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INCIDENCE AND TRANSITION RATES OF UNEMPLOYMENT IN KANSAS LABOR MARKETS, 1899*

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Unemployment at the end of century was widespread, and it was not distributed according to a random draw, as the theory of spot-labor markets predicts it to have been. Workers belonging to different occupational groups showed considerably distinctive unemployment patterns in terms of incidence and transition rates. Unemployment was pervasive among building workers and female workers while it was less widespread among railway workers and male miscellaneous workers. The transition rate of exiting unemployment as more important than that of entering unemployment in explaining difference in unemployment experiences across occupational groups during the era.

I. INTRODUCTION

One assertion commonly made about the U.S. labor market at the turn of the century is that rapid changes in economic opportunity gave rise to high degrees of labor mobility and caused brief job spells for most workers. Furthermore, high rates of turnover and the brevity of job tenure have often been used to justify a 'spot market' characterization of the labor market during the era. According to the usual portrayal of a spot labor market, flexible wages ensure full employment, and unemployment is quite temporal and only transitory when it does exist. Firms view workers both within and outside the firms as good substitutes for each other, and workers see their relationships within firms similarly. Thus, unemployment distributes according to a random draw, so that there is no a priori reason why unemployment should be concentrated on a certain group of workers.

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An interesting question is how these accounts apply to the case of the late nineteenth century, when the labor market was often assumed to operate like a spot market. If the spot-market characterization of the labor market during the era were to be correct, unemployment duration would have been brief and unemployment incidence would have been high. Unemployment would have been an unpleasant, but temporary state for most workers. Therefore, one would expect that unemployment should have been quite a marginal phenomenon for society as whole. However, reality seems to have been considerably more complicated. In his influential book, Keyssar (1986) argues that spells of unemployment were not necessarily brief and that matters of unemployment were an important social and political problem in the late nineteenth century. Supports for this view are offered by Hatton and Williamson (1991) and Goldin and Margo (1991) who find that unemployment touched a large proportion of workers each year and often for long durations. The state labor statistics movement, initiated after the Civil War, demonstrates the increased attention paid to the issue of unemployment by the authorities of those days (See Carter and Ransom 1991).

Once one accepts that unemployment problems had a significant impact upon the economic life of the time, the conventional analysis based on the assumption of a spot-labor market encounters difficulties in characterizing the functioning of labor markets, for it overlooks various aspects of the quantity adjustment of labor markets through labor allocation.[1] Furthermore, the notion that unemployment had a significant history stands as a challenge to that interpretation of the American past as one whereby the nation provided opportunities rather than obstacles to those who were willing and able to work. This paper directs its attention to the nature and structure of unemployment at the turn of the century. I use an 1899 survey of 1,058 wage earners in Kansas in order to address these questions. I begin by briefly explaining the Kansas survey. Then, I analyze the distribution and incidence of unemployment of the Kansas workers and calculate their transition rates of entering and leaving unemployment. The final section summarizes.

Ⅱ. KANSAS SURVEY

The 1899 survey of Kansas wage earners, conducted by the state's Bureau of

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[1] Recently, there have been a surge in the historical researches concerning the question of how labor markets in the late nineteenth century in the U.S. operated, in part motivated by the provision of microeconomic data on labor markets during the era. The Historical Labor Statistics Project is currently underway to create a machine-readable database of microeconomic data selected from the many separate investigations undertaken by state Bureaus of Labor Statistics. For details, see Kim (1994 a) which reviews the recent historical debates over the operation of labor markets in the late nineteenth century, and discusses the Historical Labor Statistics Project as well.

Labor and Industry, was published in its Fifteenth Annual Report for 1899. Since its creation in 1885, the Kansas Bureau of Labor had undertaken a number of worker surveys, but the 1899 survey was the first under the new law of 1898.[2] The survey was conducted by mail. The Bureau did not report the number of questionnaires it sent out, but 1,058 respondents "sufficiently complete for tabulation" were returned (Kansas Bureau of Labor and Industry 1900, p. 4). The Bureau classified the workers according to five occupational groups. The classes and numbers of the workers in each class are as follows:

Class A : Railway employees in train service 168
Class B : Railway employees in miscellaneous trades 87
Class C : Building trades 276
Class D : Miscellaneous trades 396
Class E : Female wage earners 131

This grouping of workers by the Bureau turns out to be particularly advantageous for the purpose of the this paper. Among others, the comparison of workers in railway trades (Classes A and B) with those in building trades (Class C) offers a rare opportunity to highlight the cross-sectional differences in unemployment experiences, for these two groups have been widely believed to have occupied the opposite ends of the spectrum. Railways were among the first American enterprises to introduce internal labor markets, whereas building trades were widely reputed to constitute the most casual jobs.[3] Classes A and B consist of skilled and semi-skilled workers, respectively, within the same job category of railways. Here, however, I treat railway workers in train service (Class A) and miscellaneous trades (Class B) as a single group of railway workers because they are indistinguishable from each other in terms of unemployment experience.[4] A notable difference between them was found in terms of the wage rate, implying that internal labor markets in railways differentiated workers according to their skill

[2] In 1885, a law was passed requiring the commissioner of labor to inspect workshops, factories, mills, and private works to examine the sanitary conditions and to make recommendations for changes to protect the security and health of the workers. This was revised in 1899, giving the commissioner police powers and the authority to carry out more rigorous inspections. Failure to comply was considered a misdemeanor punishable by fine and/or imprisonment. See Kansas Bureau of Labor and Industry (1900).

[3] For the development of internal labor markets in railways, see Chandler (1977), Lichter (1983), and Sundstrom (1988).

[4] Railway workers in train service (Class A) and miscellaneous trades (Class B) showed almost the same average numbers of days unemployed conditional on any unemployment (55.2 days and 56.8 days, respectively) and percentages of experiencing some unemployment (58.4 percent and 56.5 percent, respectively) during the year of 1899.

by means of wages rather than by means of employment practices.[5] Miscellaneous trades (Class D) consist of various kinds of occupations, so this class would be considered as representative of typical male wage earners in Kansas in 1899. Its comparison with female workers (Class E) would make it possible to examine gender differences in hiring practices. Moreover, such a comparison would be quite free from the bias that usually occurred due to the different compositions of occupations between male and female workers. In the sample, 42 percent of the miscellaneous trades and 78 percent of the female wage earners shared the same category of jobs such as office helpers, printers, retail clerks, and teachers.

Table 1 shows the industrial composition of workers in Kansas and the U.S. in 1900.[6] Compared to the state's total, workers in the railway and building trades sampled in the Kansas survey seem to be oversampled: As of 1900, workers in transportation and construction accounted for 29 and 17 percent, respectively, of the sample but only 14 percent and 10 percent, respectively, of the total of the state's non-agricultural labor force. On the other hand, female workers were undersampled, consisting of only 11 percent of the sample compared to 23 percent of the state's total. Nonetheless, the claim that workers in the Kansas survey were "representative of the various railway, mechanical and miscellaneous trades, as well as representative from a geographical point of view" finds acceptance (Kansas Bureau of Labor and Industry 1900, p. 4). In comparing the sample with the U.S. total, the similar tendency in the sampling biases is observed. One thing worth noting is that the proportion of workers involved in the transportation sector in Kansas was twice as large as that of the same category of works in the U.S. as a whole.[7] This might be a reason for why railway workers received such a large weight in the sample. Because of the geographical advantage due to its location, Kansas indulged itself lavishly in the construction of railways during the late nineteenth century.[8]

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[5] The difficulty of monitoring railway workers in train service caused them to be paid higher wages than those in miscellaneous trades. See Kim, ch.6 (1994 a).

[6] In Table 1, the number of the Kansas total represented the labor force, while the numbers of the U.S. total represented employment including employees, self-employed and unpaid family workers. On the other hand, the Kansas BLS samples consist of wage earners only. As a result, those numbers of the Kansas BLS sample, the Kansas total and the U.S. total do not represent the same categorization of workers. However, I believe the discrepancy makes no difference in the comparison of industrial composition of workers among them.

[7] As of 1900, workers in transportation accounted for 14. 0 percent of the total of the non-agricultural labor force in Kansas and 7.4 percent of that in the U.S. See Madden (1971) and Lebergott (1964).

[8] Despite the tremendous interest in railroads, it was not until 1865 that any serious effort was made to bridge the Kansas plains. The first major line to build extensive trackage in Kansas was the Union Pacific. The Santa Fe railroad was opened in 1869. After gaining access to Chicago and the

[Table 1] Workers by industry and their proportions, Kansas and the U.S. in 1900

	Kansas[1]	U.S.[2]
Agriculture	291.3 (100.0)	11,749 (100.0)
(Male)	284.6 (97.7)	11,019 (93.6)
(Female)	6.7 (2.3)	730 (6.2)
Non-Agriculture	216.4 (100.0)	15,548 (100.0)
Mining	11.6 (5.4)	637 (4.1)
Construction	22.3 (10.3)	1,665 (10.7)
Manufacturing	30.1 (13.9)	5,895 (37.9)
Trans., Commerce, Public Utilities	30.4 (14.0)	1,145 (7.4)
Trade, Finance, Real Estate	50.8 (23.5)	3,970 (25.5)
Service and Public Adminstration	71.2 (32.9)	2,236(14.4)
(Male)	167.6 (77.4)	12,531 (80.6)
(Female)	48.8 (22.6)	3,016(19.4)
Total	507.7	27,297

[1] The numers for Kansas are for the labor force in thousand.

[2] The numbers for the U.S. are for employment in thousand.

Note : The numbers in parentheses are the percentages of those to the total agriculture or non-agriculture labor force.

Source : Madden(1971, p. 51); Lebergott(1964, p. 510)

The railroad opened the Great Plains for settlement by providing for the easy transportation of people and goods, which thereby offered vast employment opportunities in Kansas.

According to the estimation of the business cycle by Burns and Mitchell (1946), the year 1899 was a transitional period. After a contraction from 1893 to 1896, business activity had experienced an expansion until it was interrupted by a recession starting from June 1899 and reaching a trough in December 1900. However, the Kansas survey showed that employment opportunities in 1899 increased compared to those in 1898. To the question "As compared with 1898, has opportunity for employment in your trade in your locality increased?", 452 responded with an answer of "increased", 140 with "decreased" and 260 with "same" while 240 did not respond to the question. After all, one may not feel guilty to assume that the unemployment experiences observed in the Kansas sample might not have been seriously affected by the business cycle.

Pacific coast, the Santa Fe rose to a position of national importance and played a large part in the development of the West. The last major railroad to build extensively in the state was the Missouri Pacific, most of whose expansion took place between 1879 and 1892.

Ⅲ. INCIDENCE OF UNEMPLOYMENT

The 1899 Kansas survey collected information on annual days unemployed during 1899, and workers were asked to list the causes of unemployment from among three categories: "inability to obtain work," "sickness," and "other causes". This breakdown of unemployment makes it possible to trace the distributional difference of unemployment by occupational group. Unemployment by reason of inability to obtain work corresponds to the modern concept of unemployment. However, unemployment due to sickness or other causes should be classified rather as withdrawal from the labor force because those who were unemployed due to these reasons were hardly "looking for" jobs actively at that time.[9] In a sense, unemployment for all causes combined could be categorized as "nonemployment", in the terminology of Kim B. Clark and Lawrence H. Summers (1979).[10] Recall, however, that it was quite normal for workers to take unpaid time off from work on a sporadic basis and subsequently return to their jobs before firms began to provide paid vacations and sick leave (Goldin and Margo 1991). Consequently, the classification of unemployment by cause in the survey might not have been as definite as it is nowadays.

Table 2 shows the distribution of the annual days of unemployment by cause and occupational group. For the case of unemployment for all causes combined, out of 1,058 wage earners who were canvassed in the survey, more than half, 596 workers (56.4 percent), experienced some unemployment during 1899. The percentage varies by occupational group, from a low of 45.8 percent for the female workers to a high of 60.5 percent for those in building trades. The mean number of days unemployed, conditional on any unemployment during the year, was 68.2 days for the total. The number of days lost was greatest among building workers, averaging 94.4 days. Female workers lost, on average, 73.3 days, railway workers, 57.1 days, and male miscellaneous workers, 51.5 days. It was thus the workers

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[9] The official definition of unemployment for purposes of government statistics includes those who have been laid off by their employers, those who have been fired or have quit and are looking for other work, and those who are just entering or reentering the labor force but have not found a job yet. People who are not employed and are neither looking for work nor waiting to be recalled from layoff by their employers are not counted as part of the labor force and are considered as out of labor force.

[10] Clark and Summers point out that there exists an arbitrariness in the official definition of unemployment and "out of labor force". They argue that many observed transitions between unemployment and out of labor force arise from an inconsistent reporting of quite consistent behavior, and that therefore propose a new concept of "nonemployment" which includes those outside the labor force due to their being unable to work. On the other hand, in his estimation of unemployment rates in the nineteenth and early twentieth centuries, Lebergott (1964) adjusted his estimates of unemployment for the census years by subtracting from the census estimates a figure for those who were unemployed because of such reasons as sickness, accident, and their laziness.

in building trades who suffered by far the highest incidence and longest duration of unemployment.

It is customary to use the Lorenz curve and the Gini coefficient in examining the concentration of income or wealth. These same tools can be applied to unemployment duration to describe how the number of days of unemployment were distributed among workers, given any unemployment. The coefficient would be small when the days of unemployment distribute evenly among workers. The Gini coefficients of unemployment for causes combined turn out to be very similar across occupational groups, within the range of 0.49-0.53, with an exception for the building trades that show a much smaller coefficient of 0.353, as given at Table 2. This indicates that the days of unemployment for the workers in the building trades were much more evenly distributed, such that unemployment durations were not concentrated only within short spells, as the other groups were. In other words, a large proportion of those in the building trades who experienced any unemployment during the year were out of work for relatively longer durations. Actually, among those who experienced any unemployment during the year, only 19.1 percent of the workers in the building trades were unemployed for less than or equal to 5 weeks, whereas more than half of the workers in all other trades were unemployed for the same duration of time.

[Table 2] Distribution of unemployment durations by cause

	Total	Railway	Building	Male Misc.	Female
	All Causes Combined				
(% | $u > 0$)	56.4	57.3	66.3	52.5	45.8
(Number of Days | $u > 0$)	68.2	57.1	94.4	51.5	73.3
Gini Coefficient	0.492	0.518	0.353	0.532	0.508
	Inability to Obtain Work				
(% | $u > 0$)	18.8	13.3	36.6	13.4	8.4
(Number of Days | $u > 0$)	79.5	74.5	82.5	73.2	97.5
Gini Coefficient	0.347	0.332	0.277	0.390	0.343
	Sickness				
(% | $u > 0$)	33.5	38.8	34.4	32.6	23.7
(Number of Days | $u > 0$)	27.8	27.9	41.6	20.1	17.2
Gini Coefficient	0.577	0.511	0.547	0.600	0.585
	Other Causes				
(% | $u > 0$)	22.5	22.4	22.1	23.0	20.6
(Number of Days | $u > 0$)	36.7	32.4	33.9	31.6	69.8
Gini Coefficient	0.514	0.454	0.473	0.471	0.488

Source : See the text.

The distribution of days unemployed for all causes combined may disguise the underlying grounds of unemployment across occupational groups. Thus, I have disaggregated the total days of unemployment by cause and repeated the same analyses. Table 2 shows that unemployment due to inability to obtain work had the longest duration (80 days) among the causes, but that the smallest proportion of workers (18.8 percent) experienced unemployment due to this cause. On the other hand, 33.5 percent of the workers had days off due to sickness, with an average duration of 28 days, whereas 22.5 percent of them listed other causes for their unemployment with an average duration of 37 days. The percentage of the workers who experienced unemployment due to inability to obtain work varied a lot across occupational groups. That is, unemployment due to no work took place among 36.6 percent of the workers in the building trades, while it happened among only 8.4 percent of the female workers. The large proportion among the building workers might have been influenced by seasonality. An interesting finding is that, despite the low percentage of unemployment due to inability to obtain work, female workers had the largest number of days lost for that cause, given unemployment, averaging 98 days. It suggests that female workers hardly ever lost jobs, but that, once they did, it took quite a long time for them to exit unemployment. Somewhere between 23.7 percent and 38.8 percent of the workers across occupational groups took some sick leave and their average duration was between 17 days and 42 days. It is not surprising for building workers to have experienced the largest number of days off because of sickness, considering the manual nature of their work. On the other hand, the female workers reported only 17 days of sick leave, again confirming "a greater propensity of women to tolerate more difficult working conditions and ··· to cling to their mill job until they had to leave (Hareven 1982, p. 41)." The distribution pattern of unemployment due to other causes is quite similar across all occupational groups except for its long duration for female workers. Female workers claimed 70 days off, on average, without specifying the cause, much longer than that of the 32-34 days for the male workers engaged in the railway, building, and other miscellaneous trades. It is hard to uncover the causes for the exceptionally long duration of unspecified unemployment for female workers. However, one explanation might be that female workers were more involved in household responsibility, which often kept them from returning to work for long periods of time.

Why did some workers suffer unemployment while others did not? This question is equivalent to the question as to whether or not unemployment was concentrated on a certain group of workers and associated with personal and industrial characteristics. To answer this, I have estimated a logit model, where the dependent variable takes one for those who experienced any unemployment and zero otherwise. Table 3 reports the estimated results by cause. Let's consider the case of inability to obtain work at first. The results are given in the first column in Table 3. Workers in the building trades turn out to have experienced higher

incidences of unemployment than those otherwise equivalent, which might reflect their high sensitivity to seasonal factors. The workers who were paid on piece rate had a higher risk of unemployment, implying that those who were hired on piece rate were the first to be laid off. Owning a home reduced the probability of unemployment. Home ownership might reflect the greater stability of home owners, which reduced the probability of unemployment. However, other personal characteristics, such as age, immigrant status, and the number of dependents, did not have any significant effect on the probability of unemployment. The second column in Table 3 presents the results for the case of sickness. As is expected, age mattered for unemployment due to sickness, and, interestingly, its effect was non-linear. The results show that the incidence of unemployment due to sickness took a U-shaped profile with age, making a bottom at the age of 54. It implies that workers, being other things being equal, started to increase the cases of filing for taking sick leave after the age of life.[11] Similarly, the more family members one had, the higher was the probability of one's taking sick leave. The coefficients of the dummies of male miscellaneous workers and female workers take negative signs. One could interpret this result as implying that the outdoor work involved in the railway and building trades was more likely to cause sickness than the indoor work in which most male workers in the miscellaneous trades and most female workers were engaged. Unemployment due to other causes was claimed more by those who had a larger number of family members or who were paid on piece rate and less by those who owned their own home. However, the type of occupations did not make any difference for the probability of unemployment due to other causes. For all causes combined, workers in the building trades had a significantly higher probability of unemployment. By contrast, female workers had a lower incidence of unemployment, an interesting finding given the general perception that they were highly floating. Payment on piece rate correlated highly with unemployment incidence for all causes combined.

However, it would be wise to mention several reservations regarding the interpretation of the estimated results. First, the Kansas survey refers only to those individuals who happened to be employed on the day the survey was conducted, thereby excluding those who happened to be unemployed on that day. Therefore, the duration of unemployment discussed so far may be biased because of the omission of unemployment already in progress. This bias depends on the probability of entering unemployment as well as the probability of leaving unemploy-

[11] The attempt where age was used as a correlate of explaining the probability of unemployment was also found in Hatton and Williamson (1992). Their sample was Michigan laborers, 1893, who showed a similar U-shaped age profile of unemployment. According to their estimation, the incidence of getting unemployed reached the bottom at the age of 43 for farm laborers and 41 for railway laborers. It must be noted, however, that their data made no distinction of unemployment among causes as did in those of this paper.

[Table 3] Logit Estimation of unemployment Incidence

	Inability	Sickness	Others	All Causes
Constant	−2.332**	1.109*	−0.305	1.182
	(−2.322)	(1.420)	(−0.350)	(1.573)
AGE	0.020	−0.086**	−0.060*	−0.045
	(0.380)	(−2.087)	(−1.299)	(−1.147)
AGE^2	−0.0004	0.0008*	−0.0006	0.0003
	(−0.672)	(1.613)	(−1.073)	(0.703)
IMMIGRANTS	0.073	0.177	−0.112	0.097
	(0.266)	(0.814)	(−0.434)	(0.462)
NUMBER OF DEPENDENCE	0.038	0.093**	0.062*	0.015
	(0.762)	(2.276)	(1.347)	(0.386)
PAID ON PIECE RATE	0.680***	0.010	0.485**	0.525**
	(2.673)	(0.053)	(2.279)	(2.811)
HOME OWNER	−0.591***	0.161	−0.246*	−0.131
	(−3.051)	(1.049)	(−1.400)	(−0.885)
BUILDING TRADES	1.873***	−0.109	0.316	0.764***
	(6.488)	(−0.512)	(1.251)	(3.618)
MALE MISC. TRADES	0.199	−0.312**	0.188	−0.089
	(0.745)	(−1.668)	(0.865)	(0.492)
FEMALE WORKERS	−0.286	−0.767***	−0.020	−0.478**
	(−0.685)	(−2.708)	(−0.065)	(−1.844)
Log-Likelihood	−507.3	−655.4	−548.0	−716.1
Percent of Right Prediction	81.1	66.4	77.7	59.5
Pseudo R^2	0.141	0.027	0.019	0.050

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Notes: *0* is assigned to no experience of unemployment and *1* is assigned to experience of unemployment. The numbers in the parentheses are *t*-values. Percent of right prediction is based on the 0.5 criterion. The version of Pseudo R^2 is $(L^{2/n} - L_R^{2/n})/(1 - L_R^{2/n})$, where L is the unrestricted likelihood and L_R is the restricted likelihood.

ment. Second, some on-going unemployment may have been truncated at the beginning of the year, or left censored. Some workers would have surely already been unemployed before the beginning of 1899 but have reported only the days of unemployment during 1899, which means that they actually experienced a longer period of unemployment than the number of days unemployed reported in the survey. Third, the unemployment duration may represent the summation of multiple spells. Thus, without the description of the flows of workers moving in and out of unemployment, it is hard to say just what the distribution of unemployment implies. For example, unemployment may have been a transitory phenomenon, although workers experienced many days of unemployment over an year as long as they consisted of several spells. All of these points call attention to the importance of the dynamic aspect of unemployment. Moreover, one needs to make a distinction between unemployment in a single spell and unemployment over multiple spells. Thomas S. Coleman (1986) criticizes those studies on unemployment that fail to distinguish between the distribution for time spent in a single spell of unemployment and for that in multiple spells. He maintains that the data on unemployment duration during a year may represent the summation of multiple spells and that seemingly identical distributions of unemployment duration might carry different implications for the labor-market performance, depending on the underlying dynamic processes. Following these arguments, I turn to the dynamics of unemployment, with a particular emphasis on transition rates into and out of unemployment in the next section.

Ⅳ. TRANSITION RATES OF UNEMPLOYMENT

Modeling the dynamics of unemployment requires assuming a stochastic process by which the data could have been generated. I assume a two-state Markov process. It stipulates that there are two states, employment and unemployment, and the hazards of transition between the two states are constant.[12] Since workers may have experienced multiple spells of unemployment during a year, it is essential to consider all possible paths in and out of unemployment. The two-state Markov process, on the one hand, takes account of all of the possible paths by which a worker could have entered into and thereby accumulated a certain period of unemployment without, on the other hand, limiting the number of spells.

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[12] The two-state Markov model makes inevitable the collapsing of the breakdown of unemployment by cause into a single state of unemployment. Allowing three states, i.e., employment, unemployment, and out of labor force, makes the modeling unfeasible for a practical sense. To be precise, therefore, the term of unemployment in this section should be interpreted as nonemployment.

Suppose that a worker experienced unemployment for duration t during a year. The probabilities that a worker would happen to be in a state of unemployment or employment at the beginning of the year are μ_0 and η_0, respectively. No matter which state a worker experiences at the beginning of the year, this same worker can accumulate an unemployment duration of t length in any of the following ways: with one spell of unemployment having t period, with two spells of unemployment having the sum of t period, with three spells unemployment having the sum of t period, and so on. The probability density of unemployment duration, t, can be obtained by summing all of the possible cases and weighing them by μ_0 for the state of unemployment at the beginning of the year and by η_0 for the state of employment at the beginning of the year. Equation 1 presents a probability density of the random variable t,

$$f(t) = e^{-\alpha t-\beta(s-t)}(\alpha\mu_0+\beta\eta_0)\left[\sum_{n=0}^{\infty}[\alpha t\beta(s-t)^n/(n!)^2]\right.$$
$$\left.+\ (\alpha\beta t\mu_0+\alpha\beta(s-t)\mu_0)\sum_{n=0}^{\infty}[\alpha t\beta(s-t)]^n/[n!(n+1)!]\right]. \quad (1)$$

with a point mass of $\mu_0 e^{-\alpha s}$ at $t=s$ and a point mass of $\eta_0 e^{-\beta s}$ at $t=0$.[13] α denotes an exit rate, a hazard for exiting unemployment, and β represents an entry rate, a hazard for entering unemployment. s is the total number of weeks working in the year, and n is the number of spells of unemployment.

Assume time homogeneity so that the unemployment rate is independent of time. Then, $\mu_0=\mu(t)=\mu$. As a result, the number of entries into unemployment is equal to the number of exits from unemployment, i.e., $\beta(1-\mu)=\alpha\mu$. Then, one can get the following:

$$\mu_0=\mu=\frac{\beta}{\alpha+\beta},\ \eta_0=\eta=\frac{\alpha}{\alpha+\beta}. \quad (2)$$

Define U^* as the cumulative probability of becoming unemployed during the year given initial employment, such that the following equation results:

$$U^*=[1-(1-\beta)^s]. \quad (3)$$

Let ω be the proportion of workers experiencing some unemployment over the past year. Then, ω is the sum of the proportion of those who were unemployed at the start of the year and the proportion of those who fell into unemployment from employment during the year:

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[13] Coleman (1986) derives this distribution. I reproduce the derivation of the density in a simpler fashion in Appendix.

$$\omega = \mu + \eta U^* \tag{4}$$

Equations 2 and 4 define the combination of α and β. An empirical problem that arises is that of identifying the pair of α and β that is most consistent with the observed distribution of time spent unemployed over the year. I solve this problem by means of a simulation. Since the workers canvassed in the Kansas survey were only those who were employed at the end of the year, Equation 1 does not present a relevant probability density function. Consequently, I derive a new probability density function, conditional on employment at the end of the year:

$$f(t \mid \eta) = \frac{f_s(t)}{\alpha / (\alpha+\beta)}. \tag{5}$$

To estimate the parameters α and β, I pick a combination of α and β and simulate Equation 5, comparing the actual distribution of unemployment durations to the simulated ones by occupational group.[14] Using a χ^2 goodness of fit test, I choose the pair of α and β that yields the lowest χ^2 value.

Table 4 reports the results. Kansas workers in 1899 faced a 9.6 percent probability of exiting unemployment in any given week, while employed workers became unemployed with a weekly probability of 1.5 percent. By occupational group, the exit rate from unemployment was highest for railway workers, with a rate of 11.6 percent. This implies that railway workers were reemployed or recalled the most quickly of all unemployed workers. The exit rates from unemployment, in a descending order, were 10.9 percent for male miscellaneous workers, 6.8 percent for building workers, and 5.7 percent for female workers. As for entry rates into unemployment, workers in the building trades were the most likely to become unemployed, with a weekly entry rate of 1.9 percent. Workers for the railway experienced an entry rate of 1.6 percent, miscellaneous male workers of 1.4 percent, and female workers of 1.0 percent. Interestingly, workers in the building trades and female workers, the two occupational groups who stayed unemployed for relatively longer durations, differed strikingly in their transition rates. One reason why workers in the building trades were unemployed for a long period was a high probability of entering unemployment; On the other hand, female workers found themselves unemployed because of a low probability of getting employed, although they had a small probability of entering unemployment. Recall that the female workers were lowest in both entry and exit rates among the occupational groups. In general, however, the exit rates, i.e., the probability of

[14] Equation 5 involves infinite sums. Because of double factorials in the numerator, a good approximation can be obtained with relatively few terms. I calculate Equation 5 up to n=5.

[Table 4] Estimates of transition rates by occpational group

	Total	Railway	Building	Male Misc.	Female
EXIT RATE (α)	9.0	11.6	6.8	10.9	5.7
ENTRY RATE (β)	1.5	1.6	1.9	1.4	1.0
χ^2 Statistics	192.7	59.5	114.3	132.3	87.6
Unemployment Rate	13.5	12.2	21.8	11.2	14.9

Notes: The exit and entry rates are weekly transition rates in percent. In calculating unemployment rates, unemployment due to sickness and other causes is included. The estimation of the transition rates and unemployment rates is based on Equations 5 and 2, respectively.

becoming employed, were more varied across the occupational groups than the entry rates, i.e., the probability of becoming unemployed, were. It indicates that the transition rate of exiting unemployment was more important than that of entering unemployment in explaining difference in unemployment experiences across occupational groups during the era.

Finally, I calculate unemployment rates using Equation 3. The unemployment rate in Kansas in 1899 was 13.5 percent. Under the assumption of a steady state, this implies that 13.5 percent of the workers were out of employment at any particular time during the year. The unemployment rate of building workers was the highest, reaching 21.8 percent. This reflects the casual nature of employment in these trades. Female workers recorded an unemployment rate of 14.9 percent, followed by railway workers at 12.2 percent and male workers in miscellaneous trades at 11.2 percent.[15]

V. SUMMARY

The findings in this paper suggest that the U.S. labor market at the eve of the nineteenth century did not operate like a spot market. The labor markets seems to have been segregated into a large number of noncompeting groups where workers experienced substantially different incidence and transition rates of unemployment. The burden of unemployment was shared widely among workers, and it was not eliminated very quickly. The unemployment rate in Kansas in 1899 recorded 13.5 percent, indicating that more than one out of ten workers in Kansas, on average, found themselves laid off every morning during the year.

More than half of those who were canvassed on the 1899 survey of Kansas

[15] Note, however, that unemployment in the survey included all time off work, including sick leaves, vacations and so on. Therefore, the unemployment rates would be biased upward from the perspective of the modern definition of the unemployment rate.

experienced some unemployment during the year. The mean number of days unemployed, given any unemployment during the year, was longest among building workers, followed by female workers, railway workers and male miscellaneous workers. Unemployment due to an inability to obtain work accounted for the largest part of the total duration of unemployment, while sickness caused the great frequency of unemployment. It is surprising to discover that female workers were less likely to take sick leave than male workers, contradicting the common belief that female workers are more susceptible to sickness in the workplace. The finding that railway workers enjoyed relatively stable job security could be explained in part by the fact that they were able to reenter their previous jobs the most quickly of all unemployed workers. Workers in the building trades were unemployed for the longest time because of their frequent entries into unemployment, whereas female workers were out of work due to the low probability of their getting employed once they had been laid off.

APPENDIX

The Probability Density of Unemployment Duration with Multiple Spells

The Markov process stipulates the hazards to be constant, so that the densities are exponential such as:

$$g_u(t) = \alpha e^{-\alpha t}, \qquad g_\eta(t) = \beta e^{-\beta t}$$

where $g_u(t)$ and $g_\eta(t)$ are the densities for leaving from unemployment and employment, respectively. The density of unemployment with multiple spells can be constructed by summing all possible paths. The following shows the possible paths of accumulating duration t of unemployment and their densities.

I. State of unemployment at the beginning of the year
   1. experiencing one spell of unemployment for the duration of t: $\alpha e^{-\alpha t} e^{-\beta(s-t)}$
   2. experiencing two spells of unemployment with the sum of duration of t:
      a. ending in employment : $\alpha^2 \beta t(s-t)\, e^{-\alpha t} e^{-\beta(s-t)}$
      b. ending in unemployment : $\alpha\beta t(s-t)\, e^{-\alpha t} e^{-\beta(s-t)}$
   3. experiencing $n+1$ spells of unemployment with the sum of the duration of t:
      $\alpha e^{-\alpha t} e^{-\beta(s-t)} [\{\alpha\beta t(s-t)\}^n / (n!)^2 + \beta t \{\alpha\beta t(s-t)\}^{n-1} / \{n!(n-1)!\}]$

Ⅱ. State of employment at the beginning of the year

1. experiencing one spell of unemployment for the duration of t:
   a. ending in employment : $\alpha\beta t(s-t)\, e^{-\alpha t} e^{-\beta(s-t)}$
   b. ending in unemployment : $\beta\, e^{-\alpha t} e^{-\beta(s-t)}$
2. experiencing two spells of unemployment with the sum of duration of t:
   a. ending in employment : $0.5\beta^2(s-t)^2\alpha^2 te^{-\alpha t} e^{-\beta(s-t)}$
   b. ending in unemployment : $\beta^2(s-t)\alpha^2 te^{-\alpha t} e^{-\beta(s-t)}$
3. experiencing $n+1$ spells of unemployment with the sum of the duration of t:
   $\beta\, e^{-\alpha t} e^{-\beta(s-t)}[\,\alpha(s-t)\{(\alpha t)^n / n!\}\{(\beta(s-t))^n / (n+1)!\}+\{(\alpha t)^n / n!\}\{(\beta(s-t))^n / n!\}]$

Equation 1 can be obtained by summing all the possible paths above and weighing them by μ_0 for the state of unemployment at the beginning of the year and by η_0 for the state of unemployment at the beginning of the year.

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