The Impact of Tenure, Experience, and Type of Work on the Turnover of Newly Hired Drivers at a Large Truckload Motor Carrier

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Abstract

The American Trucking Associations' quarterly turnover report typically shows the average turnover rate at large truckload (TL) motor carriers to be in excess of 100% per year. The present study utilizes several years of proprietary data on newly hired drivers from such a carrier to examine the pattern of turnover in three dimensions: as driver tenure increases within the cooperating firm, by training or experience level before hire, and by type of work, comparing long-haul with local. Survival curves and hazard functions based on individual driver data, and associated statistical tests, are presented. We show that the time path of exits has two peaks, and that 50% of newly hired drivers are gone at the end of 27 weeks (6.3 months). We also find significant differences in retention performance by level of prior training or experience, but that, surprisingly, drivers with no trucking background at all and those with lots of experience at other firms are relatively close in performance. Although there are problems in our data with correctly identifying the type of work drivers are assigned, we also find evidence that drivers doing local and regional intermodal work have the highest retention, while those on dedicated accounts have an intermediate level, and drivers running all forty-eight states have the lowest.

JEL Categories: L92, J63

Keywords:
for-hire carriage, truckload (TL), driver turnover, employment duration, survival models

I. Introduction

The American Trucking Associations' (ATA) quarterly turnover report typically shows the average turnover rate at large truckload (TL) motor carriers to be in excess of 100% per year (ATA Economic & Statistics Group 2005). Driver turnover among these carriers is an economically significant phenomenon—truckload carriers make up the largest segment of for-hire motor carriage by employment, with approximately one half million drivers working at any given time (U.S. Census Bureau 2004). This segment of the universe of for-hire trucking firms emerged into its present form after the economic deregulation of 1980, which transformed the structure of the trucking industry. In the post-deregulation period carriers specialized quite strongly in one or another specific shipment size, from the smallest (parcel), through middle-sized shipments (less-than-truckload, or LTL), to the largest ones (truckload, or TL) (Corsi and Stowers 1991; Belzer 1995; Burks, Monaco et al. 2004). As the truckload industry segment emerged, so did a parallel segmentation of the labor market for truck drivers (Belzer 1995; Burks 1999)[1]. Drivers wanting to enter employment at parcel and less-than-truckload carriers generally found job queues[2], while the labor market for truckload driving jobs began exhibiting high rates of turnover. In fact, the labor market in the truckload segment has essentially been in a high-turnover equilibrium since the end of the recessions of 1981-82.[3]

A stable equilibrium characterized by high turnover rates defines what labor economists call a "secondary labor market" (Cain 1976; Dickens and Lang 1993).[4] This situation has occasioned much discussion in the trucking industry trade press over the

years, as well as a number of academic studies (examples include (Casey 1987; Griffin, Rodriguez et al. 1992; Stephenson and Fox 1996; Griffin and Kalnbach 2002; Beadle 2004)). Through the American Trucking Associations the industry has commissioned significant analytic efforts to understand the management issues raised by a high turnover business model, and the long term demographic trends affecting the viability of the model (Gallup Organization 1997; ATA Economic & Statistics Group 2005). Most of this research, however, has relied upon surveys of drivers or firms, along with various types of publicly available industry or labor force data.

The present analysis takes a different tack. It is part of a statistical case study of human resource data from single large truckload firm. The goal is to begin the task of quantifying and statistically analyzing the flow of new employees into and out of this type of firm. Using proprietary data from the cooperating carrier (referred to hereafter as "TL Firm #1"), we examine retention and exit over a one to two year time-horizon for a large group of newly hired and trained drivers. We provide survival curves and hazard functions that characterize the drivers' cumulative probability of staying, and their weekly probability of exit, at any point over this horizon. And we compare the behavior of trainees that enter with different levels of prior training and/or experience, and drivers that are assigned after training to work with differing characteristics, testing for the statistical significance of these differences where appropriate.

We find that for our particular carrier, the best retention characteristics are exhibited by rehires, while an intermediate level of retention characterizes both drivers with high prior experience that was not with TL Firm #1, and new trainees with no trucking background at all. Perhaps surprisingly, trainees with a little prior experience, or

with some previous training, have the worst retention performance. The time paths of exit risk are similar across all groups in having an early peak (at between 6 and 8 weeks), but less experienced drivers also have a spike just after a year (associated with completing a training contract and having enough experience to easily switch jobs), while rehires show a strong early periodicity in exit risk that is probably linked to the firm's quarterly bonus system. Our data has some serious limitations as far as accurately capturing the type of work to which a driver is assigned, but within these limitations we also find evidence that, unsurprisingly, drivers doing local and regional intermodal work have the highest retention, while those on dedicated accounts have an intermediate level, and drivers running all forty-eight states have the lowest.

The structure of the paper is as follows. The next section more carefully explains what it means for a carrier to be in the truckload (TL) segment. Section III offers a brief overview of the issue of turnover in the TL segment, and Section IV describes our data. Next we present results. Section V discusses findings for the entire pool of new drivers for whom we have data, Section VI presents our most detailed findings, which are on the impact of previous training or experience, and Section VII briefly examines differences in retention by type of work. Section VII concludes.

II. What is a "Truckload" Motor Carrier?

To a casual observer one truck looks much like another, but in fact, the operations that provide trucking services in the U.S. are meaningfully differentiated from each other on several dimensions. At the broadest level, trucking operations are broken into private carriage versus for-hire carriage, based on a legal relationship: whether the carrier also

owns the freight (private carriage), or is hauling it for another party (for-hire carriage).[5] In recent years for-hire carriers, which are the focus of the present study, have typically operated about one-third of the heavy trucks[6] in the overall U.S. fleet, but about three-fifths of the total miles run by such vehicles (Burks, Monaco et al. 2004).

For-hire trucking is itself further broken into a number of distinct segments, separated along three cross-cutting dimensions. Within each segment inter-firm competition is significant, but across segments it may be muted, or in some cases even absent. The 2002 Economic Census, because of its use of the relatively new North American Industrial Classification System (NAICS), which is based on production process characteristics, gives a good overview of the structure of the for-hire trucking industry at this level of segmentation (see Table 1). For-hire truck transportation as a whole, NAICS category 484, generated $165.56 billion in revenue in 2002, or about 1.56% of that year's GDP.[7]

The first broad scale distinction within for-hire trucking is between firms that use general purpose equipment (i.e. standard enclosed van trailers) to handle general commodities, and those that use specialized equipment to handle special commodities (examples of the latter would be refrigerated vans, flatbeds, tank trailers, and various other types of specialized equipment). According to the Economic Census, in 2002 general freight operations generated $111.60 billion annual revenue (67.3% of the total) and specialized freight had $54.01 billion annual revenue (32.3% of the total). A second cross-cutting broad scale distinction is between firms that make long distance inter-city hauls, and those that specialize in operations in and around a particular metropolitan area.

In 2002 the Economic Census reports $120.21 billion in annual revenue for long distance trucking (72.6% of the total), and $45.35 billion for local hauls (27.4%).

A third cross-cutting broad scale distinction is based on the size of the typical shipment hauled, and this dimension on which firms differ is of particular relevance to the present study. It is easiest to understand this distinction by considering the two extremes, full-truckload service, and parcel service. At one end of the spectrum are firms like the one providing data for the current study. The archetypal full truckload (TL) carrier sends a driver with a tractor-trailer to a shipper's dock to fill up the trailer with a load, typically weighing from 10,000 to 48,000 pounds. The driver takes the loaded trailer wherever in the U.S. the shipment is destined, and unloads at the consignee's dock. The driver is then dispatched empty, possibly after waiting for a while, to the next location where a full load is available for pick up. TL carriers may use specialized equipment for special commodities, but if they haul general commodities they use general purpose equipment to maximize the chance of backhauls.

By contrast, both parcel and LTL firms aggregate large numbers of individual shipments collected at local terminals by local drivers into full trailer loads, and move them between terminal systems on fixed routes. Parcel carriers handle very small shipments (typically each piece being no larger than 150 lbs., with the average nearer to 50 lbs.), and LTL carriers aggregate medium-sized shipments (widely varying, but with average size around 1,000 lbs.). The Economic Census does not group parcel service firms with the for-hire trucking industry, but with air freight carriers. However, it does capture LTL and TL firms within trucking. In 2002 the TL segment dominated the general freight portion of (non-parcel) for-hire trucking, with 67.9% of the total

employment, and 83.8% of the total revenue. If the segments of specialized freight that are primarily TL by shipment size are added to the mix[8], then TL's share of the total employment of 1.137 million jumps to 72.8%, and its share of the total revenue of $124.50 billion rises to 77.1%.

The differences across the segments in the operational routines needed affect the form and intensity of competition within each segment. Specifically, in the parcel and LTL segments, the need for a fixed network of freight re-handling terminals creates what industrial organization economists call an entry barrier.[9] While competition among parcel and LTL carriers is frequently strong, it generally takes place among incumbents. This is evidenced by the numbers of firms in the long distance parcel and LTL segments. In parcel there are really only four firms with full national coverage (UPS, FedEx, DHL, and the USPS). There are more LTL firms, but the number is still small. The 2002 Economic Census identifies 89 long distance general freight LTL firms with five or more establishments, which is the minimum number of terminals needed to give any kind of geographic scope; there are only 57 firms with ten or more.

But in TL there are essentially no entry barriers. Since TL carriers do not normally re-handle freight once it is loaded, they do not typically require terminals, nor regular route patterns, for cost-competitive operations. So a one-truck carrier is competitive, on a load-by-load basis, with most of the services offered by one of the TL-segment's giants. When more complex service coordination is the key factor in market penetration, small firms can subcontract to third party logistics providers.[10] And in fact, there is a continual flow into, and out of, the TL segment, mostly by firms operating at small to medium scales. In TL, the 2002 Economic Census identified 25,831 long

distance general freight firms.[11] The market concentration levels in these two segments also show the differing nature of competition. In LTL, the 2002 Economic Census puts the share of the top 4 long distance general freight LTL firms at 36.3%, while that of the top 4 long distance general freight TL firms is only 14.7%.

The implication of these facts is that most of TL service is what business analysts call a "commodity business", and what economists call "perfectly competitive. As a result, the wage scales in TL are set by what drivers at small firms in the competitive fringe of the industry segment are willing to accept. Owner-operators can always choose to pay themselves less in order to get started in the business. Small firms generally face more modest wage expectations from their employees than do large ones, and they also have the benefit of more personal relationships between owners, managers, and drivers. Large firms can pay a modest premium above the level set by such firms, but if they raise their wages too high they will make their costs uncompetitive.

III. Why Is Turnover So High in TL?

Driving a tractor-trailer requires training for, and passing, the state-administered written and driving tests for a commercial drivers' license (CDL). Typically a high-school equivalent level of literacy is required, along with two or more weeks of training, and the minimum legal age at which the tests may be taken is 21. A driver is generally considered experienced after a year of work, so the level of human capital required makes the job fit between unskilled and skilled, as "semi-skilled".

Once a driver is licensed, the key problem in retention is generally perceived to be the working conditions faced by a tractor-trailer operator in the archetypal long-haul,

randomly dispatched, 48-state service provided by most TL firms. In addition to the stresses of handling a big rig among swarms of cars, many drivers have very long weekly work hours on an irregular schedule. In one published survey of long haul drivers, 21.9% reported working 70 plus hours each week, and two out of three drivers reported working 60 plus hour weeks (Stephenson and Fox 1996). Other surveys report similar findings (Belman and Monaco 2001). These hours contrast to those in two industries in which there are occupations with similar human capital requirements, manufacturing and construction, which had average work weeks of 40.8 and 38.3 hours in 2004, respectively (Bureau of Labor Statistics 2002).

A related issue is that long-haul drivers are often away from home for multiple weeks at a time, with little predictability about the date of return. In the same survey previously mentioned, only 20.7% of TL drivers reported that they were home almost every day, while 28.7% of drivers in the same study reported being home less often than once every two weeks (Stephenson and Fox 1996). A less tangible issue is that both drivers and firms like to think of CDL holders as professionals, in command of a big rig and responsible for its safe operation. But trucking is a service business, and a primary job function of the driver is to make shippers and receivers happy. The implications vary by customer, but this can place drivers somewhat lower than they might expect on the supply chain status hierarchy.

Of course, not every driver in TL operations faces the same conditions. The foregoing description applies to those “running the system”, or being randomly dispatched across the 48 U.S. states. Some TL operations are dedicated to the service of particular large customers, and drivers in these operations have a more restricted set of

pickup and delivery locations, more regular schedules on average, and generally enjoy more time at home, as well. And some TL operations move freight between cities via trailer-on-flat-car (TOFC) or container–on–flat-car (COFC) intermodal methods. Drivers in these operations have regional or local runs, and are often home nightly.

Given these facts, a labor economist would expect to observe a "compensating differential" built in to the wages of TL drivers that have the worst conditions. In other words, other things equal, TL firms should offer a higher earnings level than stay-at-home jobs requiring similar human capital, to compensate for their poorer working conditions. What is not equal, of course, is the level and nature of competition across the segments of for-hire trucking. And so dissatisfaction over wage compensation levels is frequently cited as a leading reason for TL driver turnover (Cox 2004).

A major study done by consultants at Global Insight for the ATA links the supply of truck drivers to the supply of labor for semi-skilled jobs in construction, since this type of work often represents the next best opportunity for likely truckers. During the 1990's there was a modest premium—TL truckers' earnings were an average of 6-7% above a position demanding similar levels of human capital in construction. The downturn of the economy in 2000-01 created slack in the labor market, and as a result the average long haul TL driver could expect to make less than if employed in the construction industry. By 2004 the gap had narrowed, with long haul TL drivers are 1.5% below that of construction workers (Global Insight Inc. 2005). These facts show that TL wage levels do adjust over time to changes in the balance of labor supply and labor demand, but the persistence of the high turnover numbers shows that the levels of compensating

differential being offered are not sufficient to raises retention to the levels typical in other blue collar jobs.

The long run dynamics of the driver shortage issue are made more complex by the growth of the TL long-haul industry. Between 2004 and 2014 Global Insight projects it will grow at a rate of 2.2% which translates into an additional 320,000 heavy-duty long-haul new jobs. This statistic does not include the number of drivers needed to replace those who will retire during this time; the industry will additionally need to find an estimated 219,000 drivers to replace 1 in 5 drivers who are 55 years old or older and are approaching retirement. Concurrently with an increase in demand for drivers, the overall labor force's growth rate will slow from 1.4% to .5% between 2005 and 2014 (Global Insight Inc. 2005). Another challenging trend for the industry is that to date Hispanics, who comprise the fastest growing segment in the workforce, represent a lower percentage of drivers than they do of the overall labor supply.

The flows into and out of industry (as well as related movement of dissatisfied drivers between firms) represent a substantial cost to firms. The Upper Great Plains Transportation Institute found in 1998 that replacing one dry van TL driver conservatively costs $8,234 and the industry wide the cost total was estimated at nearly $2.8 billion then (Rodriguez, Kosir et al. 2000). The estimate was considered conservative because the costs that can be associated with recruiting a new driver tend to increase with the specificity that costs are measured. This is the magnitude of the turnover cost that TL firms must balance against the alternative costs of raising wages and/or adjusting operational and dispatching decisions, in order to lower turnover.

J.B. Hunt, then the second largest firm in the industry, engaged in a highly publicized experiment with switching from a business model with high turnover and modest wage costs to one with higher wage costs but lower turnover in 1996. It took the portion of its workforce facing the worst conditions (long and irregular dispatches) and raised wages by 35%, while at the same time closing down its driver training schools (Cullen 1996; Isidore 1997). The net result was a cut in both turnover and accident rates by approximately one-half (Belzer, Rodriguez et al. 2002). However, the long run net financial benefits were not as clear (Waxler 1997), and most of the other large firms in the industry, including the one providing data for the present study, continue to train many of their new drivers from scratch, and nearly all TL firms use the high-turnover-modest-pay-premium model.

We next turn to what an examination of TL Firm#1's data can tell us about how this high-turnover-modest-pay-premium model works in practice.

IV. The Data and the Statistical Methods

The proprietary human resource data set used was constructed from three distinct initial data files, which share the feature that each record provides information on one driver during one calendar week. The constituent files covered different calendar periods, so we utilize the calendar window during which all three overlap, September 1, 2001, through March 31, 2005. The first file, Weekly Hires, consists of some of the data elements recorded about a driver during the week he or she is hired. Drivers who are rehired during the calendar window have more than one line in this file. The second file, Weekly Separations, contains information recorded about a driver during the week that

he or she separates from the firm. Drivers who are rehired and who, as a result, also separate more than once during our calendar window, have more than one line in this file. The third file, Weekly Employment, consists of one observation in each week for each driver employed during that week. Combining all three data sets gives a complete picture, week by week, of flows in, flows out, and who is currently working, for the firm.

However, there are some important limitations in these data, and a resulting major problem with analyzing them. The Weekly Hire and Weekly Separations data files contain a number of useful variables, including several key breakout variables, such as the driver's division (e.g. dedicated, intermodal, system) and what kind of prior training or experience the driver had when they joined the firm.[12] Unfortunately, the Weekly Employment data file is missing these key variables. This means that we don't have this information on the drivers who do not experience either a hire or a separation event during our calendar window. And our information is incomplete for drivers who experience only a hire or a separation event. In particular, the division to which the driver is assigned is known prospectively at the time of the hire event. But it changes later for many drivers, and we only have the updated information in the separation event record for that subset that does depart.

To partially compensate for these problems, we take the following steps. Breakout variables that are of interest in the present study are carried forward to all observations on a given driver, from that driver's hiring observation. This gives us reasonably accurate information on the previous trucking industry training or experience of each driver (since this is not information that changes with tenure). It also tells us which division of the firm's operations a new driver is expected to be assigned to at the

time of hire. In addition, we flow the values from the separation observation backward, to all prior observations of that particular driver, for the variable recording division to which the driver is assigned. This gives us improved information on those who separated, but at the cost that noise is differentially left in the observations on those who do not separate. For this reason, unfortunately, we cannot place much weight on specific findings about the impact of the type of work on retention in the present analysis.

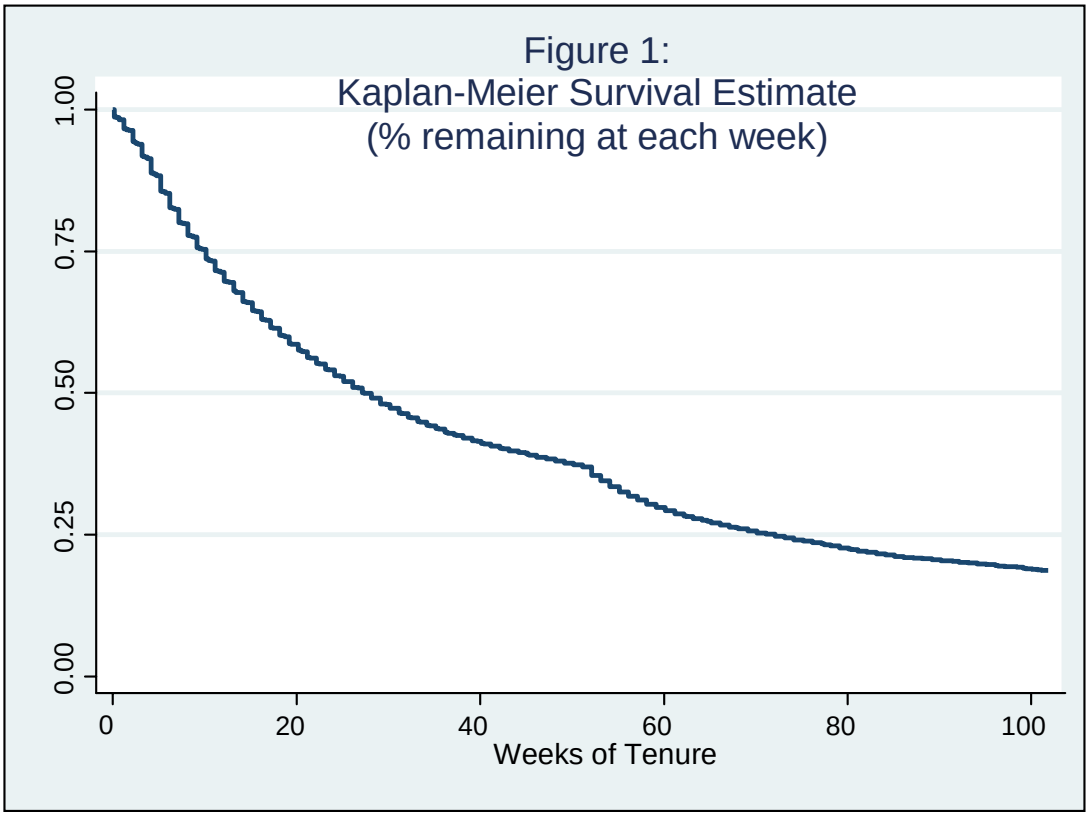
A further implication of the data limitations is that we restrict ourselves to the subset of drivers for which we observe a hiring event during our calendar window, because we do not have either hire or separation observations for long-time incumbent employees, and so are missing their key breakout variable values. Given the industry context, however, this subgroup is of significant independent interest, irrespective of what might be found if a more inclusive group could be analyzed. Also, because we are not confident that we can correctly identify all the characteristics of second or later spells of employment, we here only examine the first spell of employment during our calendar window, for those drivers who have more than one observed hiring event.[13] Finally, we restrict our attention to the three divisions (types of work) that are of greatest initial interest: the traditional long-haul, randomly dispatched drivers "running the system", drivers whose trucks are "dedicated" to the service of a particular large customer, and drivers whose primary job function is to move intermodal trailers and/or container chassis to and from railheads. These restrictions result still leave us with a lot of data: we analyze a set of more than one half million observations covering more than 5,000 distinct individual drivers, observed during the period from September 1, 2001, through March 31, 2005.[14]

The primary statistical methodology will be survival analysis. Standard descriptive and analytical methods are problematic when the key dependent variable (here, the length of job tenure) is a time period. There are a number of potential complications, but the main difficulty is that when an observation is made of a population at a point in time, individuals who are incumbents in the state of interest (here, being employed at the cooperating firm) have spells of job tenure that are ongoing. The spell length of these subjects is thus "censored", in that we only know they have stayed employed up to the moment of observation, but not how much longer they will stay employed. To give a simple example, computing the average length of job tenure from the raw observations of a cross section of the driver population at a point in time, or even from the observations of the cross section plus the additional observations on those who have already left, would produce a biased outcome. Instead, a conditional probability approach is needed, to correctly take into account the statistical information contained in partially completed but censored observations (Kiefer 1988; Cleves, Gould et al. 2004).

Our procedure will be to first examine the survival curve for the entire set of drivers we consider here, along with the associated hazard function, which exhibits the time path of exit risk that gives rise to the survival curve. Then we will separate out the survival curves for discrete subgroups of interest, and test for differences between them, and we will also examine the hazard functions for each subgroup for useful insights. It should be noted that our analysis does not distinguish between the possible different reasons for separation. In particular, of the separation events that we observe, 76.4% are voluntary quits, while 23.6% are discharges for cause, but our survival curves and hazard functions include both.

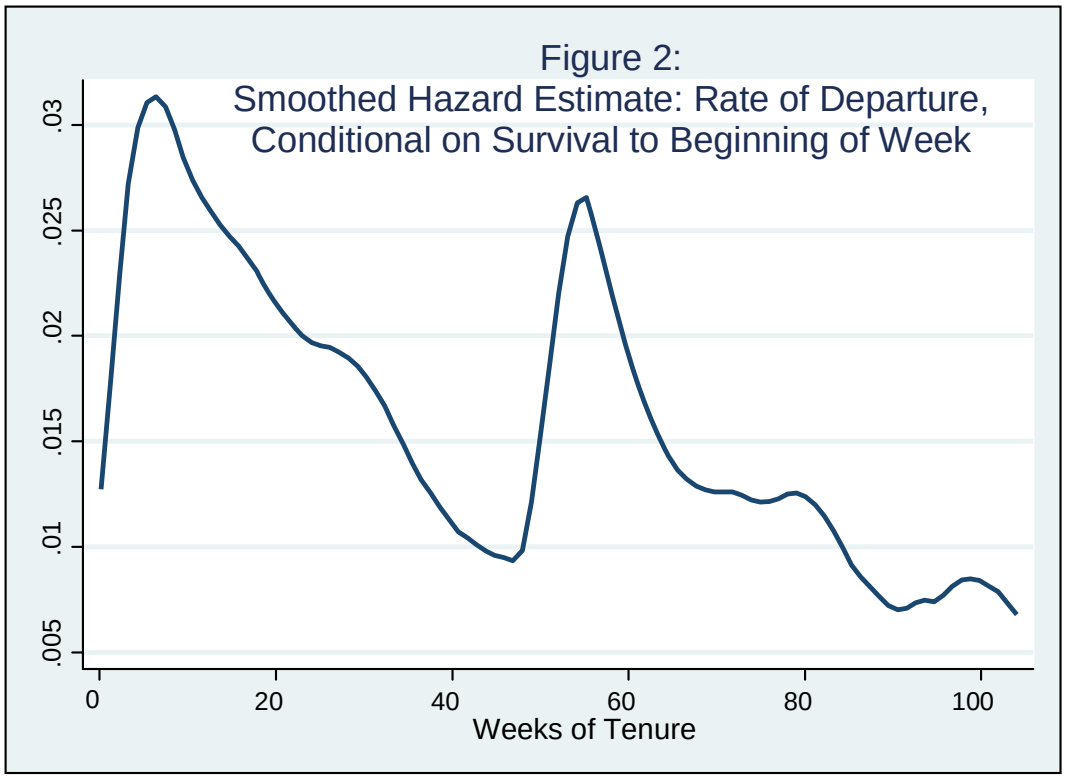
V. Results for All First-Hire-Event Employment Spells

We begin by examining the survival pattern for the first observed employment spell of all drivers having a hire-event during our calendar window. Figure 1 displays the central results. The vertical axis indicates the percentage of the population initially entering employment that remains after each amount of time on the job, shown on the horizontal axis in weeks from the start of employment. Some key qualitative facts emerge from this picture. First, turnover rates do look extremely high. At 10.1 weeks 25% of the population is gone, 50% have left by 29.1 weeks (the median survival time), and 75% have departed by 75 weeks. Second, there is a leveling off of departures in the second half of the first year on the job, followed by an acceleration at the end of the first year. This is consistent with the fact that most of the trainees observed here who undergo



the firm's full training program sign a contract to pay back about half the cost of training (several thousand dollars) if they do not complete a year of service after training. Plus, the job options within trucking are more plentiful for drivers with a year of experience. The surprise, in fact, is that so many new drivers leave before the first year is up. Clearly, these departures cause both the firm and the drivers to incur real costs.

Further insights may be obtained by examining the hazard function for this group

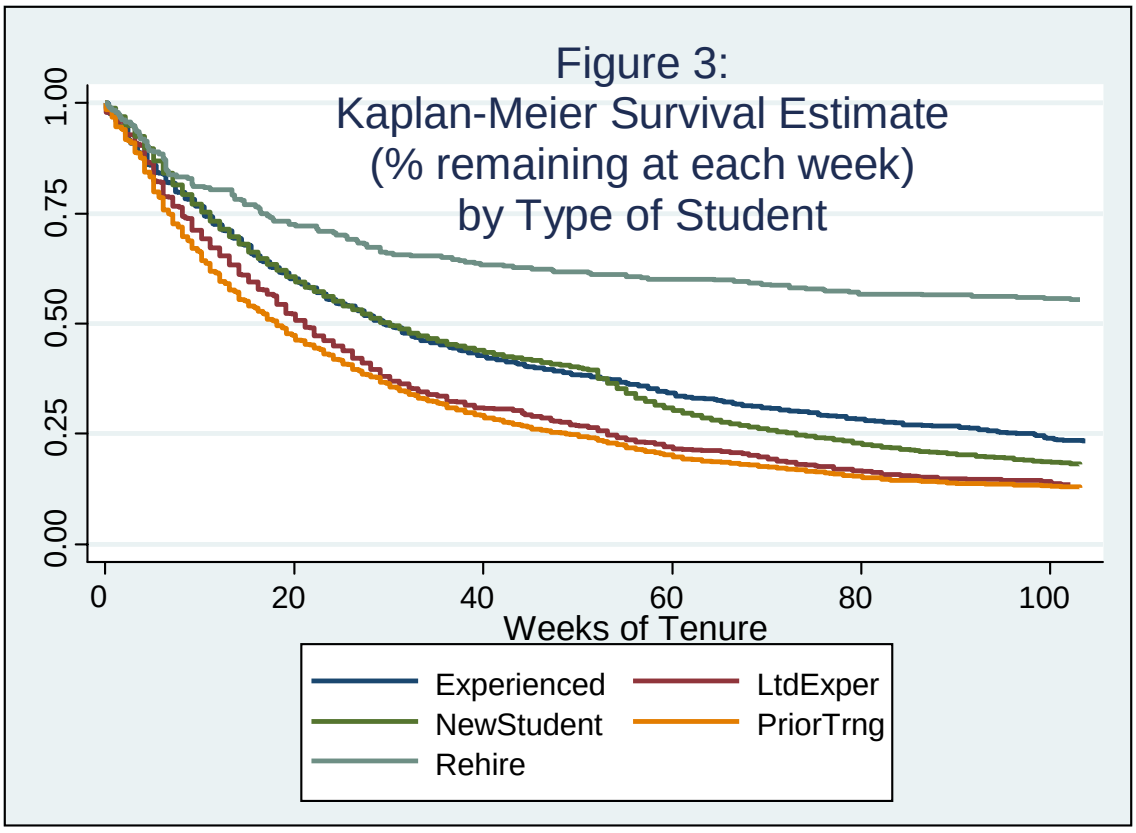


of drivers. The vertical axis indicates the probability of leaving during any particular week shown on the horizontal axis, given that the driver made it to the beginning of the week. (Or, to be slightly more careful, the vertical axis shows a "departure rate", because it is the conditional probability just described, divided by the number of analysis-time units contained in each unit on the horizontal axis. In our case the denominator is one, so the rate is also a simple conditional probability.) Here the differences in risk of departure

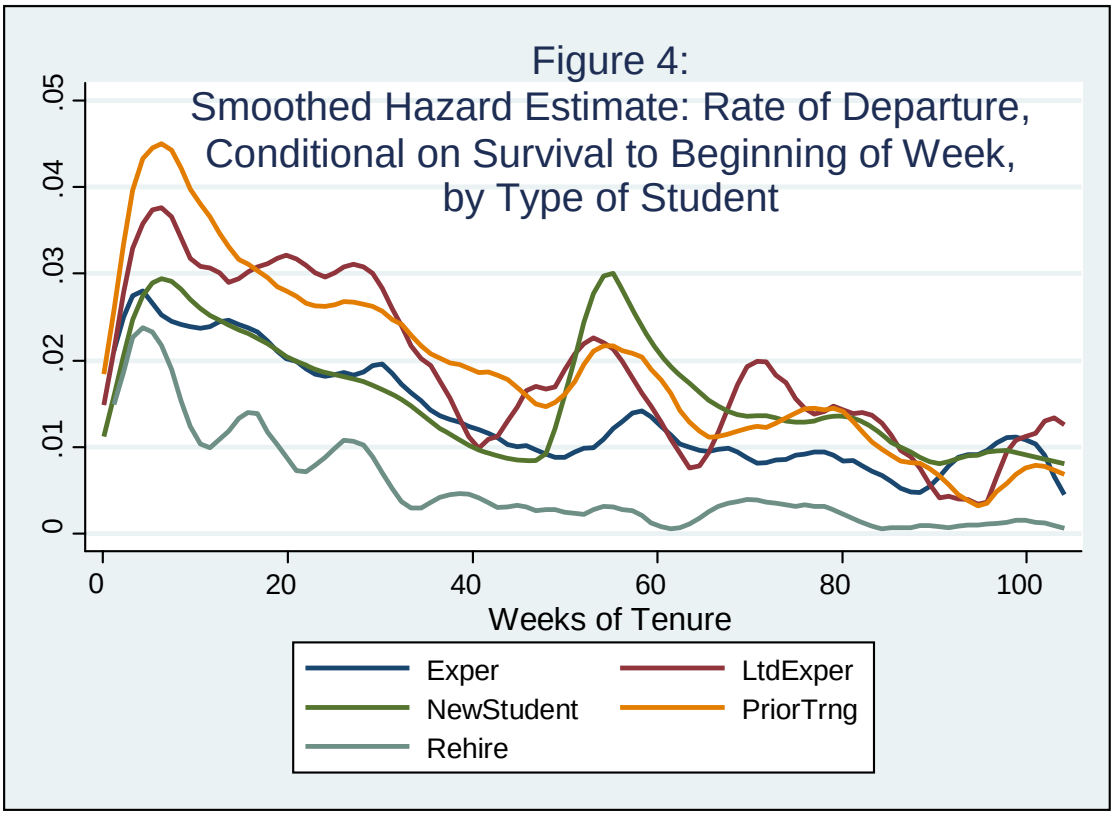
are shown more clearly. Exit risk is highest at about 6 to 8 weeks, which is approximately when new trainees first pull a load by themselves, without the assistance of an instructor-driver in the cab. Once drivers make it past this stage, exit risk declines sharply, until the one-year mark is reached, when separation risk spikes to almost the same level as at the beginning. Drivers who make it to the end of two years are essentially self-selected to have a high likelihood of turning out to be longer-term employees.

VI. Results by Level of Previous Experience or Training

Drivers who are hired by TL Firm #1 arrive with different levels of prior training and prior experience. In Figures 3 and 4, and Table 1, the differing performance of these subgroups with respect to retention gives rise to separate survival curves and hazard functions. The best retention is exhibited by the small group (4% of the total) of rehires. This can be observed from the fact that their survival curve is well above the curves of the other subgroups, and is quantified in Table 1. We can see there that they have the longest period of any group for 75% to remain (almost 4 months), for 50% to remain (over 5 years), and have a retention period for 25% of the starting population that is so long that it cannot be meaningfully calculated in our data. This is not surprising—rehires are the self-selected subset of drivers who are not only experienced drivers, but who have worked at least once already for TL Firm #1. Having explored other opportunities, they now choose to return to this firm as their best current option.



The hazard function for these drivers is distinctive, as well. It shows a modest spike in exit probability early, with falling exit risk thereafter, and also a very distinct periodicity up to the first year, which likely reflects the incentive effects of the firm's quarterly bonus system. Rehires are eligible for the firm's quarterly bonus immediately upon starting work, and also have experience with the incentive provided by the particular bonus system offered by the firm. The periodicity in the rehire hazard function suggests drivers in this group who may consider leaving during the first year are likely to wait until they have completed a quarter and qualified for the bonus, before separating. Also noteworthy, and sensible, is that there is no "first-year-effect" spike in their hazard rate—this effect in the aggregate hazard function is entirely due to the behavior of other subgroups.



Consider next experienced drivers. These are students who have significant levels of over-the-road tractor-trailer experience with other employers, before coming to TL Firm #1. Like rehires, they only have to take a refresher training course that takes a few days, instead of the multiple-week basic training course all other drivers new to the firm are required to pass. Their retention performance is not as good as that of the rehires, but it is still well above that of the lowest groups, with 75th, 50th, and 25th percentile retention periods of 10.4, 29.4, and 98.3 weeks, respectively. Their hazard function shows the usual pattern of an early peak, with later declines, and appears to have a muted version of the periodicity seen in rehires. This would make sense, as experienced drivers are eligible for the bonus system immediately, but don't have as much experience with its incentives as rehires.

The next item to note is akin to Sherlock Holmes' famous observation about the mysterious behavior of the dog in the night. The dog didn't bark when it should have,

and correspondingly one would expect new students with no prior background of any kind in trucking to have different (and in particular, poorer) retention performance than experienced drivers.[15] But in these data both new students who are learning the industry from scratch, and experienced drivers who are new to TL Firm #1, have closely similar retention behavior for nearly the first entire year of employment. New students actually do slightly better than experienced drivers, near the end of the first year. At that point their hazard function spikes very sharply, and their performance drops below that of experienced drivers, and which is associated with the facts that their training contracts are completed and they then have enough experience to easily switch trucking jobs if they desire. Since new students are by far the largest group (73%) of drivers for whom we observe a hire event, their behavior is very important in determining that of the entire aggregate driver population. Thus the size of their initial aggregate spike in exit risk, as well as that after a year of service, both strongly shape the aggregate survival curve and hazard function.

Table 1: Weeks Of Job Tenure by Type of Student

Drivers for whom a "hire event" is observed; N > 5,000	Estimated Job Tenure in Weeks			
	Percent of Drivers	75% of Drivers Remaining	50% of Drivers Remaining	25% of Drivers Remaining
All Drivers	100%	10.1	27.4	72.1
Rehire	4%	16.6	284.7	n/a (long)
Experienced	8%	10.4	29.4	98.3
New Students	73%	11.1	30.1	73.1
Ltd Experience	3%	8.1	21.1	53.1
Prior Training	14%	6.7	18.1	49.1

As it turns out, a Chi-square statistical test of the significance of the difference in overall survival performance between new drivers and those with non-TL Firm #1 experience shows that experienced drivers do better overall, at the 5% significance level ($p = .018$). But, as Table 1 shows, the effect is all driven by the one-year exits of new drivers, and the magnitude of the effect is much smaller than the difference between

either of these groups and rehires.[16] For instance, 50% of the rehire group is estimated to still be at work for TL Firm #1 5.48 years after the hire event we observe, while for drivers with non-TL Firm #1 experience it is only 6.8 months, and for new students it is essentially the same, at 6.9 months.[17] At longer durations of employment we see a modest difference: 25% of the drivers with non-TL Firm #1 experience still remain at 22.6 months, while it is only 16.9 months for the same proportion of new drivers.

Last, consider the retention performance of the two final groups: drivers with some prior experience, or some prior training. Both these groups are identified by the driver recruiting staff at TL Firm #1 as having some background in trucking, but not enough to qualify the student to take only the short training course for fully experienced drivers. To extend the previous allusion, here is a dog barking loudly—these two groups do quite badly, by comparison to students wholly new to trucking. The job tenure lengths for the retention of the 75th, 50th, and 25th percentiles of students with limited driving experience is 1.87 months, 4.94 months, and 12.25 months, respectively. This tells us that only 25% make it to the completion of their one-year-service-after-training employment contract; the other 75% are incurring a multi-thousand dollar debt in order to leave early.[18] Students with only some prior training, but no prior experience, do even worse, with retention periods for the 75th, 50th, and 25th percentiles of only 1.58, 4.18, and 11.33 months. So less than one quarter of these students complete their training contracts. (The difference between these two groups is significant by the Chi-square test, at the 5% level (p-value of .045.[19]))

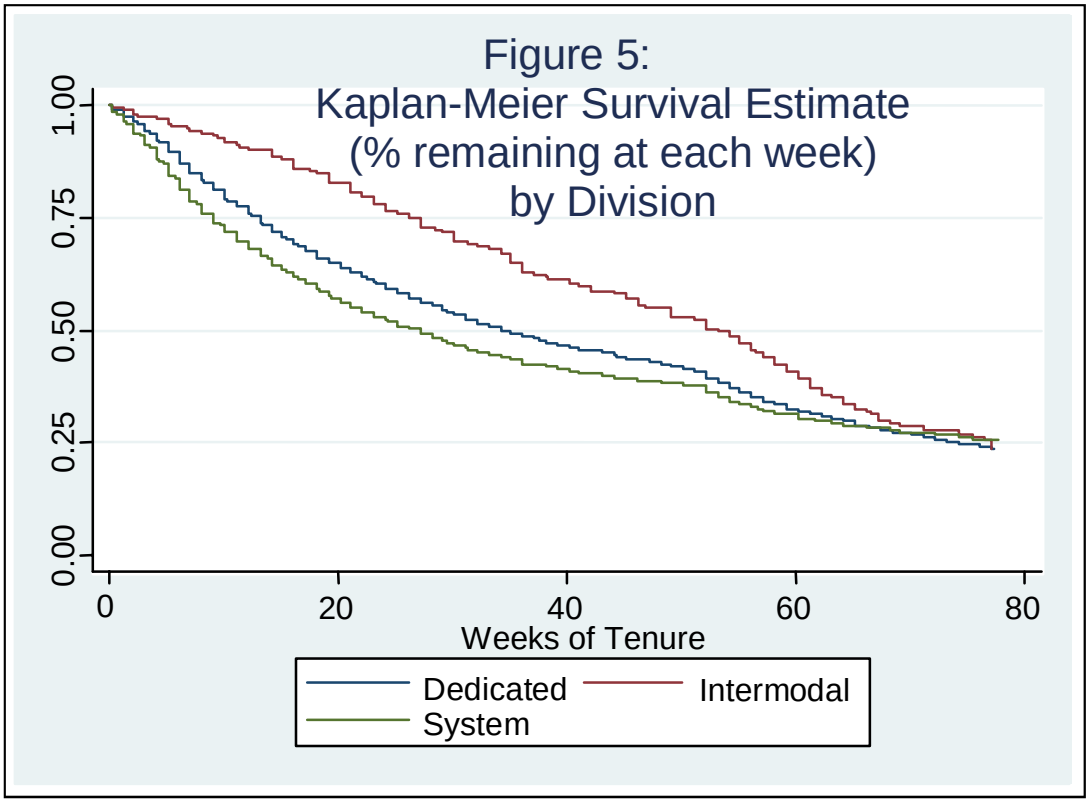
Why should these students be at the bottom of the performance ranking, when normally prior training or experience would be expected to improve retention? A

reasonable hypothesis is that it has to do with the distinctive characteristics of a high-turnover, secondary, labor market. In this type of market there is always demand for drivers at some job or other. So someone with prior experience of any kind, as well as the graduates of any of the many commercial driver training schools, can get some job, as long as they have a CDL. It may not be a very desirable job, but it is possible to accumulate experience if one is willing to put up with some of the poorer working conditions available in an industry segment know for having poor conditions on average. In this context, coming to TL Firm #1 and being willing to assume the debt contract that accompanies the full training program is a bad signal. There may be many specific reasons outside a prospective driver's control that lead to such a decision. For example, the student could have experienced some kind of family event that stopped their prior training before the CDL exam, or caused them to quit a prior job quickly. But on average students with these backgrounds are more likely either to be job switchers who just couldn't do better for the time being, but who will be looking to leave as soon as possible, or to be job candidates who couldn't complete someone else's training course, or were otherwise judged inadequate by other firms. Either of these reasons means the student is more likely to fail.

VII. Results by Type of Work

Drivers who complete training and go to work for TL Firm #1 may be assigned to quite different types of work. The firm has several divisions operating in different part of the truckload market. In the final section of our analysis we focus how the retention performance varies across three different types of operations: drivers who have the

archetypal TL job of running on random dispatches across the 48 U.S. states, drivers whose trucks are dedicated to the service of only one large customer, and drivers whose job is to shuttle trailers and/or containers to and from intermodal junction points at railheads, where the trailers or containers are put on and taken off railroad trains. At the



outset it must be noted that the data problem we noted in Section IV, above, with regard to how we are able to classify drivers in our data by Division, is potentially serious. Recall that we have only the prospective Divisional assignment from the hire-event record for drivers who don't separate from the firm, but have updated information from the separation-event record for those that do. We are of the opinion that this affects the results more strongly the farther from the hire event we look, so we have cut off the survival curves that breakout the population by Division at 78 weeks, and we give little

Table 2: Weeks Of Job Tenure by Type of Work				
	Survival Time in Weeks			
N>5,000	Percent of Drivers	75% Drivers Remaining	50% Drivers Remaining	25% Drivers Remaining
All	100.0%	10.1	28.1	n/a
System	74.4%	9.1	26.1	n/a
Dedicated	24.6%	13.1	34.1	n/a
Intermodal	1.2%	26.1	52.1	n/a

credence to the fact that all the curves converge there. A second problem that adds to our doubts about the right-had end of the curves in Figure 5 is that most of TL Firm #1's intermodal drivers are employees of relatively long tenure, so we don't see many of them being hired in our calendar window—they make up only 1.2% of the drivers in our data.

So what can we glean from Figure 5 and Table 2? We are reasonably confident that the separation of the survival curves during the first year is about right in illustrating the magnitude of the effect on retention of the different working conditions in the three different Divisions. Table 2 shows that these differences are of similar magnitude to those for the differences by type of student, differences about which we are more confident. The predicted retention for intermodal drivers is particularly high, and if sustained with better data would be especially noteworthy.

VIII. Conclusion

The truckload segment of for-hire trucking has a distinctive secondary labor market, characterized by a long standing equilibrium with high turnover and only modest wage premiums as compared to work requiring similar human capital. Firms in the industry appear to have balanced the costs of recruiting and training many employees who leave after very short tenures against the wage costs of high enough premiums to compensate fully for the difficult working conditions, or alternatively, against the

productivity costs of ameliorating those conditions sufficiently to lower turnover. This decision appears to be driven by the low entry barriers to the industry, and the consequent determination of price levels charged to customers by the wages drivers at small and newly entering firms.

In this context the present analysis examines human resource data from a large truckload motor carrier in order to begin statistically characterizing the pattern of the flows of drivers into and out of this segment of the trucking industry. Using survival curves and hazard functions we characterize the time path of retention and exits at the participating carrier. We then examine the differences in these measures for drivers by type of prior training or experience, and by type of work to which they are assigned within the cooperating firm.

We find that for our particular carrier, the type of prior training or experience is associated with retention as follows, from best to worst: (1) rehires, (2) drivers with high prior experience with other firms, (3) new trainees with no trucking background at all, (4) trainees with some prior experience, and (5) trainees with some previous training. The time paths of exit risk are similar across all groups in having an early peak (at between 6 and 8 weeks), but less experienced drivers also have a spike just after a year, when they have completed a contractual obligation that makes their training free and have enough experience to easily switch firms, while rehires show a strong early periodicity in exit risk that is probably linked to the firm's quarterly bonus system. Although there are problems in our data with correctly identifying the type of work drivers are assigned, we also find evidence that drivers doing local and regional intermodal work have the highest

retention, while those on dedicated accounts have an intermediate level, and drivers running all forty-eight states have the lowest.

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Endnotes

[1] In fact, the argument of the second cited work is that the labor market segmentation was itself a significant driver of the parallel industry segmentation.
[2] This was especially at unionized carriers, but was also to some degree at non-union ones.
[3] It is an indication of the institutionalization of the high-turnover secondary labor market equilibrium in TL trucking that the ATA has published its turnover report continuously since 1996.
[4] Correspondingly, the ATA typically reports turnover rates at LTL firms to be in the 10% to 20%, which makes them roughly equivalent in turnover to non-trucking jobs requiring similar amounts of human capital.
[5] Private carriers are firms primarily in non-trucking lines of business who provide trucking services internally as support functions to their primary business operations. Examples might be deliveries of food by a retail grocery chain to its stores in trucks it also owns, or pickups of parts for assembly at an auto plant by the auto manufacturer's freight vehicles.
[6] Heavy freight vehicles are defined here as having a gross vehicle weight (GVW) of more than 26,000 lbs., the level at which weight alone is sufficient to require the driver to hold a commercial driver's license (CDL).
[7] Calculation by the authors; total GDP is from the U.S. Department of Commerce, Bureau of Economic Analysis; URL: http://bea.gov/ .
[8] Essentially, this means adding all specialized freight except household goods moving.
[9] A brand new LTL carrier that wants to serve more than a single metropolitan area must create and operate a network that is of minimum size necessary to attract sufficient traffic from shippers with differing destination demands, relative to the total shipment flow densities in the geographic area it wishes to serve. But such networks exhibit strong economies of scale—at low volumes the average costs are high, but they fall rapidly as volume increases. The expenses of running such a network until a large enough market share is obtained to make the new network cost competitive with those of incumbent carriers are non-recoverable (or "sunk") if the firm exits. And the existence of a sunk cost of entry is the classic definition of an entry barrier.
[10] Since a TL carrier can subcontract actual movements in a spot market to owner-operators, it is possible for a firm to enter TL for-hire carriage initially with zero trucks.
[11] Unlike the case of LTL, since TL firms don't have freight terminal networks, single establishment firms can be of national geographic scope, but in fact 997 of these had more than one establishment, which is still an order of magnitude larger than in LTL.
[12] Not included, on the other hand, are items such as age, gender, level of formal education, or ethnic category.
[13] This does not prevent us from examining rehires, as a significant number of the first spells we observe are of rehired drivers.
[14] The precise number of drivers and observations is suppressed for confidentiality reasons.
[15] The mysterious behavior (in "The Silver Blaze") was that the dog did not bark when someone removed a valuable race horse from the barn, which was a clue to the thief's identity.
[16] The pairwise differences between rehires and new drivers, and between rehires and experienced drivers, are both significant—the Chi-square p-values for Type 1 error are zero to four decimal places.
[17] The base time unit for the statistical analysis is weeks, so months are everywhere calculated as weeks divided by 4.33.
[18] Except for those who are hired by a rival firm that is willing to pay off their indebtedness—something which is known to occur in this labor market.
[19] The pairwise differences between either of these groups and any of those with better retention performance is highly significant—the Chi-square p-values for Type 1 error are zero to four decimal places.