095**	-0.106	-0.007	0.015	-0.022
Electric power per worker	-0.082	-0.442	0.360	**-0.870**	**-0.867**	-0.003
% Hours 60 and over	**0.022**	**0.024**	-0.002	**0.039**	**0.042**	-0.003
% Female workers	**-0.012**	**-0.032**	0.020	**-0.042**	**-0.045**	0.003
% Managers	**-0.488**	**-0.560**	0.072	**-0.546**	**-0.541**	-0.005
% Clerks	**0.074**	**0.155**	-0.081	0.087	0.094	-0.007

Sources: Columns (1), (2), (4), and (5) are drawn from, respectively, regression (1) of Table 5, regression (2) of Table 2, regression (2) of Table 5, and regression (2) of Table 4; Column (3) = (1) – (2); Column (6) = (4) – (5).
Note: "Total" refers the total effect of each industry variable on the dependent variable; "Preference" denotes the effect of each industry variable on the dependent variable through changing preference for work; "Productivity" stands for the effect of each industry variable on the dependent variable through changing the labor productivity of the industry. See equation (4) and related text for more detailed explanations. Statistically significant variables are given in bold numbers.

Table 7
Changes in Selected Average Characteristics of Manufacturing Industries, 1889-1929

Industrial Characteristics	1889	1899	1909	1919	1929
(1) Value of capital per establishment ($)	18,359	19,165	68,636	153,228	
(2) Value of product per establishment($)	26,370	25,386	76,993	215,157	333,879
(3) Value of product per worker ($)	1,989	2,450	3,125	6,862	7,969
(4) Expenses on materials / Wages	2.26	3.16	3.54	3.55	3.32
(5) Power per 100 workers (horse power)	140	218	288	333	491
(6) % Electric power		4.8	25.4	55.0	82.3
(7) % Female workers	19.5	20.0	20.6	20.1	21.0
(8) Managers per 100 worker			2.0	3.1	
(9) Clerks per 100 worker			8.7	11.4	
(10) Managers & clerks per 100 worker		7.5	10.7	14.5	15.4

Source: Calculated from published manufacturing censuses of 1889, 1899, 1909, 1919, and 1929, except for (4) hours power per 100 workers and (5) Electric power / total power that are drawn from Carter et al. (2006), Table Dd848-853.

Appendix Table
Industry Matching between 1910 Population Census and 1909 Manufacturing Census

Industries in Population Census	Number of Establishments	Number of Wage Earners	Industries in Manufacturing Census
Sawmills, planing mills, and mill work	40671	826978	Lumber and timber products
Miscellaneous wood products	4033	59189	Baskets, and rattan and willow ware Boxes, cigar Cooperage and wooden goods, not elsewhere specified Lasts Looking-glass and picture frames Wood carpet Wood preserving Wood, turned and carved
Furniture and fixtures	4453	148451	Furniture and refrigerators Mattresses and spring beds Show cases Window shades and fixtures
Glass and glass products	1094	88222	Glass Glass, cutting, staining, and ornamenting Mirrors
Cement, concrete, gypsum, and plaster products	4625	61338	Artificial stone Cement Lime Wall plaster
Structural clay products	4263	91615	Brick and tile Crucibles
Pottery and related prods	862	53331	China decorating Pottery, terra-cotta, and fire-clay products
Miscellaneous nonmetallic mineral and stone products	5491	78086	Emery and other abrasive wheels Kaolin and ground earths Marble and stone work Sand and emery paper and cloth Statuary and art goods Steam packing
Blast furnaces, steel workers, and rolling mills	731	336106	Galvanizing Iron and steel, blast furnaces Iron and steel, steel works and rolling mills Tin plate and terneplate
Other primary iron and steel industries	385	25899	Horseshoes, not made in steel works or rolling mills Iron and steel, bolts, nuts, washers, and rivets, not made in steel works or rolling mills Iron and steel, doors and shutters Iron and steel forgings

			Iron and steel, nails and spikes, cut and wrought, including wire nails, not made in steel works or rolling mills
Primary nonferrous industries	5725	146244	Babbitt metal and solder Brass and bronze products Copper, tin, and sheet-iron products Gold and silver, leaf and foil Gold and silver, reducing and refining, not from the ore Lead, bar, pipe, and sheet Smelting and refining, copper Smelting and refining, lead Smelting and refining, zinc Smelting and refining, not from the ore
	1537	23336	Jewelry
Fabricated steel products	4664	173083	Cuttery and tools, not elsewhere specified Electroplating Enameling and japanning Engravers' materials Engraving and diesinking Files Firearms and ammunition Gas, illuminating and heating Safes and vaults Saws Screws, wood Springs, steel, car and carriage Stoves and furnaces, including gas and oil stoves Wire Wirework, including wire rope and cable
Fabricated nonferrous metal products	656	17875	Gas and electric fixtures and lamps and reflectors Vault lights and ventilators
Agricultural machinery and tractors	674	56789	Agricultural implements Windmills
Office and store machines	176	12438	Scales and balances Typewriters and supplies
Miscellaneous machinery	14882	607867	Food preparations Foundry and machine-shop products Foundry supplies Pumps, not including steam pumps Screws, machine Type founding and printing materials Washing machines and clothes wringers
Electrical machinery, equipment, and supplies	1411	88451	Brushes Electrical machinery, apparatus, and supplies

			Phonographs and graphophones
Motor vehicles and motor vehicle equipment	743	96060	Automobiles, including bodies and parts
Ship and boat building and repairing	1353	43564	Shipbuilding, including boat building
Railroad and miscellaneous transportation equipment	7471	470911	Bicycles, motorcycles, and parts Carriages and wagons and materials Cars and general shop construction and repairs by steam-railroad companies Cars and general shop construction and repairs by street-railroad companies Cars, steam-railroad, not including operations of railroad companies Cars, street-railroad, not including operations of railroad companies Cash registers and calculating machines Wheelbarrows
Professional equipment	2265	49784	Dentist's materials Hosiery and knit goods Instruments, professional and scientific Optical goods Surgical appliances and artificial limbs
Photographic equipment and supplies	16	353	Moving pictures
Watches, clocks, and clockwork-operated devices	120	15775	Clocks and watches, including cases and materials
Miscellaneous manufacturing industries	4799	105545	Artificial flowers and feathers and plumes Artists' materials Billiard tables and materials Candles Carriages and sleds, children's Coffins, burial cases, and undertakers' goods Cork, cutting Fire extinguishers, chemical Fireworks Furs, dressed Hair work Hand stamps and stencils and brands Ink, writing Jewelry and instrument cases Lapidary work Models and patterns, not including paper patterns Musical instruments and materials, not specified Musical instruments, pianos and organs and materials Needles, pins, and hooks and eyes

			Pens, fountain, stylographic, and gold Pipes, tobacco Signs and advertising novelties Silverware and plated ware Soda-water apparatus Sporting and athletic goods Toys and games Umbrellas and canes Wool pulling All other industries
Meat products	1641	88352	Slaughtering and meat packing
Dairy products	8736	22962	Butter, cheese, and condensed milk Butter, reworking Dairymen's poulterers', and apiarists' supplies
Canning and preserving fruits, vegetables, and seafoods	3767	67219	Canning and preserving
Grain-mill products	87	1930	Flax and hemp, dressed Rice, cleaning and polishing
Bakery products	23926	84956	Bread and other bakery products
Confectionery and related products	2017	21159	Chocolate and cocoa products Confectionery Peanuts, grading, roasting, cleansing, and shelling
Beverage industries	7464	77288	Cordials and sirups Liquors, distilled Liquors, malt Liquors, vinous Malt Mineral and soda waters
Miscellaneous food preparations and kindred products	4540	61322	Baking powders and yeast Beet sugar Coffee and spice, roasting and grinding Flavoring extracts Glucose and starch Ice, manufactured Oleomargarine Sugar and molasses Vinegar and cider
Not specified food industries	11691	41787	Flour-mill and gristmill products
Tobacco manufactures	15822	90417	Tobacco manufactures
Dyeing and finishing textiles, except knit goods	426	36486	Dyeing and finishing textiles
Carpets, rugs, and other floor coverings	567	21147	Carpets and rugs, other than rag Carpets, rag
Yarn, thread, and fabric	3433	331283	Cotton goods, including cotton small wares Haircloth Silk and silk goods, including throwsters Upholstering materials

			Wool scouring Woolen, worsted, and felt goods, and wool hats
Miscellaneous textile mill products	434	24863	Cordage and twine and jute and linen goods Hats, straw Oilcloth and linoleum Shoddy Waste
Apparel and accessories	15790	224177	Clothing, horse Clothing, men's, buttonholes Clothing, men's, including shirts Clothing, women's Corsets Fur goods Furnishing goods, men's Hat and cap materials Hats and caps, other than felt, straw, and wool Hats, fur-felt Millinery and lace goods
Misc fabricated textile products	1273	10199	Awnings, tents, and sails Bags, other than paper Cloth, sponging and refinishing Flags, banners, regalia, society badges and emblems Hammocks House-furnishing goods, not elsewhere specified
Pulp, paper, and paper-board mills	777	68497	Paper and wood pulp
Paperboard containers and boxes	1443	22573	Boxes, fancy and paper Fancy articles, not elsewhere specified
Miscellaneous paper and pulp products	880	22079	Bags, paper Card cutting and designing Labels and tags Paper goods, not elsewhere specified Paper patterns Pulp goods Stationery goods, not elsewhere specified Wall paper
Printing, publishing, and allied industries	32014	212753	Engraving, wood Photo-engraving Printing and publishing Stereotyping and electrotyping
Drugs and medicines	3667	12141	Drug grinding Patent medicines and compounds and druggists' preparations
Paints, varnishes, and related products	791	13207	Paint and varnish
Miscellaneous chemicals and allied products	5445	152579	Blacking and cleansing and polishing preparations Bluing