AN EMPIRICAL ANALYSIS OF CAREER DYNAMICS AND INTERNAL LABOR MARKETS DURING THE GREAT DEPRESSION

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Barton H. Hamilton and Mary MacKinnon

Abstract

This paper uses personnel records for workers employed by the Canadian Pacific Railway (CPR) between 1921 and 1944 to examine the extent to which observed career dynamics are consistent with the predictions of various models of internal labor markets. In addition, the findings provide new insight into how internal labor markets responded to Great Depression. Similar to some previous empirical studies, wages are attached to jobs rather than workers at the CPR. Consistent with theoretical models emphasizing job matching and learning, promotion, demotion, and layoff probabilities decline over the job spell, and while fast-tracking is not present for promotions, it does protect workers from layoffs. Job characteristics play a larger role in explaining promotions. One feature that is not easily explained by many existing theoretical models is the widespread use of demotions by the CPR, even during periods of expansion. The CPR appears to have been a very attractive employer during this period, since those demoted were no more likely to quit the firm than those who were not. Human capital requirements play a major role in explaining how the firm's internal labor market responded to the Great Depression. Comparing two job hierarchies within the firm, employees with significant firm-specific human capital were demoted down the job ladder during this period, while those with more general skills were laid off rather than demoted.

JEL Classifications:

J41 Contracts: Specific Human Capital, Matching Models, Efficiency Wage Models, and Internal Labor Markets
N32 Economic History – Labor, Demography, Education, Income, and Wealth, U.S.; Canada: 1913-1971

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1. INTRODUCTION

A number of recent theoretical studies in labor and personnel economics examine the employment relationship within the firm. Using contract and information theory, they attempt to provide theoretical explanations for a variety of phenomena commonly observed in employment relationships, such as promotion dynamics, the connection between wages and jobs, and incentive pay, that do not appear to adhere to simple spot market models of the labor market. For example, a variety of theories argue that "fast-tracking" (serial correlation in promotion rates) reflects initial uncertainty and then subsequent learning about a worker's underlying productivity.[1] Many different models, such as tournament theory (Lazear and Rosen (1981)) or hierarchical employment models (e.g., MacLeod and Malcomson (1988)), argue that wages are tied to jobs and to some extent are independent of the workers that fill them.[2]

Unfortunately, as noted by Baker and Holmstrom (1995), there are "too many theories, too few facts." Empirical work examining internal labor markets has not kept up with the growing theoretical literature. Most studies investigate the relationship between pay and performance.[3] Only a handful of

[1] See, for example, Jovanovic (1979), Harris and Holmstrom (1982), Demougin and Siow (1994), and Gibbons and Waldman (1999). Gibbons (1996; 1997) and Lazear (1998; 1999) summarize the theoretical and empirical literature on incentive pay and careers in organizations.

[2] See also Milgrom and Roberts (1992).

[3] See Prendergast (1996) for an excellent survey of this literature.

empirical studies have investigated whether the predictions of the theoretical models are observed in the career structures of workers in the internal labor markets (ILMs) of firms. The lack of empirical work primarily reflects the fact that such studies require detailed information on the firm that employs the worker, which is generally unavailable in standard labor market survey data. Consequently, the few empirical studies, such as Lazear (1992), Baker, Gibbs, and Holmstrom (1994), Chiappori, Salanie, and Valentin (1999), and Seltzer and Merrett (2000), examine personnel records of a particular firm.[4] These papers find a number of empirical regularities that accord with theoretical predictions, such as fast tracks. However, these studies focus on white-collar professional workers[5] in service sector firms experiencing moderate or strong growth. As a result, the stylized facts generated by these studies may not be applicable for blue-collar workers or firms experiencing substantial demand cycles for their output.

In this paper, we use personnel records to examine the extent to which theoretical models of ILMs correspond to the observed career patterns of workers from a large firm, the Canadian Pacific Railway (CPR), between 1921 and 1944. The CPR was one of Canada's largest employers in this period, and (effectively) a duopolist in the Canadian railway industry (Lamb (1977); Rountree (1936)). The CPR data provides an interesting study of an ILM for a variety of reasons. First, we examine two job hierarchies within the CPR, one that relied on workers with general skills, and another that required workers to develop substantial firm-specific human capital. We are thus able to investigate the impact of human capital requirements on ILMs with a common firm effect. Rosen (1968) finds that US railway

[4]There are a number of studies in fields outside of economics using personnel records, most notably Rosenbaum (1984).

[5]Doeringer and Piore (1985) focus on blue-collar workers.

workers with a high level of firm-specific investment exhibit smaller employment and hours variation than workers with more general skills. Second, we focus on blue-collar workers, who have been excluded from many recent studies of ILMs. Third, we are able to investigate how an ILM responds to substantial changes in product demand conditions.[6] The CPR experienced moderate but steady growth in railway activity and employment during the 1920s, saw a substantial and sustained downturn during the Great Depression, and then experienced explosive growth (and a tight labor market) during the Second World War.

We also provide new insights into the employment effects of the Great Depression by determining the extent to which the firm rationed jobs by pushing workers down the job ladder or by using layoffs followed in many cases by rehires. Because of a lack of data for the labor market as a whole, little is known about these types of changes in the Great Depression.

The paper utilizes duration models with multiple destinations to jointly estimate the length of time spent in a particular job and the probability that the individual exits the job via a promotion, demotion, quit, or layoff. We focus on these transitions rather than wages because wages at the CPR are tied to jobs rather than workers. In fact, there is virtually no variation in wages within job categories. Individual wage increases or decreases are almost always associated with a promotion or demotion to a different job title.

Perhaps the most surprising feature of the CPR's internal labor market is the common use of demotions not only during the Great Depression, but also in periods of firm growth. This finding poses a particular challenge to many theoretical models of ILMs, which often rule out demotions, or assume that

[6]Rosenbaum (1979) is the only study that we are aware of that examines the impact of firm growth on promotion rates. His study incorporates only crude controls for worker characteristics. Rosen (1968) examines the cyclical behavior of employment and hours variation for U.S. railways.

they are exceedingly rare. The main results of the paper show that certain occupations requiring substantial firm-specific human capital investment were protected from outside entry and insulated from external economic conditions, while other levels of the CPR hierarchy experience substantial outside entry. We also find some evidence consistent with job matching and learning models, although unlike other studies this appears to be more important in determining layoffs and demotions as opposed to promotions. Most notably, the timing of movements within the ILM was sensitive to external economic conditions in many occupations. Holding seniority constant, the CPR responded to the Great Depression by reducing new hiring, laying off workers with primarily general skills, and demoting (rather than laying off) workers with substantial firm-specific human capital. The CPR recovered from the Great Depression by hiring many new employees during the boom period of World War II. However, the promotion prospects of workers at the bottom of the ladder did not improve beyond their 1920s levels, and it appears that many of these workers quit the CPR as a result.

The remainder of the paper is organized as follows: Sections 2 and 3 describe the economic environment in which the CPR operated between 1921 and 1944, the organization of employment hierarchies in the firm, and presents summary measures of the firm's workers and their mobility prospects from the 1920s through the 1940s. Section 4 presents the empirical framework, while the results are presented in Section 5. A short conclusion summarizes the findings of the paper.

2. THE CPR AND THE CPR EMPLOYEE SAMPLE

In the first half of this century, the Canadian Pacific Railway was one of the largest employers in Canada. The data set is drawn from the pension records of workers employed by the CPR between 1921 and 1944.[7] The CPR was a mature firm by 1921, and the profound changes in industrial relations

[7] See MacKinnon (1997) for a description of the pension plan.

brought about by the upheavals of the First World War had already occurred. The period from 1921 to 1944 was largely marked by business cycle contractions and expansions. The employee record cards normally show the name, birthdate and nationality of each worker. The start date of each job, along with its location and the wage rate are given, as are reasons for leaving the company.[8] Consequently, for each worker we are able to construct the sequence of job spells over his career at the CPR, as well as how the spell ends: Quits (Q) occur when the individual resigns from the firm; Layoffs (L) include both reductions due to economic conditions and outright dismissals;[9] Promotions (P) occur when an individual changes occupations and moves from a lower to higher level;[10] Demotions (D) occur when the worker changes occupations and moves to a lower level.[11] Given the highly structured and bureaucratic nature of the CPR's ILM, promotions and demotions almost always occur one level at a time. Workers pass through a series of upgradings or downgradings rather than one big jump.

The data for the analysis consists of 9841 job spells for workers employed at the CPR between January 1, 1921, and December 31, 1944. A career or employment spell at the CPR consists of a sequence of job spells. We thus have a total of 7062 employment spells for 2437 workers (many workers left the firm and were subsequently rehired).

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[8]Hamilton and MacKinnon (1996a, b) provide a detailed description of the construction of the data set.

[9]Dismissals were about 20% of layoffs.

[10]When the move is lateral we consider it to be part of the same job spell. If the job change led to a loss in pay, but an increase in later chances for promotion we consider the change to be a promotion. This is very rare, and occurs in cases where workers become apprentices. Workers are also sometimes listed as holding two jobs, and we assign them to the higher-level job. Again, this situation is rare.

[11]Initial investigation of the data indicated that many individuals were temporarily promoted into a position for a few days and then demoted. These temporary promotions appear to occur because the individual is filling in for another worker who is on vacation or is ill. Because the goal of the analysis is to understand more permanent changes in job assignment over the worker's career, we treat temporary promotions followed by a demotion within 45 days as part of the same job spell. These temporary promotions and demotions are thus not treated as the end of the job spell in the subsequent empirical analysis.

2.1 JOB HIERARCHIES

We analyze job ladders in two divisions of the CPR, Mechanical and Operations. Most of the Mechanical department employees worked in railway workshops or station buildings, repairing and maintaining locomotives, passenger coaches, and freight cars.[12] As shown in Figure 1, the bottom of the job ladder at the CPR consisted of unskilled workers, generally not union members, who could be readily promoted into semi-skilled jobs in the Mechanical department. The left-hand side of Figure 1 indicates that the job ladder in the Mechanical department then consisted of progressively more skilled jobs, culminating in highly skilled occupations such as machinists. Alternatively, young boys working as unskilled workers sometimes entered a formal apprenticeship, which then led to a highly skilled job. A very small number of highly skilled workers would then be promoted to a managerial position.

Each of the rungs of the job ladder in the Mechanical department shown in Figure 1 group together a variety of jobs, so that promotion occurs both within and between levels. However, the ILM was highly bureaucratized and wages were set by collective bargaining for most workers. Consequently, in almost all jobs there is only one wage per occupational title, with virtually no worker-specific variation in wages. In any given year between 1921 and 1944, there were only 8-9 different wage levels in the Mechanical department. To highlight this fact, a regression of workers' log wages on dummies for each occupational title yields an R^2 of 0.95. While it may be argued that CPR managers got around the bureaucratized wage setting process by creating new job titles for workers, a regression of log wages on dummies indicating whether the worker's occupation was highly skilled, skilled, semi-

[12] Another reason for concentrating on workers in the Mechanical Department was that we mainly wanted to study occupations that also existed outside the railway industry. We also wanted to limit the total number of occupations in the sample. While there are over 1000 occupational titles in the sample, the most common 100 account for over 80% of all the jobs.

skilled, or unskilled, yielded an R^2 of 0.82. These four broad categories explain over 80% of the variation in wages in the Mechanical department. Wages thus appear to be tied to jobs rather than workers, and this motivates our focus on career movements through the hierarchy rather than wages.

While there is a distinct job ladder for employees in the Mechanical department, the skills of the workers in this division appear to be more general than CPR-specific. Table 1 shows the fraction of workers employed at the CPR on April 1, 1928 who were initially hired at their current skill level, as well as the fraction of workers initially hired at a lower (or higher) level. While it is unsurprising that most unskilled workers were initially hired at that level, it is the case that the majority of skilled and highly skilled workers were hired from outside the firm rather than promoted into their jobs. The large number of outside hires at all skill levels suggests that the human capital of workers in the Mechanical department tends to be general rather than specific to the CPR.

The second job ladder that we analyze consists of employees in the Operations department. The occupational hierarchy for this division is shown on the right hand side of Figure 1. Unskilled workers could be promoted to locomotive fireman (after passing a vision test), and the job ladder culminated in the job of locomotive engineer (train driver). In contrast to the Mechanical department, jobs in Operations appear to require substantial firm-specific capital. Engineers required detailed knowledge of the CPR's train tracks in order to operate the train safely. The bottom three rows of Table 1 indicate that the vast majority of workers with any responsibility for driving engines were internally promoted into their position rather than hired from the outside. In addition, Operations employees were paid by the mile travelled, rather than by the hour, with the mileage rate adjusted for

train type and terrain, perhaps due to the difficulty in monitoring these workers.[13] Consequently, due to the performance pay component, the wages of Operations Department workers were more flexible than those of Mechanical workers, and firm-specific human capital acquisition is much more important in Operations. The subsequent analysis examines how these differences translate into different career structures at the CPR.

2.2 THE ECONOMIC ENVIRONMENT OF THE CPR

At the beginning of our period of study (1921), the CPR was a mature firm in a mature industry in which almost all of the CPR's competitors had been nationalized and were being amalgamated into the Canadian National Railways (CNR) system. The CNR had excess employment during this period, so the possibility for CPR employees to shift to the CNR was very limited. In addition, by this time wage rates had become standardized in the railway industry, so that virtually all workers with the same occupational title were paid the same rate (MacKinnon (1996)).

The effects of the business cycle on traffic were pronounced. Figure 2 plots the growth in profits and output (as measured by net operating revenue and freight ton-miles carried by the railway, respectively) for the CPR, as well as Canadian per capita real GNP growth for the period of this study, 1921-1944. CPR revenues and output were closely tied to the business cycle, with substantial declines in output and profits observed between 1929-1933, with some recovery in the 1934-1939 period. Finally, the outbreak of World War II signalled a dramatic improvement in the CPR's fortunes between 1940 and 1944.

The top line of Figure 3 shows that employment at the CPR fell substantially from a peak in

[13]Unfortunately, data is not available on performance or contract pay provisions of individual Operations department employees.

1929, so that by the mid-1930s the workforce had been downsized by approximately 30%.[14] The remaining three lines in the figure plot the ratios of total hires, hires that were new to the CPR, and exits, respectively, to total employment. The difference between the "Internal or External Hire" line and the "New Hire" line represent the fraction of workers hired from the outside with past CPR experience. The figure shows that the drop in employment between 1929 and 1930 reflected both a reduction in hires and an increase in exits. Between 1930 and 1936, the reduction in employment primarily reflects a fall in hiring rather than an increase in exits. Most layoffs occurred in 1930, and quits declined substantially during the Great Depression. The CPR virtually stopped hiring workers without CPR experience between 1930 and 1941. In 1937, the CPR began to rehire some of the workers it had laid off in 1930, but exits also rose due to another increase in layoffs during the late 1930s. Finally, the boom period of World War II restored CPR employment to near pre-Great Depression levels, in part through a huge increase in new hiring. Consequently, the figure shows that the CPR responded to the onset of the Great Depression through an initial round of layoffs coupled with a substantial reduction in overall hiring and a freeze on new hires throughout the 1930s.

3. CYCLICAL VARIATION IN PROMOTIONS, DEMOTIONS, AND JOB TURNOVER

To begin to understand how the ILM of the CPR reacted to the changing economic conditions experienced by the firm, Table 2 summarizes the characteristics of workers at the time they started a job spell, broken down by period. The first row of the table shows that average time spent in a job declined substantially for workers starting jobs after the 1920s. The median durations indicate that while some jobs lasted for a long time at the CPR, most were relatively brief. The short spells also

[14]The employment index in Figure 3 is constructed from the stock of employees working at the CPR as of April 1 of each year.

emphasize the importance of using actual job durations. Focusing on year-to-year job transitions would miss most of the turnover and transitions at the CPR.

The next four rows of Table 2 show that while promotion and quit rates fell for workers hired in the 1930s, layoffs increased. In contrast, demotions changed little until the late 1930s. It should be emphasized that layoffs increased despite the fact that workers starting jobs in the 1930s had more firm-specific experience, and hence more human capital or perhaps a better match, than individuals in the 1920s. We investigate the cyclical changes in exit patterns in more detail below.

Table 2 shows that increases in the fraction of highly skilled workers were offset by declines in the fraction of skilled workers hired by the CPR. At the same time, the fraction of job starters that were unskilled workers did not decline until late in the Great Depression. The remainder of the table emphasizes that more workers were demoted into jobs during 1929-33, and that the CPR increasingly relied on workers with previous CPR experience to fill jobs during the 1930s. Most of these workers were being recalled from layoff, and were being substituted for new hires. Individuals with no CPR experience filled 16% of the jobs beginning between 1921 and 1928, while the comparable figure for the 1930s was only 3-5%. The boom period of the 1940s increased the fraction of new hires to 33%.

While the summary statistics in Table 2 provide some insights as to how the CPR's overall workforce changed during the downsizing of the Great Depression, we might expect substantial differences in promotion, demotion, quit, and layoff probabilities across the two branches of the hierarchy, since individuals working in the Operating department had a different pay system and substantial firm-specific experience. Figure 4 plots the yearly quit, layoff, promotion, and demotion

hazards for workers in the Mechanical department.[15] Except during the Second World War, job spells tended to end in a layoff or promotion. With the exception of the spike in 1929, layoff probabilities during the early 1930s were not substantially higher than in the 1920s. In fact, if one examines Figure 4 without knowing the horizontal scale, it is not obvious when the Great Depression began, since there are other spikes in layoffs. After 1935, layoff probabilities begin to rise again, and did not decline until the start of World War II. The probability of demotion also changed little between the late 1920s and early 1930s for these workers. However, the composition of the CPR's workforce was changing during this period. One of the main responses of the ILM to the onset of the Great Depression is a decline in the probability of promotion after 1929 that persisted until the late 1930s. The extent to which the railway labor market improved after the outbreak of war shows up very clearly in rises in both promotions and in quits in the 1940s.

A different picture is shown in Figure 5 when we plot the annual promotion, demotion, quit, and layoff hazard probabilities for workers in Operations (unskilled workers are grouped with Mechanical workers). During the 1920s, the patterns in the layoff and demotion hazards were quite similar.[16] However, the onset of the Great Depression is clearly shown by the two-fold increase in the probability of being demoted in 1929. The contrast between the response of the CPR to the Great Depression in its treatment of Mechanical workers and those in Operations is striking. As hypothesized above, an explanation for this discrepancy is the importance of firm-specific human capital. Locomotive engineers

[15]The promotion hazard for a particular year is the number of job spells ending in a promotion in the year divided by the total number of job spells occurring in that year. The other hazards are calculated analogously.

[16]The small promotion hazard reflects the fact that locomotive engineers, who make up almost half of the workers in the Operating hierarchy, almost never get promoted to manager. For almost all workers, engineer is the top rung of the ladder. In contrast, all workers in the Operations sample could be demoted.

started at the bottom of the job ladder and acquired a substantial body of knowledge about the CPR's locomotives and railway routes. Consequently, the firm wished to retain these workers, and did so by demoting them into more junior positions. On the other hand, the skills required by Mechanical workers may have been more general, in which case the CPR would be more likely to lay them off. This argument is buttressed by the fact that Firemen and Engineers were less likely to quit throughout the period.

The figures above show how the exit hazards varied over the business cycle. The next step in the analysis is to examine how the conditional probabilities of promotions, demotions, quits, and layoffs changed over the course of the worker's job spell. To do this, we construct the empirical transition intensity for destination r, $?_r(t)$, which describes the fraction of job spells that last exactly t months and end for reason r, given that the job spells are at least t months long.[17]

Figures 6 and 7 plot the empirical transition intensities for workers leaving their jobs via a promotion ($?_P(t)$), demotion ($?_D(t)$), quit ($?_Q(t)$), or layoff ($?_P(t)$), over the first five years at the CPR for employees in the Mechanical and Operations departments, respectively. Figure 6 shows that the conditional probability of being laid off in a given month is fairly high over the first 7 months on the job, and then declines rapidly thereafter. One interpretation of the negative duration dependence observed for layoffs in Figure 6 is that job matching and learning were important for internal mobility. The CPR hired a worker into a new job, and then decided very quickly that the worker was either above average, in which case he was promoted, or that the worker was a bad match for the position, which resulted in a demotion or layoff. Promotion probabilities also appear to decline after the first 7 months on the job,

[17]The empirical transition intensity is defined as $?_r(t)$ = (# of job spells lasting exactly t months and ending for reason r)/(# of job spells lasting at least t months).

while demotions also decline after month 6. These results are more difficult to interpret. In certain cases, human capital theory suggests that promotions should at least initially increase with time on the job as the worker acquires job or firm-specific knowledge. On the other hand, if job matching or learning is particularly important, then poor matches should end relatively quickly in promotion or demotion, while those workers who are particularly well matched or of high ability will persist in that job. The data seem more consistent with this second interpretation, since promotions and demotions fall with duration. Some of these patterns may also result from seasonal labor force needs, although demotions are still observed more than twelve months after the start of the job.

Figure 7 shows that consistent with learning and matching models of ILMs, layoff patterns in the Operations department are similar to those shown in Figure 6 in that layoffs decline rapidly over the first 12 months on the job. However, the conditional probability of demotion increases rapidly up to month 6, and then quickly declines thereafter. While the extensive use of demotions is ruled out in learning models such as Gibbons and Waldman (1999), it may be that ability has a job-specific component, rather than being purely firm-specific. In this case, the firm may use demotions to return the worker to a task where he is more productive. In addition, workers may be more willing to accept demotions because the CPR is a high paying employer.

As discussed in Baker, Gibbs, and Holmstrom (1994), the empirical transition intensities shown in Figures 6 and 7 may differ substantially for workers hired into their jobs from inside the firm through a promotion or demotion, as opposed to workers hired from the outside. If firm-specific human capital were important, then "inside" hires would have higher promotion probabilities than outside hires, all else equal. Therefore, in order to compete, outside hires must have more general human capital. To

investigate the promotion prospects for incumbents and outside hires, we examine $?_P(t)$ over the first 24 months on the job for firemen, semi-skilled, and skilled Mechanical Department workers, decomposed into workers promoted or demoted into their current job, or hired from the outside. We chose these occupations because each experience intake from both inside and outside the firm and each also has good promotion prospects. We only examine workers hired between 1921 and 1928 to limit macro-economic effects.

Figure 8 shows that individuals demoted into their jobs have the highest conditional probability of promotion over the first 12 months of the job spell. This suggests that some demotions are seasonal, perhaps because of a lack of manpower in other occupational levels.[18] However, these demoted workers still had a positive promotion hazard even after 12 months on the job, suggesting that seasonality alone cannot explain this pattern. Individuals demoted into their jobs were also 4-6 years older on average than other employees were. The rest of the figure indicates little difference in the promotion probabilities of promotees and outside hires.[19] This finding is similar to that found in Baker, Gibbs, and Holmstrom (1994). One would expect outside hires to have lower promotion probabilities if firm-specific human capital was important. However, outside hires are on average two years older than promotees, so this general human capital advantage may offset the lack of firm-specific experience.

In contrast to promotions, the layoff transition probabilities plotted in Figure 9 show marked differences between incumbents and outside hires. Outside hires are substantially more likely to be laid off than incumbents during the first year on the job. One explanation is pure seniority: the last hired are

[18]Many promotions appear to be temporary because they are often followed by a demotion, even after excluding spells lasting less than 45 days.

[19]In Figures 8 and 9 we have grouped both new hires and rehires into workers hired from the outside. The promotion (and layoff) hazards for these two groups tend to be very similar.

the first fired. The second explanation is that the CPR has more information on incumbents and has screened them at a lower level. Less information is available on outside hires, and hence they are more likely to be laid off. In this case, the CPR uses the career structure to eliminate low ability employees. We attempt to distinguish between these two explanations in the subsequent empirical analysis that includes controls for CPR experience and age. Note that if seniority were the dominant factor, then we might have expected the promotion probabilities of promotees shown in Figure 8 to be higher than those of outside hires. The fact that the promotion probabilities were the same suggests that seniority alone cannot explain the differences in the promotion and layoff transition intensities of incumbents and outside hires.

4. A FRAMEWORK FOR EXAMINING PROMOTIONS AND DEMOTIONS AT THE CPR

We now construct an empirical framework for examining the duration of job spells and the probabilities of worker promotions, demotions, quits, and layoffs at the CPR. A convenient methodology for jointly modeling the duration of job spells at the CPR (t) and the reason for leaving the job (r) is a competing risks model.[20] The competing risks framework allows us to incorporate the information that a job spell may end due to a promotion, demotion, layoff, or a quit. Only quits and layoffs lead to the end of an employment spell. Define T_r as a random variable that represents a worker's duration of employment until a transition out of a job due to reason r (individual subscripts have been dropped for clarity). We thus have four possible transition times for each worker: T_P, T_D, T_L, and T_Q. The transition intensity, or cause-specific hazard function represents the probability of

[20] McCue (1996) also uses a duration framework to analyze promotion probabilities for workers in the Panel Study of Income Dynamics.

leaving a job for reason r after a duration time of t, conditional upon not having left for reason r prior to time t, and upon individual characteristics X_t:

$$(1) \qquad ?_r(t \mid X_t) = \lim_{?t \to 0^+} \frac{\Pr[t < T_r \leq t+?t \mid T_r \geq t, X_t]}{?t}, \quad r = P, D, L, Q.$$

Given the transition intensity (1), the probability of observing a separation for reason r after a job spell of time t is

$$(2) \qquad f_r(t \mid X_t) = \lambda_r(t \mid X_t) \exp(-\int_0^t \lambda_P(u \mid X_u)du) \exp(-\int_0^t \lambda_D(u \mid X_u)du)$$
$$* \exp(-\int_0^t \lambda_Q(u \mid X_u)du) \exp(-\int_0^t \lambda_L(u \mid X_u)du), \quad r = P, D, L, Q.$$

The duration sub-density defined by equation (2) may be interpreted as follows: The first term is the transition intensity representing the probability that the random variable T_r equals t given that T_r is greater than or equal to t. The exponential terms give the probability that T_r is greater or equal to t,[21] since the individual leaves the job either by a promotion, demotion, quit, or layoff. The fact that the individual leaves for reason r implies that a separation for any other reason is not observed at time t. For example, suppose r = P. The first two terms are the probability that $T_P = t$. $T_P = t$ necessarily implies $T_D > t$, $T_Q > t$, and $T_L > t$, and the remaining terms yield the probability of this event.[22]

In our model, the likelihood function is the joint probability that workers leave their jobs at the CPR at time t due to a promotion, demotion, quit, or layoff. In addition, it must account for the possibility that workers leave for other reasons, such as death or retirement. Individuals leaving for

[21] In the single risk case, the second term of equation (2) is termed the survivor function.

[22] The specification of equation (2) implies that T_D, T_P, T_Q and T_L are assumed to be independent, conditional upon X_t.

other reasons at time t are treated as right censored, since $T_r > t$ for $r = \{P, D, Q, L\}$. Less than 10% of job spells at the CPR end for other reasons. Let the indicator variables d_P, d_D, d_Q, and d_L equal one if the individual was promoted, demoted, quit or was laid off, respectively, and zero otherwise. Denoting job spells by i, the likelihood function for the sample may be written as

$$(3) \quad L = \prod_i [\, f_P(t_i|X_{it})\,]^{d_{iP}} [\, f_D(t_i|X_{it})\,]^{d_{iD}} [\, f_Q(t_i|X_{it})\,]^{d_{iQ}} [\, f_L(t_i|X_{it})\,]^{d_{iL}}.$$

The final step in the construction of the empirical model involves the specification of the functional forms of the transition intensity functions. We follow the common approach in the literature and use a proportional hazards specification:

$$(4) \quad \lambda_r(t \mid X_t) = \exp(X_t \beta_r)\lambda_{0r}(t),$$

where $?_{0r}(t)$ represents the baseline hazard function for an individual with $X_t = 0$. Individual characteristics thus shift the hazard function above or below its baseline. Several parametric and non-parametric methods are available to estimate the baseline hazard (see Lancaster (1990)). We seek a flexible form for the baseline hazard since misspecification of $?_{0r}(t)$ may lead to biased parameter estimates (Heckman and Singer (1984)). To avoid such problems, we adopt the Cox proportional hazard specification in which the baseline hazard is estimated non-parametrically. This approach allows us to capture the features of the empirical hazard functions for each risk as shown in Figures 6 and 7.

4.1 COVARIATES

In our application, the X_t vector is partitioned into a component that is constant over the course of the job spell, X_1, and a time-varying component, X_{2t}. The X_1 variables describe the demographic and productivity characteristics of the worker at the time he starts his job. These include the individual characteristics thought to influence worker mobility, such as age and ethnic group. Of particular interest

are two sets of variables. The first set consists of indicators for the individual's level in the hierarchy. Examination of the coefficients on these variables will indicate whether particular skill groups are more likely to be promoted or demoted, and whether particular groups are protected from layoffs induced by economic fluctuations. The second set of variables consists of measures of the worker's CPR experience when he starts the job, including indicators of whether the individual was promoted (or demoted) into the job, as opposed to being hired from the outside.

Finally, Beaudry and Dinardo (1991) argue that if implicit contracts are important, wages (and therefore in the case of the CPR, mobility) should be correlated with employment conditions at the time the worker is hired. For example, if a worker enters the firm during a period in which the CPR is doing a great deal of hiring, the CPR may have been forced to "scrape the bottom of the barrel" and hire low quality workers. In employment contractions, it may take only the exceptionally able. To control for these factors we include in the X_1 vector the CPR's net income growth during the year in which the worker is hired. To allow for possible asymmetries, we allow for separate coefficients for periods of expansion and contraction.[23]

To capture the changes in the CPR's hierarchy between the 1920s, the Great Depression, and the World War II expansion, we include year effects in the X_{2t} vector. These variables capture the effects of changes in the business cycle on promotion, demotion, quit, and layoff probabilities. For example, workers hired during the late 1920s were almost certain to be laid off when the Great Depression hit. Therefore, the transition intensities are allowed to vary over the course of a worker's job spell as economic conditions change through the year effects. Since including individual year effects

[23]We considered other cyclical measures, such as economy wide GNP growth and growth in employment. The results using these measures were qualitatively similar to those presented below using net income growth.

requires the estimation of a large number of parameters, we group the years into periods and restrict the effects to be the same within each of four eras: the Twenties (1921-28); the early Great Depression (1929-33); the late Great Depression (1934-39); and World War II (1940-1944). We also include calendar month dummies since the company's output, and thus employment opportunities, exhibit a strong seasonal component over the year.

5. EMPIRICAL RESULTS

Table 3 shows parameter estimates for the duration model described above using the full sample of Mechanical and Operations workers.[24] Positive coefficients indicate that an increase in the variable is associated with an increase in the transition intensity. Column (1), which presents the results for the probability of leaving a job because the worker is promoted to a better CPR job, exhibits many notable features. First, the conditional probability of promotion declined significantly during the Great Depression and then increased in the 1940s (relative to the level in the 1920s) when demand for the CPR's output increased. This suggests that the CPR did have to worry about the external labor market -- they either could not hire workers directly into higher-level jobs in periods of labor market tightness, or feared that employees would quit lower level jobs unless they were promoted. Second, the pyramid nature of job ladders at the CPR is clearly shown in Column 1. As one moves up the job ladder in the mechanical department, from unskilled to highly skilled, promotion transition intensities decline monotonically since there are fewer slots to move into farther up the ladder. Similarly, promotion probabilities decline as workers move up the Operations hierarchy, so that in both cases the job ladder became narrow and hard to move up.

[24] Results for some of the variables, such as the month dummies, indicators for ethnic group, region, and veterans status are not surprising and are not included in Table 3. These estimates are available from the authors upon request.

A somewhat surprising result shown in column (1) is that workers who had been demoted into their current position were more likely to be promoted (not necessarily back to the job they had previously held, although this was often the case) than were new hires, rehires, or individuals promoted into their current job. One reason for this finding is that the CPR made widespread use of promotions (demotions) followed by a subsequent demotion (promotion) in response to seasonal fluctuations in demand. Thus, a previous promotion or demotion may not be a sign that managers think a worker has particularly low ability; it may be a signal of a previous imbalance between the number of workers in a job and the number of jobs of a given type to be filled. However, it is still true that some demoted employees are subsequently promoted after six months or more in the lower-level position. It may be that during this period, the CPR is able to acquire additional information concerning the employee's ability that leads them to promote or demote the worker.

The estimates also provide little evidence of fast tracking in promotions. The promotion probabilities of individuals who had been promoted into the current job are not significantly different from those of new hires or rehires. No significant relationship exists between previous total CPR experience or time in the current employment spell and the conditional probability of promotion, as might be expected if human capital or job matching characteristics were important. In general, age, job level, and economic conditions appear to be the dominant factors in explaining promotions, while the worker's CPR experience tends to play a relatively minor role, with the exception of workers demoted into their current position. Finally, there is marginal evidence that the economic conditions at the time the worker was hired play a role. Workers hired in bad times have relatively higher conditional promotion probabilities, but the coefficient is only statistically significant at about the 10% level, which is

consistent with the view that implicit contracts are not a major factor in explaining promotions.

The estimates for demotions presented in column (2) generally show patterns similar but opposite in sign to those found for promotions. The CPR responded to the onset of the Great Depression by increasing the conditional probability of demotion. Demotion probabilities tend to decrease as one moves down the job ladder in the Mechanical department. In contrast, engineers have lower demotion probabilities than workers at lower rungs of the job ladder in Operations. Similar to the findings in column (1), individuals promoted into the job had significantly higher demotion hazards than other workers, suggesting that some promotions were likely to have been seasonal. There does appear to be some learning about individual ability, however, since individuals demoted into their current job were also more likely to be demoted again, while those with high levels of previous CPR experience are less likely to be demoted.

The estimates for quits and layoffs presented in columns (3) and (4), respectively, confirm the observation from Figure 4 that both are cyclically sensitive. In addition, while more skilled workers showed greater attachment to the firm than unskilled workers did, the CPR did little to shield employees on the top rungs of the Mechanical Department hierarchy from layoffs over the period as a whole. In the Operations department, on the other hand, workers with substantial firm-specific human capital, such as locomotive engineers, have significantly lower layoff probabilities than firemen, who have yet to accumulate CPR-specific skills. As seen in column (2), the CPR adjusted the number of engineers through demotions and promotions, rather than through external entry and layoffs.

With regard to the CPR experience of workers, new hires have higher quit hazards than other workers, perhaps reflecting their lower amounts of human capital or relatively poorer matches. These

explanations are consistent with the fact that individuals with more CPR experience are less likely to quit. There is also little evidence of a "green card" effect (Baker, Gibbs, and Holmstrom, (1994)). Given the rigid salary structure at the CPR, one might expect that high ability individuals who experienced a number of rapid promotions would have been more likely to quit, since the CPR is unable to adjust its pay within levels to differentially compensate the individual. However, the quit hazards of promotees are significantly lower than those of new hires, and similar to the rates for rehires and individuals demoted into their jobs. Even demoted workers exhibit strong attachment to the firm, since their quit hazard is lower than that of a new hire. Similarly, individuals hired during periods of positive income growth are less likely to quit, perhaps because they have poorer options outside the firm.

The individual employment histories of workers at the CPR have a substantial impact on layoffs. While workers promoted into their jobs did not have a higher probability of promotion than others, the estimates in column (4) suggest that the firm did attempt to protect these individuals from layoffs. Due perhaps to institutional constraints, the firm may have been unable to promote workers it had identified as being of high ability, but was able to insulate those workers from demand-induced reductions in employment. On the other hand, the finding that workers demoted into their jobs have higher layoff probabilities is consistent with ILM models emphasizing learning about worker ability. While rehires were more likely to be laid off than new hires, the impact was mitigated by the significant effect of past CPR experience in reducing the prospect of layoffs. For example, the estimates imply that a rehire with five years of past CPR experience had about the same conditional probability of layoff as a new hire.

5.1 BUSINESS CYCLES AND THE INTERNAL LABOR MARKET

The results shown in Table 3 indicate that during periods of substantial economic contraction,

the CPR reduced promotions and increased demotions and layoffs, while the opposite occurred in the rapid expansion of 1940-44. While the model in Table 3 assumed that these changes were common across all levels of the hierarchy, certain levels may be more protected from economic fluctuations than others. For example, the substantial firm-specific human capital investment by locomotive engineers suggests that these workers may be less likely to be laid off during the Great Depression, and perhaps instead more likely to demoted. To investigate such possibilities, we re-estimate the model including interactions between skill level and the year dummies. In addition, given the differences between the Mechanical and Operations hierarchies, we estimate separate models for the two groups.

Table 4 presents estimates of the skill-year interactions for high skilled, skilled, semi-skilled, and unskilled workers. The coefficient estimates are interpreted relative to unskilled workers employed during 1921-1928. The results for the layoff transition intensities in column (4) show that while high skilled and skilled workers have higher layoff probabilities than unskilled workers in the 1920s, all workers in the Mechanical department experienced significantly higher probability of layoff during the Great Depression. Moreover, column (2) indicates that high skilled and skilled workers actually had a lower probability of demotion during the 1930s, indicating that the firm did not attempt to keep these individuals by pushing them down the job ladder. Only for semi-skilled workers in Panel C do we observe an increase in the demotion hazard between 1929 and 1933. The pain of the Great Depression thus appears to have been shared across skill groups in the Mechanical department.

Table 5 presents a different picture for individuals in the Operations department. Layoff hazards during the Great Depression for workers at the top of the hierarchy, locomotive engineers, were not significantly higher than those of workers at the bottom, firemen, during the 1920s. Firemen, on the

other hand, experience a significant increase in the conditional probability of layoff. Column (2) shows that demotion hazards increase significantly at the onset of the Great Depression for each group in Operations (recall that firemen can be demoted to unskilled positions). Overall, the findings in Tables 4 and 5 demonstrate that the pain of downsizing in the Great Depression was not equally shared by all. As might be predicted by human capital models, layoffs were concentrated among workers with general skills. Individuals with a significant shared investment in the firm were more likely to be demoted down the job ladder and retained by the firm. Thus, workers at the top of the ladder, who had substantial firm-specific human capital, tended to be insulated from economic contraction, while employment reductions were primarily borne by the generally skilled.

6. CONCLUSION

This paper adds to the growing empirical literature on internal labor markets. In many ways our findings are similar to studies examining modern firms, and many aspects of career dynamics at the CPR are consistent with alternative models of ILMs in the literature. However, no single model is consistent with all features. There is evidence of an ILM at the CPR in which pay is strongly tied to jobs and not worker characteristics, as predicted by certain contract models. Human capital requirements appear to be important in explaining the exposure of workers within the firm to external economic conditions. Unlike most other studies of ILMs, a unique feature of our data is that we are able to compare the cyclicality of promotions, demotions, quits, and layoffs in two job ladders within the firm, one which requires general human capital, and the other that is characterized by firm-specific human capital. Workers in the latter group were shielded from layoffs in the Great Depression, and were demoted down the job ladder rather than laid off. In contrast, across all skill groups, employees with primarily

general human capital were laid off during this period, and were often not rehired until the 1940s.

Some of the findings are also consistent with models emphasizing job matching or learning about unobserved worker abilities. Promotion, demotion, and layoff probabilities are substantially higher in the first few months of the job spell, indicating uncertainty regarding worker ability. Like Baker, Gibbs, and Holmstrom (1994), we find some evidence of fast tracking, although this tends to protect workers from layoffs at the CPR rather than predict promotions. Job characteristics appear to play a larger role in determining promotion prospects than at the firm studied by Baker, Gibbs, and Holmstrom. On the other hand, there appears to be serial correlation in demotions.

We also find some results that differ from those in the literature, and which are not easily explained by many theoretical models of ILMs. Most notably, demotions are used on a much wider scale at the CPR, even during periods of expansion, than is predicted by many of these models. While it may be the case that some demotions result from seasonal labor demand factors, it is still the case that workers on a job for six months or more have a positive probability of demotion. Perhaps reflecting uncertainty regarding an individual worker's match to a specific task, many promotions are followed by demotions. It may be that the compensation structure is too rigid to allow adjustments through pay changes within occupation, and demotions at the CPR play the role that real wage cuts would at other firms. Finally, it is important to account for the outside options available to workers. Because the CPR was a relatively high paying employer, workers appeared to be willing to accept demotions rather than quit the firm. This is unlikely to be the case in many modern firms.

In addition to presenting new empirical evidence on the operation of internal labor markets, this paper also provides new insights into how firms and workers responded to the Great Depression.

When economists think of the 1930s, they tend to concentrate on the characteristics of the unemployed. Looking at the employed reminds us that their characteristics also changed over the business cycle. As noted above, workers at the top of the job ladder with firm-specific human capital tended to be insulated from the prospect of unemployment as they were able to stay at the firm, albeit in a more junior position in many cases. As a result, the pain of downsizing at the CPR in the Great Depression was disproportionately felt by workers with more general skills, through increased layoffs, while employees with high levels of firm-specific human capital were pushed down the job ladder rather than let go. To a very great extent, CPR workers employed at the outbreak of the Second World War were a subset of workers present at the onset of the Great Depression. The only important change in their characteristics was that they were older. In the early 1940s they were rejoined by many of those who had been laid off early in the Depression, and there was also (finally) an inflow of workers with no previous employment at the CPR.

TABLE 1
ENTRY POINTS IN THE CPR HIERARCHY, 1928

Skill Level	Fraction Initially Hired		
	at Same Level	at Lower Level	at Higher Level
Highly Skilled	.66	.34	0
Skilled	.66	.27	.07
Semi-Skilled	.53	.39	.08
Unskilled	.90	0	.10
Firemen	.52	.48	0
Hostlers	.19	.75	.06
Loco. Engineers	.18	.82	0

Note: Figures calculated for workers employed by the CPR on April 1, 1928. Table entries are similar for other years.

TABLE 2
VARIABLE DEFINITIONS AND SUMMARY STATISTICS

VARIABLE DEFINITION	YEAR STARTED JOB			
	1921-28[a]	1929-33	1934-39	1940-44
Months in job spell (mean)	32.4	18.3	15.1	24.1
(median)	6	4	4	7
Job spell ends in promotion	.19	.14	.14	.26
Job spell ends in demotion	.13	.12	.07	.10
Job spell ends voluntarily	.18	.12	.09	.33
Job spell ends involuntarily	.45	.59	.64	.19
Age at start of spell (years)	34.3	36.4	40.9	36.8
Highly skilled group (%)	.18	.19	.25	.23
Skilled group	.18	.12	.12	.08
Semi-skilled group	.18	.15	.13	.18
Unskilled group	.33	.43	.36	.43
Apprentice	.03	.01	.01	.01
Fireman	.07	.08	.10	.04
Hostler	.02	.02	.01	.02
Locomotive engineer	.01	.01	.02	.01
Previously worked at CPR	.49	.65	.78	.30
Promoted into current job	.22	.15	.12	.27
Demoted into current job	.13	.15	.07	.10
Months worked at CPR in current employment spell[b]	33.5	59.9	66.2	45.3
Total months worked at CPR[c]	59.7	93.8	134.0	105.6
Observations	4587	1543	1714	1997

[a] Figures for 1921-28 include 695 men hired prior to 1921 (their characteristics are recorded at the beginning of their job spell).
[b] Table entry is calculated for positive values (does not include duration of current job spell).
[c] Includes duration of previous (non-contiguous) employment spells. Table entry is calculated for positive values.

TABLE 3
TRANSITION INTENSITY ESTIMATES

Independent Competing Risks, Unrestricted Baseline Hazard				
VARIABLE	PROMOTIONS (1)		DEMOTIONS (2)	
Employed 1929-33	-0.586	(-7.953)	0.249	(2.865)
Employed 1934-39	-0.479	(-5.145)	-0.017	(-0.133)
Employed 1940-44	0.331	(4.780)	-0.559	(-5.279)
Positive Net Income Growth	0.397	(1.213)	0.035	(0.085)
Negative Net Income Growth	-0.490	(-1.656)	-0.276	(-0.630)
Age	0.076	(4.391)	0.005	(0.817)
$Age^2/10$	-0.012	(-4.933)	-0.0007	(-0.238)
High Skilled	-1.834	(-14.946)	0.578	(4.554)
Skilled	-0.878	(-7.207)	0.384	(2.917)
Semi-Skilled	-0.614	(-7.511)	0.335	(2.701)
Apprentice	-0.608	(-4.145)	-1.125	(-2.371)
Fireman	-1.219	(-8.403)	1.250	(9.031)
Hostler	-2.327	(-5.497)	1.208	(6.066)
Engineer	-2.536	(-6.496)	0.413	(1.520)
Temporary Job	0.116	(1.666)	0.543	(6.695)
Rehired	0.025	(0.306)	0.258	(1.589)
Promoted into Job	-0.075	(-0.751)	1.600	(10.175)
Demoted into Job	0.780	(8.175)	0.540	(2.780)
Months in Current Emp. Spell	0.002	(1.119)	-0.001	(-0.726)
Months in Current Emp. $Spell^2$	-0.0004	(-0.594)	0.0003	(0.543)
Previous CPR Experience (Months)	0.001	(1.583)	-0.002	(-3.694)
Log-Likelihood	-13747.54		-8432.63	

Note: t-statistics in parentheses. Number of observations is 9841. Each model includes a constant, indicators for ethnic group, veterans status, region, and whether hired in the mechanical department. No locomotive engineers were promoted so no parameter was estimated for that group.

TABLE 3 (continued)
TRANSITION INTENSITY ESTIMATES

Independent Competing Risks, Unrestricted Baseline Hazard				
VARIABLE	QUITS (3)		LAYOFFS (4)	
Employed 1929-33	-0.283	(-3.212)	0.585	(13.419)
Employed 1934-39	-0.246	(-2.620)	0.840	(15.697)
Employed 1940-44	0.436	(6.210)	-0.942	(-12.604)
Positive Net Income Growth	-1.219	(-3.215)	0.274	(1.114)
Negative Net Income Growth	0.026	(0.089)	-0.312	(-1.467)
Age	-0.038	(-2.854)	-0.023	(-2.042)
$Age^2/10$	0.005	(2.933)	0.002	(1.440)
High Skilled	-0.342	(-3.633)	0.273	(4.483)
Skilled	-0.203	(-2.025)	0.255	(3.549)
Semi-Skilled	-0.212	(-2.502)	-0.080	(-1.314)
Apprentice	-0.944	(-4.645)	-0.657	(-5.542)
Fireman	-0.838	(-5.223)	0.546	(5.937)
Hostler	-0.055	(-0.189)	0.184	(0.858)
Engineer	-0.484	(-2.114)	-0.345	(-0.830)
Temporary Job	0.214	(3.324)	0.605	(12.988)
Rehired	-0.527	(-6.472)	0.367	(7.001)
Promoted into Job	-0.549	(-5.737)	-0.175	(-2.414)
Demoted into Job	-0.513	(-4.380)	0.188	(2.158)
Months in Current Emp. Spell	-0.010	(-4.746)	-0.028	(-11.552)
Months in Current Emp. $Spell^2$	0.002	(2.614)	0.005	(5.077)
Previous CPR Experience (Months)	-0.001	(-2.314)	-0.005	(-10.775)
Log-Likelihood	-13382.66		-35944.82	

Note: t-statistics in parentheses. Number of observations is 9841. Each model includes a constant, indicators for ethnic group, veterans status, region, and whether hired in the mechanical department.

TABLE 4
ESTIMATES OF TRANSITION INTENSITY PARAMETERS
SKILL GROUP-PERIOD INTERACTIONS
MECHANICAL DEPARTMENT
(Excluded Category is Unskilled, 1921-28)

	Promotions (1)		Demotions (2)		Quits (3)		Layoffs (4)	
Panel A: High Skilled Workers								
1921-28	-2.228	(-8.700)	0.684	(4.213)	-0.279	(-2.029)	0.386	(5.223)
1929-33	-2.425	(-8.189)	0.072	(0.309)	-0.486	(-2.567)	0.852	(10.733)
1934-39	-1.789	(-7.590)	-0.086	(-0.228)	-0.501	(-2.916)	1.126	(12.748)
1940-44	-1.317	(-7.224)	0.001	(0.003)	-0.200	(-1.527)	-0.590	(-5.342)
Panel B: Skilled Workers								
1921-28	-0.792	(-5.520)	0.435	(2.708)	-0.224	(-1.636)	0.239	(2.281)
1929-33	-1.506	(-6.756)	0.122	(0.505)	-0.470	(-2.246)	0.783	(7.897)
1934-39	-1.130	(-4.347)	0.002	(0.006)	-0.369	(-1.868)	1.303	(9.145)
1940-44	-0.377	(-1.663)	-0.404	(-1.211)	-0.089	(-0.493)	-0.368	(-1.623)
Panel C: Semi-Skilled Workers								
1921-28	-0.554	(-4.688)	0.273	(1.807)	-0.300	(-2.467)	0.046	(0.630)
1929-33	-1.249	(-6.044)	0.624	(3.375)	-0.535	(-2.651)	0.466	(4.715)
1934-39	-1.633	(-6.659)	0.217	(0.887)	-0.462	(-2.155)	0.778	(7.252)
1940-44	0.018	(0.175)	-0.451	(-2.075)	0.142	(1.118)	-1.114	(-5.736)
Panel D: Unskilled Workers								
1929-33	-0.497	(-5.417)	-0.221	(-0.979)	-0.521	(-3.719)	0.659	(8.932)
1934-39	-0.263	(-2.434)	0.321	(1.495)	-0.575	(-3.197)	0.904	(10.454)
1940-44	0.286	(3.593)	-0.315	(-1.495)	0.578	(6.635)	-0.891	(-7.569)

Note: Coefficient estimates are for skill group-year interactions for Mechanical Department workers. Each coefficient interpreted as relative to an unskilled worker employed between 1921 and 1928. Variables included are the same as those in Table 3.

TABLE 5
ESTIMATES OF TRANSITION INTENSITY PARAMETERS
SKILL GROUP-PERIOD INTERACTIONS
OPERATIONS DEPARTMENT
(Excluded Category is Firemen, 1921-28)

	Promotions (1)		Demotions (2)		Quits (3)		Layoffs (4)	
Panel A: Locomotive Engineers								
1921-28	-2.406	(-2.544)	-1.596	(-2.107)	-0.126	(-0.196)	-0.750	(-1.511)
1929-33	-		1.462	(3.784)	1.211	(1.818)	0.665	(1.246)
1934-39	-1.583	(-1.469)	0.737	(1.720)	1.026	(1.965)	0.631	(0.632)
1940-44	-0.727	(-0.989)	-1.274	(-1.221)	0.923	(1.427)	-	
Panel B: Hostlers								
1921-28	-1.688	(-2.065)	0.474	(1.430)	1.403	(3.147)	-0.018	(-0.075)
1929-33	-0.491	(-0.820)	1.179	(3.539)	1.423	(2.032)	0.636	(1.325)
1934-39	0.473	(-0.731)	0.493	(0.863)	0.878	(1.444)	-0.296	(-0.389)
1940-44	-1.644	(-1.407)	0.292	(0.703)	1.084	(1.728)	-	
Panel C: Firemen								
1929-33	-0.384	(-0.864)	1.392	(7.739)	-0.128	(-0.248)	1.051	(6.096)
1934-39	-0.484	(-1.123)	0.846	(3.033)	0.183	(0.370)	0.832	(4.634)
1940-44	0.550	(1.558)	-1.441	(-2.653)	0.762	(1.702)	-1.118	(-2.746)

Note: Coefficient estimates are for skill group-year interactions for Operations Department workers. Each coefficient interpreted as relative to a Fireman employed between 1921 and 1928. Variables included are the same as those in Table 3.

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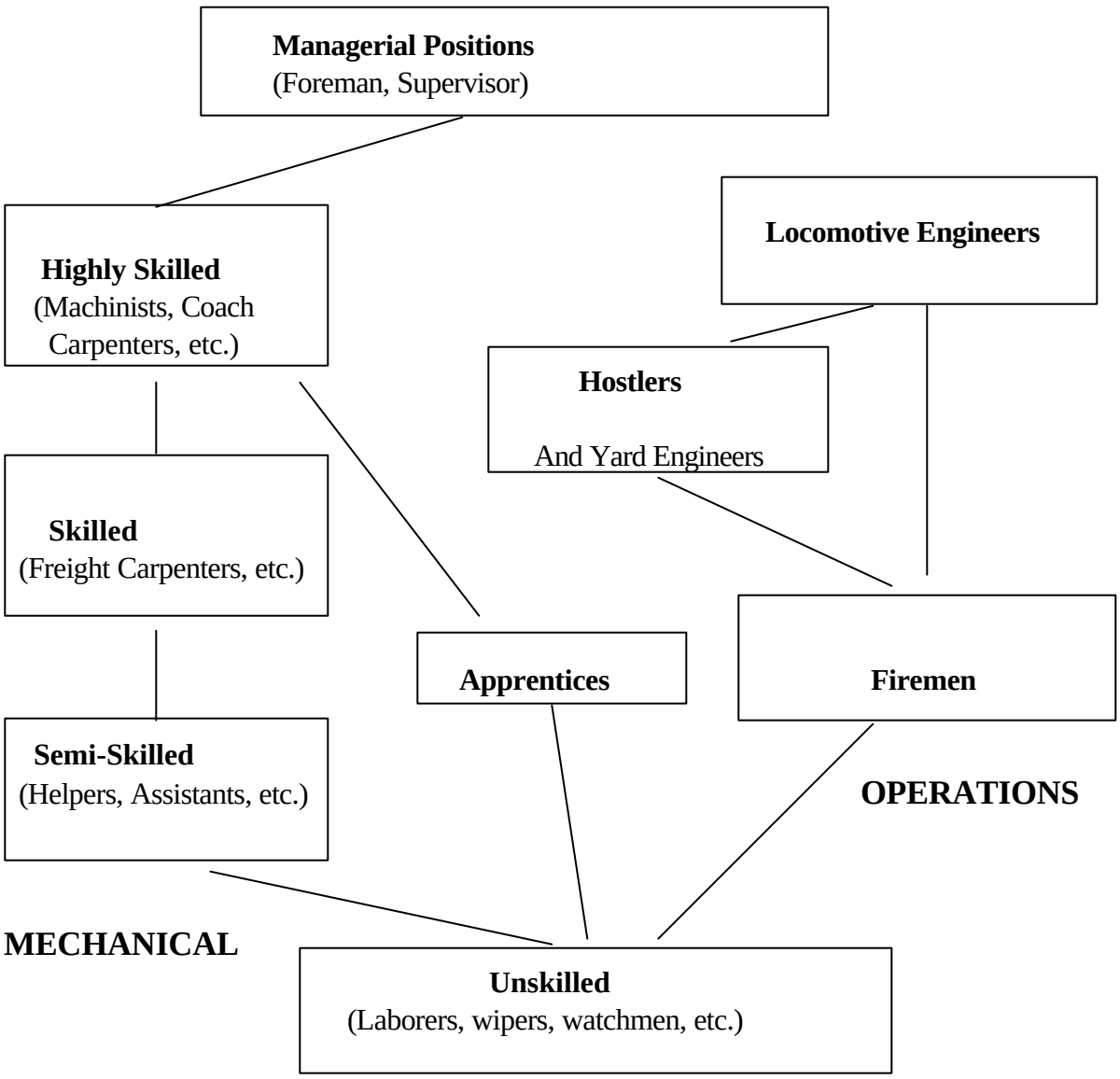

Figure 1: Occupational Hierarchy at the CPR

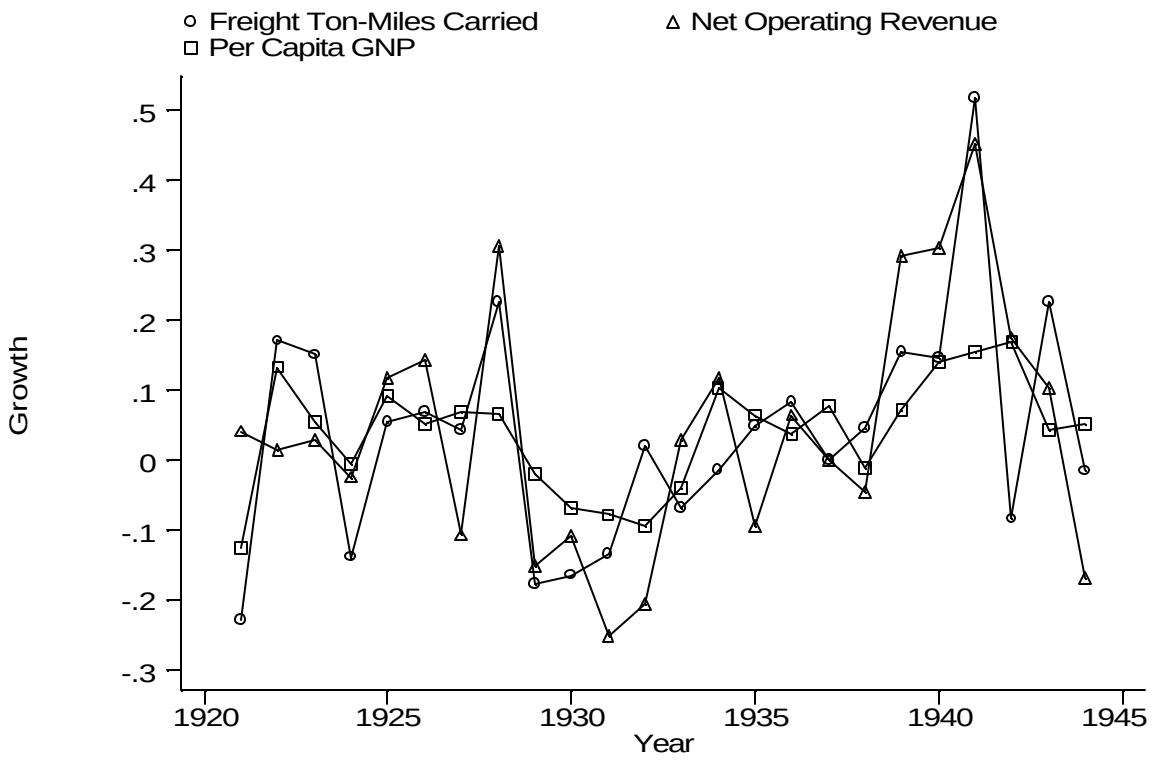

Figure 2: Yearly Real Growth in CPR Aggregates and Canadian Per Capita GNP

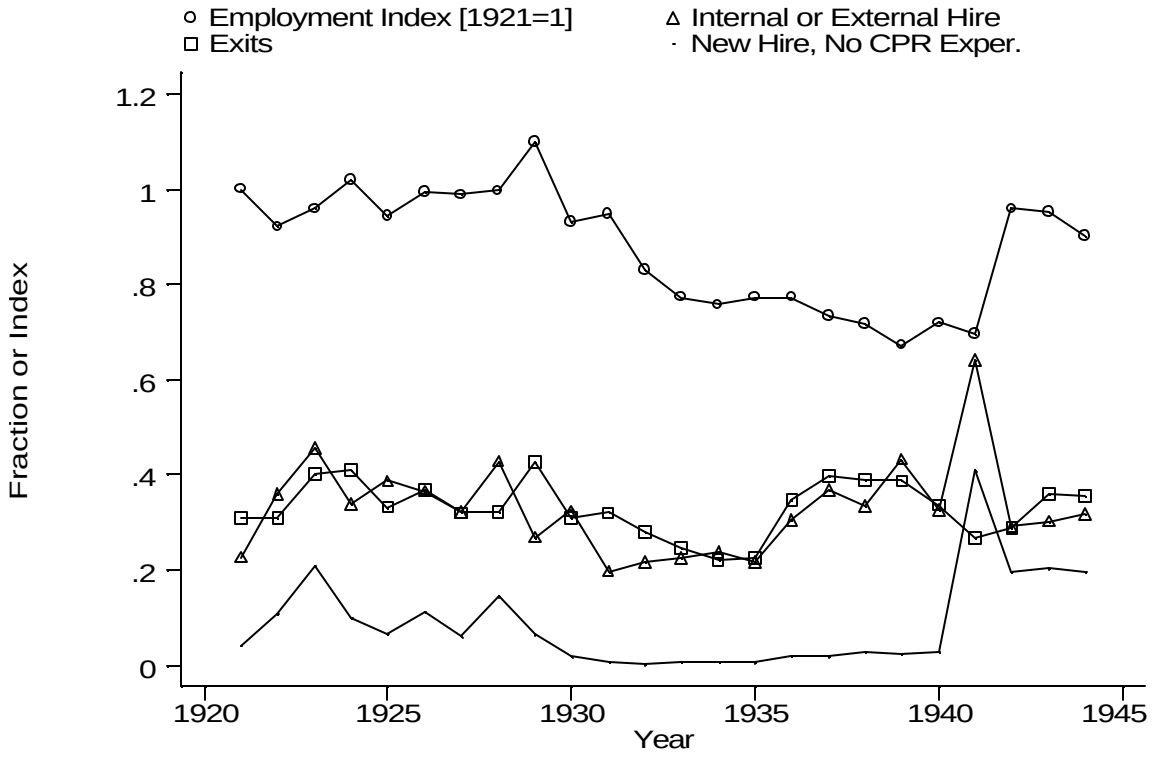

Figure 3: Job Entrants and Exits as Fraction of CPR Employment

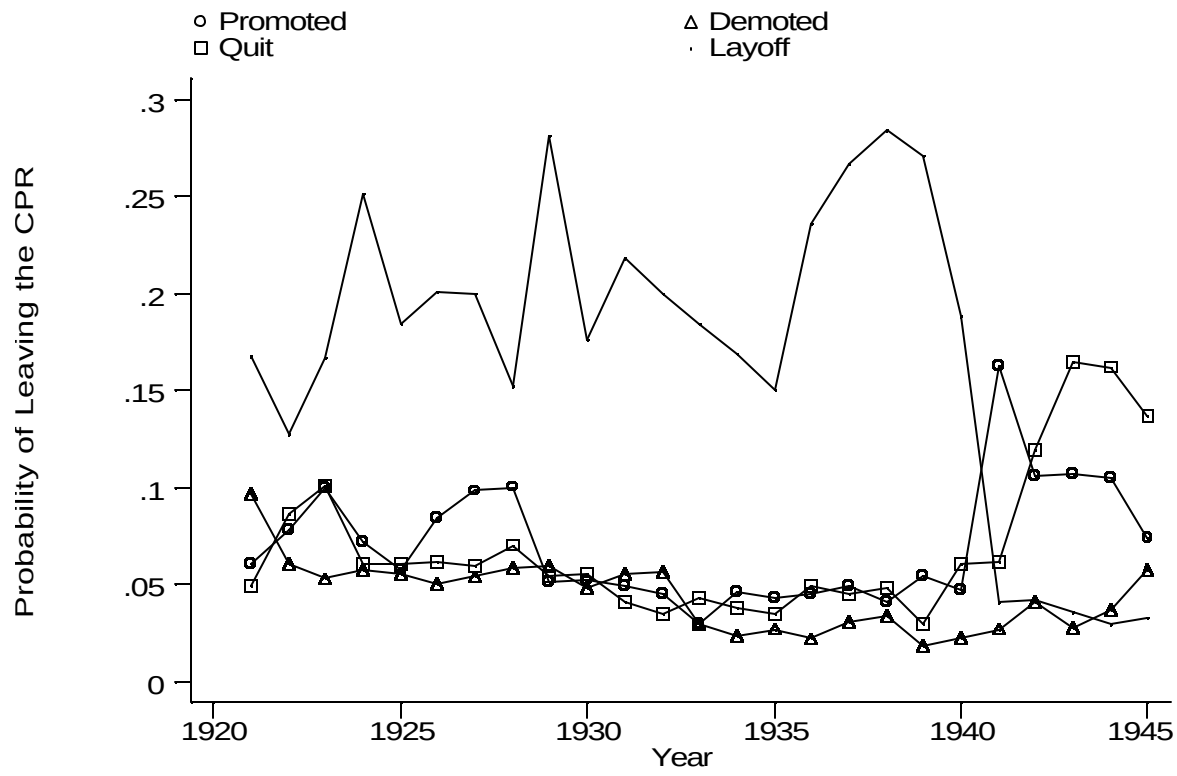

Figure 4: Yearly Hazard Rates, Mechanical Department

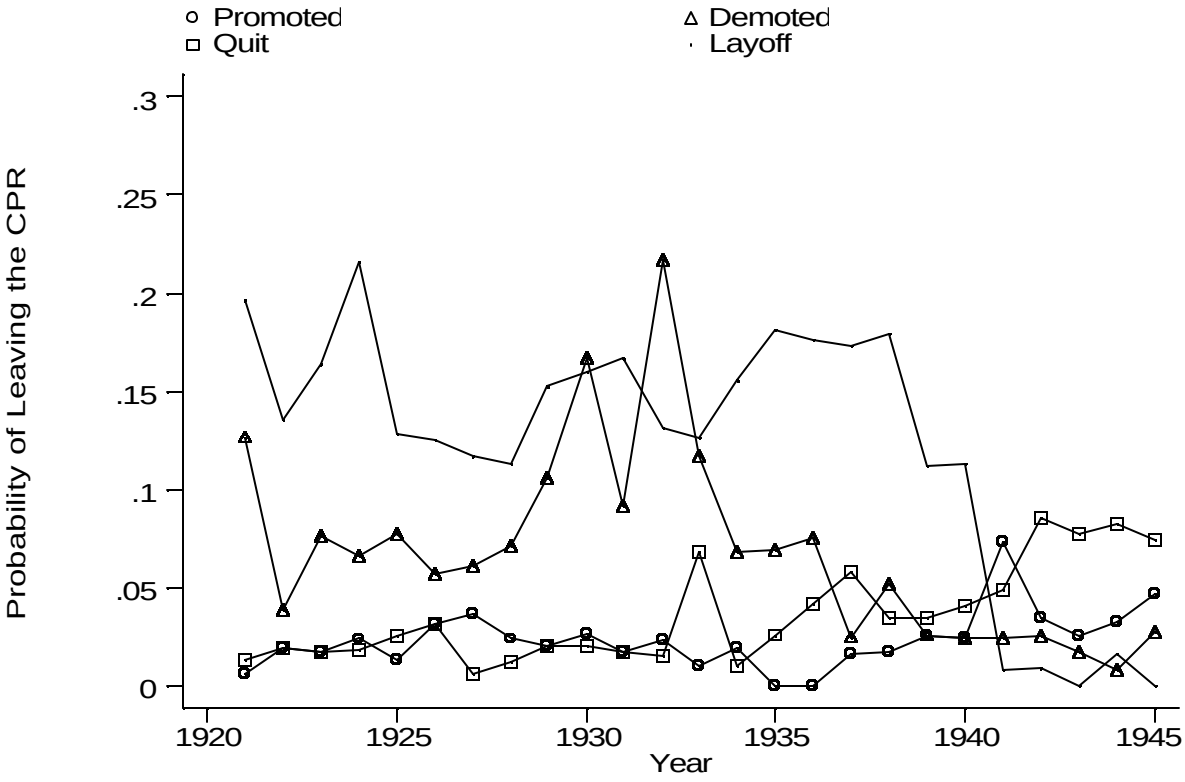

Figure 5: Yearly Hazard Rates, Operations Department

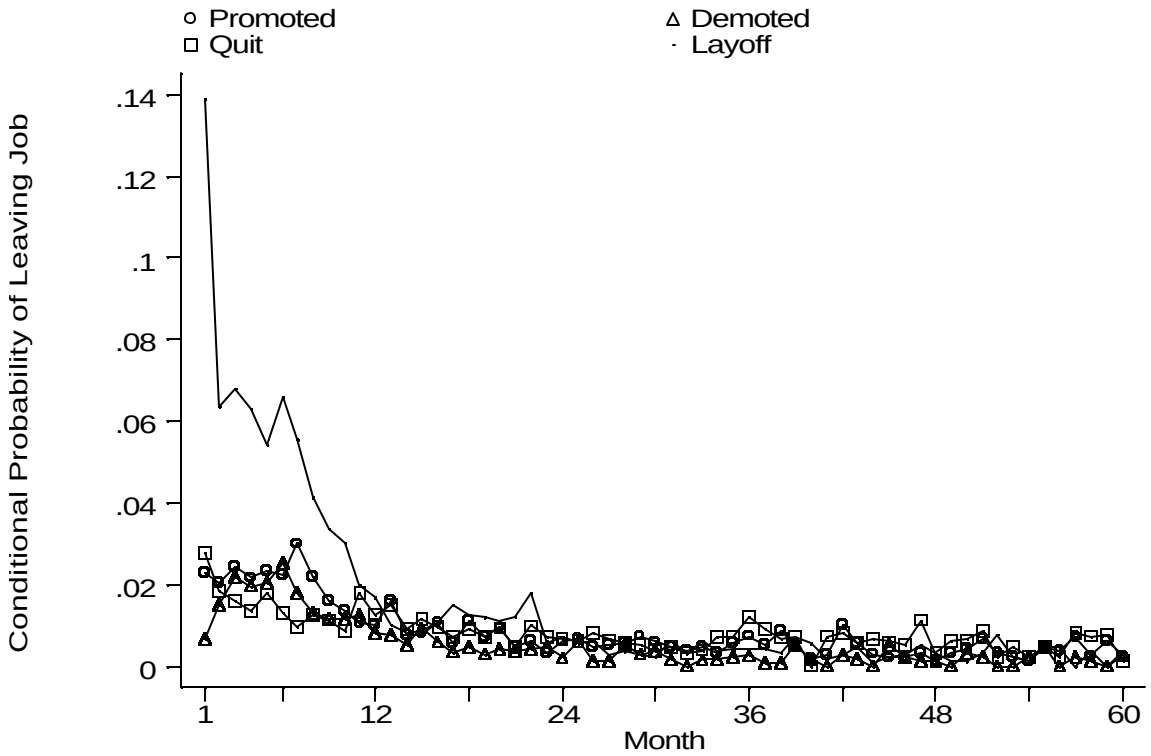

Figure 6: Empirical Transition Intensities, Mechanical Department

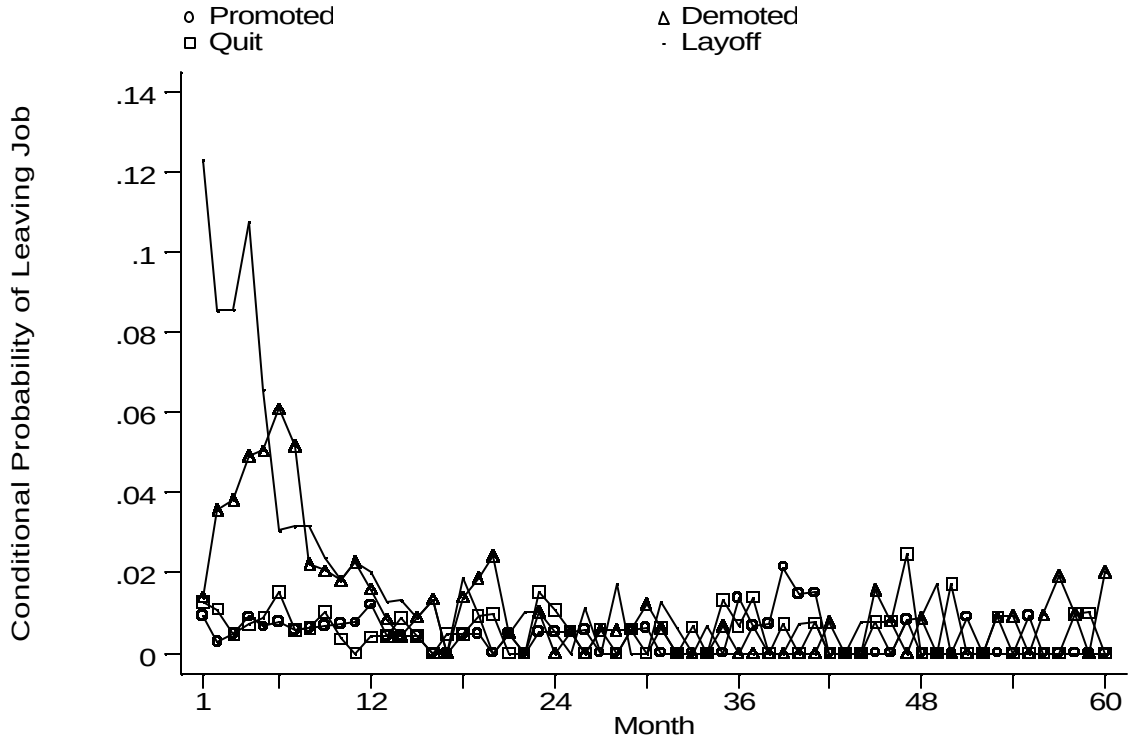

Figure 7: Empirical Transition Intensities, Operations Department

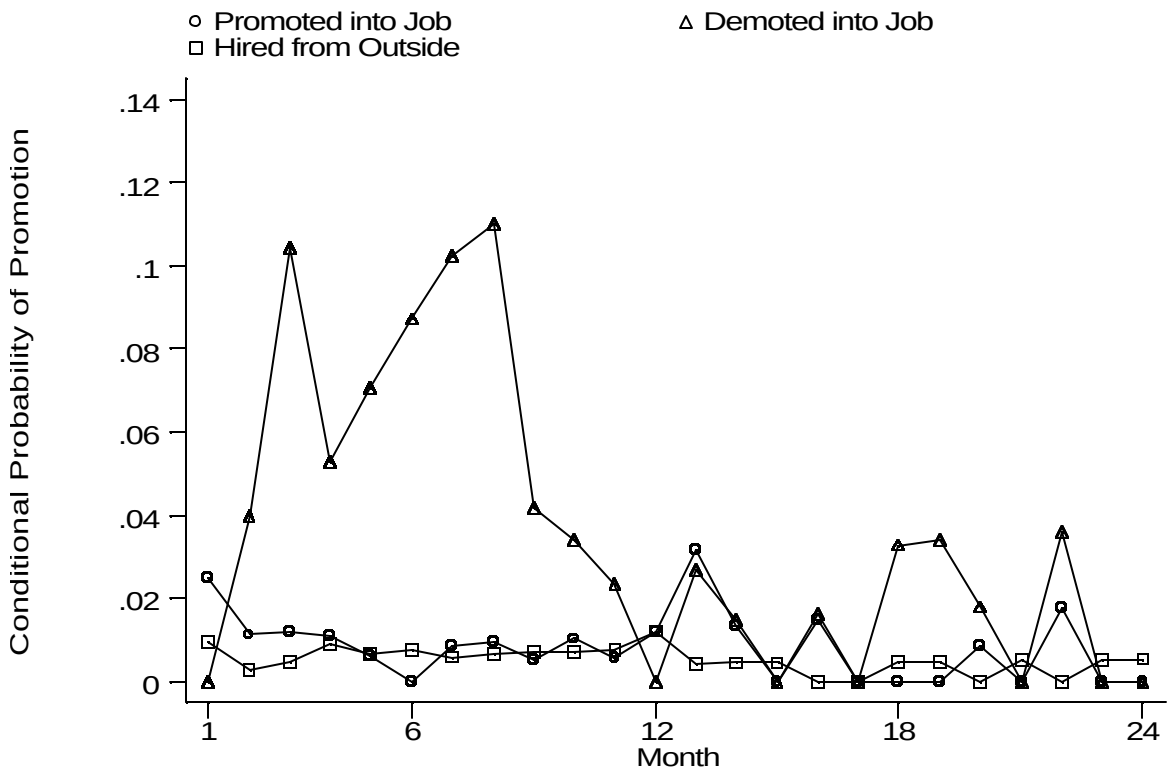

Figure 8: Promotion Transition Intensities by Worker Incumbency Status

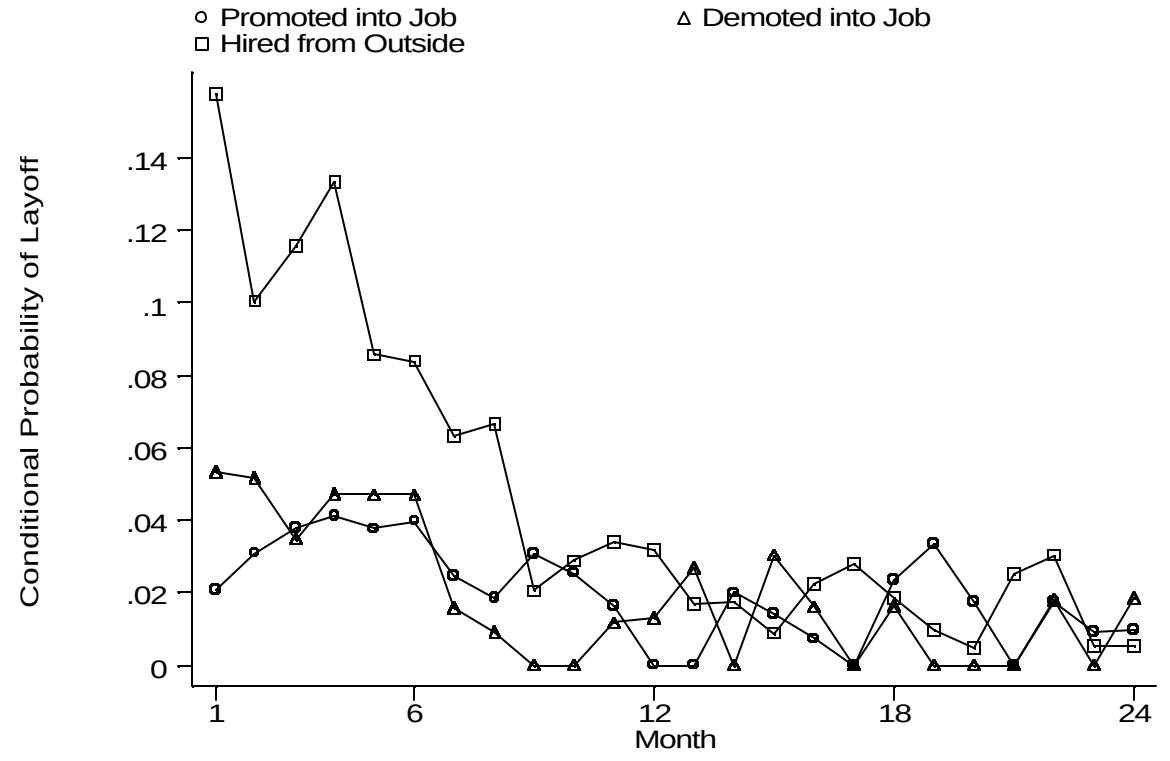

Figure 9: Layoff Transition Intensities by Worker Incumbency Status