Why Aren't All Truck Drivers Owner-Operators? Asset Ownership and the Employment Relation in Interstate For-Hire Trucking

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Abstract

Transaction cost and agency theorists have frequently cited trucks as prototypical user-owned assets, and have consequently predicted a predominance of self-employed drivers who contract with motor carriers. In fact, owner-operators accounted for less than one-third of trucking activity conducted by large interstate trucking firms in 1991, a proportion that has changed little since deregulation. Given the predictions of organizational economists, why is self-employment in the interstate trucking industry not the dominant organization form?

We propose that transaction costs and agency costs are indeed important in the trucking industry. In the absence of externalities across hauls, contracting between carriers and owner-operators is preferred for traditional agency reasons. However, when the outcome of one haul imposes externalities on other hauls or on the carrier's reputation, an owner-operator will not internalize all costs associated with poor outcomes. Given problems of non-contractibility of maintenance effort, carrier ownership of the vehicle is the preferred organizational form in such a case. We also propose that vehicle idiosyncrasy can create thin market conditions that encourage carrier ownership of vehicles. A study of the organization and operations of 354 trucking firms for 1991 provides evidence consistent with these predictions.

1. Introduction

The employment of drivers by U.S. for-hire trucking companies presents an intriguing puzzle to organizational economists. Transaction cost theorists have frequently cited trucks as prototypical non-specific assets. Williamson (1985: 54), explaining the distinction between fixed assets and specific assets, states that "durable but mobile assets such as general purpose trucks…[are] redeployable," and hence should not be subject to the contracting hazards that specific investments incur. Klein, Crawford and Alchian (1978: 244) contend that, unlike installed printing equipment, trucks are "generally easily movable and not very specific." Given the generic nature of trucks – mobility, simplicity of operation, ease of redeployment and thick resale market – transaction cost reasoning predicts that contracting between motor carriers and owner-operators will be a dominant organization form.

Similarly, agency theorists have frequently cited truck driving as an obvious assignment for an independent contractor. Alchian and Demsetz (1972: 792) contrast the ease of monitoring individual driver performance with the difficulty of monitoring individual performance in the team loading of trucks, concluding that "trucks will be owned by the driver except when the same vehicle is assigned to multiple drivers, as in…public transit buses." Milgrom and Roberts (1992: 249, 311) argue that, given the pairing of relatively easily-measured delivery performance and difficult-to-measure vehicle care, long-haul drivers should own their trucks.

How do these predictions conform to reality? In 1991, among trucking firms with $1 million or more in revenue, owner-operators accounted for less than one-third of trucks and less than 30% of miles driven, with carriers and employee drivers accounting for the rest (American Trucking Association, 1991). These proportions have generally remained steady since deregulation in 1980 (Corsi and Grimm 1989; Wittekind 1996). The level of self-employment among truck drivers indeed appears higher than that of most other occupations (Bregger 1996). But given the predictions of organizational economists, why is it not the dominant organizational form?

In this paper we explore the discrepancy between theory and practice in interstate trucking. Our analysis indicates that transaction costs and agency costs are indeed important in the trucking industry. Drawing upon the incomplete contracting literature, we highlight the tradeoffs a carrier makes in its choice between owner-operators and company drivers. Asset ownership provides an incentive to an owner-operator to expend more effort and resources in vehicle maintenance and careful driving than would a company driver. In the absence of externalities, a carrier would therefore prefer to contract with an owner-operator than to hire a driver to operate a company-owned truck. However, when the outcome of one haul imposes externalities on the rest of a carrier's system, an owner-operator will not internalize the total cost to the carrier of a breakdown of his truck. In the presence of externalities, then, a carrier will prefer to own and maintain a vehicle, operated by a company driver, rather than to contract with an owner-operator.

We identify two such externalities, one related to the coordination needs of less-than-truckload logistics and one to investments in carrier reputation. In addition, we find that not all vehicles are general-purpose assets, and that vehicle idiosyncrasy can create thin market conditions that invite a carrier to employ company drivers in company-owned vehicles. Our empirical analysis of the vehicle ownership and employment choices of 354 carriers in 1991 yields evidence consistent with the argument that agency and transaction costs matter in trucking, and that carriers' employment mode choices are at least partly driven by the desire to reduce these costs.

In the spirit of studies of governance by Pirrong (1993), Sherer, Rogovsky and Wright (1998), and Hubbard (1999), this study motivates theoretically and demonstrates empirically that transaction cost and agency cost logic inform the choice of organizational form even in an industry traditionally considered to be free of transaction cost concerns.

2. Employment Practices and Predictions

This section draws on our analysis of motor carrier employment contracts and interviews with motor carrier personnel. We conducted semi-structured interviews with executives and dispatchers at twelve interstate for-hire motor carriers around the U.S., one truck dealership, and one transportation consulting firm to identify both the features of driver employment and the factors on which the employment relation decision may depend. These interviews typically lasted 45-75 minutes. In addition, we interviewed briefly several truck drivers at highway truck stops. This section also draws on Burks (1998), Hubbard (2000), and Wittekind (1996).

There are two common driver employment modes in interstate for-hire trucking: company drivers and owner-operators. Company drivers are hired under open-ended employment contracts to drive vehicles provided and maintained by the carrier, using fuel for which the carrier pays. A carrier usually assigns a driver to the same truck for an extended period of time.[1] Company driver compensation can take a variety of forms, but interstate drivers are typically paid per-mile rates and may receive some benefits (Burks 1998).

Owner-operators own and maintain their vehicles, pay for their fuel, and contract with carriers. Relationships range from single-haul transactions ("trip leases") to long-term contracts, with the usual arrangement resembling repeated short-term contracts (Burks 1998). Contracts typically can be terminated by either party at will, except mid-haul. Owner-operators are paid either per mile or per haul (for which the driver receives a fixed percentage of the haul revenue).[2] Taking into account capital, maintenance, and fuel costs, owner-operators typically cost motor carriers less per mile than company drivers (Corsi and Grimm 1987; Belzer 1995).[3]

The employment mode choice facing a motor carrier parallels in many ways the organization form choice facing a franchiser. Much as a franchiser serves a coordinating function for its outlets, a carrier coordinates the activities of its drivers. Both franchisers and carriers deal with a large number of small, geographically dispersed operators. In both settings, spillovers from the actions of one outlet (driver) on the overall value of the franchiser (carrier) system are a concern. Finally, since successful delivery requires effort from both the driver and the carrier (Corts

[1] This was universally reported by interviewees.
[2] John Seaberg, Owner Operators Independent Driver Association (personal communication).
[3] This raises concerns about driver heterogeneity: Are company drivers inherently "better" than owner-operators? Although no systematic empirical research exists on this issue, in his research Richard Beilock has collected information on age, education, gender, and employment mode of truck drivers. Professor Beilock shared with us information from a 1991 survey of drivers at Florida weigh stations (Beilock 1995). Difference of means tests show no significant difference between company drivers and owner-operators in education, age, or gender.

2000), trucking may involve two-sided moral hazard problems of the type suggested by Rubin (1978) and analyzed by Lafontaine (1992) and Lutz (1995).

The existing literature suggests that in the absence of specific investments, the choice between employee and independent contractor turns on the incentives associated with asset ownership (Grossman and Hart 1986; Lafontaine and Slade 1997) and on externalities and specific investments attendant to the exchange (Williamson 1985). Specifically, asset ownership provides an actor with incentives to expend effort to utilize that asset efficiently (Brickley and Dark 1987). In trucking, carriers cannot monitor driver actions. In particular, they cannot monitor how carefully drivers operate their vehicles (Hubbard 2000). This is problematic because truck deliveries are disrupted by breakdowns, which occur stochastically but are inversely related to how well trucks are maintained and how carefully they are operated. For an individual haul, then, a carrier can ameliorate the monitoring problem by contracting with an owner-operator, who (by virtue of ownership) will care for his vehicle more than will an employee driving a company-owned truck.

However, when the investments by one asset owner impose externalities on others in a system, the investment incentives of the asset owner diverge from that of others (Hart and Moore 1990). In trucking, when the success or failure of one haul imposes externalities on the rest of a carrier's operations, the owner-operator may not maintain his truck at the carrier's desired level. Though ownership gives the owner-operator incentives to maintain the truck well generally, under the externality argument the owner-operator's optimal decision does not internalize all of the costs associated with breakdowns. The higher the level of externalities, the more likely an owner-operator's choice of maintenance level will fall below the level that the carrier finds optimal. Consequently, the higher the level of externalities the more likely it is that the carrier will choose to acquire and maintain its own vehicles, and to hire employees to operate them, rather than contract with owner-operators. Externalities in trucking are likely to be most prevalent for less-than-truckload (LTL) carriage and where investments in reputation are large. Also, idiosyncratic investments in trucking are likely to arise when the spot market for certain vehicle configurations is relatively thin, which favors carrier ownership of vehicles. These issues are described below.

2.1. Externalities in motor carriage

LTL trucking and coordination externalities: In contrast to truckload (TL) carriage, where full truckloads of freight go directly from origin point to destination point, less-than-truckload (LTL) freight consolidates and carries multiple shipments to multiple destinations, typically through a hub-and-spoke system. Whereas TL carriage requires virtually no coordination across hauls, LTL carriage requires the timely coordination of truck arrivals and departures at "breakbulk" facilities, large warehouses in which freight is rapidly unloaded, sorted, and reloaded. One late arrival at a breakbulk facility can cause a costly ripple effect throughout an entire LTL network. Thus, a tardy driver imposes externalities on deliveries throughout a carrier's system.

Investment in reputation: Some carriers invest in a reputation for quality service in the expectation of reaping a price premium in return. Interviewees explained that "quality" in trucking pertains to on-time delivery, low freight damage, and a high level of driver professionalism when dealing with the customer to whom freight is delivered. Poor performance by a driver can tarnish a carrier's reputation, imposing costs well beyond those borne directly by the driver.

These externalities raise an important question: why can't a carrier contract on driver performance? In turn, if a contract is not feasible, why can't the carrier just maintain the owner-operator's vehicle?

Although driver on-time outcomes can be monitored fairly easily, driving includes a stochastic element (e.g., traffic; construction) that may make it difficult to contract on outcomes (Baker and Hubbard 2000). More importantly, as Corts (2000) argues, since carrier effort is a necessary input to motor carriage, a contract that imposes "tardiness" penalties sufficiently high to affect driver behavior will also adversely affect carriers' incentives. Finally, it is costly for a carrier to observe truck maintenance and driver professionalism, and to verify the source of any freight damage, which could be incurred during packing, loading, transit, unloading or unpacking. Freight damage verifiability problems are particularly exacerbated when freight goes through many hands, as in LTL carriage.

As for carrier maintenance, a carrier could maintain an owner-operator's vehicle to insure a high level of reliability. However, since the owner-operator is the residual claimant to the vehicle, he can exit the exchange before a carrier has recovered its maintenance investment. This problem is exacerbated by adverse selection because those owner-operators most in need of maintenance will seek out carrier maintenance. Since the carrier is not guaranteed the future returns on its maintenance investment, its incentive to maintain the vehicle is attenuated (Lutz 1995). Alternatively, a carrier could maintain the owner-operator's vehicle and require the owner-operator to pay for the required maintenance, but such an arrangement provides the carrier with incentives to pad the maintenance bill, and thus is likely to be resisted by the owner-operator.

2.2. Idiosyncratic drive-train configurations and temporal specificity

The fuel efficiency of a tractor is highly dependent on the match between characteristics of the haul (e.g., city vs. highway driving; heavy freight vs. light freight) and the tractor's drive-train configuration.[4] Our interviewees reported that a tractor configured inappropriately for a haul could experience fuel efficiency of fewer than 4 miles per gallon, as compared to 7-10 miles per gallon for an optimal configuration – a severe penalty, given that fuel costs comprise nearly one-fourth of total trucking operating costs (*Fleet Equipment*, 1998). However, some drive-trains are not widely available on the spot market. When the spot market for a particular drive-train is thin, temporal specificities (and the associated hazards of hold-up) arise.[5] As in the case of ocean

[4] A drive-train configuration consists of an engine, transmission, drive-shaft, and rear axle. Most engine producers make two or three different engine blocks, each of which has two dozen configurations that produce different speed, horsepower, and torque characteristics. For instance, in 1996, Caterpillar and Cummins each supplied a total of 45 different engine configurations. Each engine configuration can be connected to approximately 16 different transmission and drive-shaft combinations. For each engine, transmission, and drive-shaft combination, between 4 and 6 rear axles are available, each of which can have up to 20 different gear ratios. While for technical reasons all 72,000 configurations in this illustration are not feasible, several truck dealerships indicated that the number of feasible choices exceeds one thousand, which indicates that a large number of alternative configurations with a wide variety of fuel consumption and performance characteristics is available.

[5] Hubbard (1999) finds that thin markets for certain types of truck trailers, such as those used to transport forest products, lead to trailer ownership by shippers rather than carriers. However, regardless of the specificity of the

shipping (Pirrong 1993), such temporal specificities encourage carriers to own vehicles and hire company drivers when tractors are less redeployable, and encourage owner-operators to acquire tractors that offer broad redeployability.

The above discussion leads to three predictions:

Prediction 1: A carrier is more likely to employ company drivers, as opposed to owner-operators, the more it conducts LTL service.

Prediction 2: A carrier is more likely to employ company drivers, as opposed to owner-operators, the greater its investment in reputation.

Prediction 3: A carrier is more likely to employ company drivers, as opposed to owner-operators, the more it carries freight that requires non-standard tractor configurations.

3. Data and Results

Our empirical analysis is based on a database compiled by the Interstate Commerce Commission (ICC). Until it was "sunsetted" in 1995, the ICC required all certified motor carriers with annual revenue exceeding a threshold – $1 million during the years 1980 to 1995 – to file an annual report known as a Form M. The Form M provides a detailed income statement, balance sheet, description of hauling activities and other operating characteristics. We use these data for the year 1991 to create our dependent and independent variables. We chose 1991 because it is the only year in which 1) the data are considered accurate by industry experts, and 2) the data required to construct one of our independent variables (advertising expenditures) and one of our dependent variables (the portion of trucks owned by the carrier) are widely available for carriers. After 1991, motor carriers increasingly resisted submitting Form Ms on the grounds that the requirement to do so was inconsistent with the spirit of regulatory reform. Prior to 1991, a smaller subset of carriers was required to report their advertising expenditures, thus limiting the number of usable observations. Also, carriers were not required to report the composition of their truck fleet – company-owned vs. owner-operator-provided vehicles – until 1988. Nevertheless,

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trailer, owner-operators typically own only the tractor – the front section of a truck that includes the engine – and hitch it to a trailer to undertake a given haul. Hence, while trailer idiosyncrasy may affect trailer ownership, it need not affect the driver mode choice.

below we refer to unreported estimations from other years when discussing the robustness of our results.

Reliance on Form M data imposes two broad limitations. First, the Form M provides information on a carrier's aggregate annual hauls, rather than recording characteristics of each individual haul. To the extent that a carrier engages in hauls with widely varying characteristics, this limitation may obscure underlying relationships. Our coefficients are more likely to be insignificant due to the resulting noise in the data. Second, these data do not permit us to analyze motor carriers with revenue consistently less than $1 million, which limits the generalizability of our results.

The ICC data for 1991 provides relevant information on 1,485 carriers. Of these, 414 are Instruction 27 carriers, defined as those carriers that derive at least 75% of hauling their revenue from general freight. These carriers are subject to the most rigorous reporting requirements by the ICC. Other interstate carriers are not required to provide information on advertising expenditures.

We undertook several reliability checks to identify and omit observations with likely coding errors. First, we dropped observations if any variable had an infeasible value (which, if identifiable, are discussed below by variable). Second, we constructed a ratio for revenue per mile and dropped observations with unreasonably high values (in excess of $15/mi).[6] Third, we compared 1991 data to 1990 data and omitted any observations in which our variables increased by a factor of three or decreased to one third their prior level (variation in these assumed cutoffs did not affect our results). Finally, we inspected all observations to see if inconsistencies, such as high revenue but few hauls, existed among data. These reliability checks reduced our sample to 354 observations.

[PLACE TABLE 1 ABOUT HERE]

[6] $15/mile is a reasonable maximum rate for a particular unusual haul, but may be unreasonably high for a carrier's annual average rate. A more common range of rates for over the road hauling is around $1.00/mile to $1.50/mile. Thus, we also re-ran our empirical analysis after restricting our sample to those firms with below $5 (which excluded twenty additional firms), and below $2 (which excluded 112 more firms). Results from these more restrictive samples are consistent with the results presented herein.

Table 1 summarizes our variables and, where applicable, their predicted signs. We employed two alternative dependent variables. One dependent variable, COMPANY TRUCKS, was calculated as the proportion of a carrier's trucks and tractors that were company-owned as of the first day of business in 1991. This measure is a continuous variable, bounded at 0 and 1. We also constructed an alternate dependent variable, COMPANY DRIVER MILES, which is calculated as the proportion of a carrier's miles driven by company drivers in 1991. This measure is also a continuous variable, bounded at 0 and 1.

Each alternative has advantages and disadvantages. COMPANY TRUCKS is useful because the fraction of company vehicles should be correlated with the fraction of hauls driven by company drivers. However, because it is a "snapshot" of a carrier's fleet on a particular day, this measure may be problematic because fleet composition may vary with seasonal business cycles during the year, and this cyclicality may differ by the type of freight in which a carrier specializes. For instance, the peak season for general freight is in the fall, whereas the peak season for agriculture products occurs several times through the year. Such differences may exist for other freight categories as well. Thus, carriers may be at different points in their respective business cycles when truck ownership is reported. As a cumulative measure of a carrier's activity for the entire year, COMPANY DRIVER MILES is less vulnerable to the problems associated with a snapshot measure. Yet, while COMPANY DRIVER MILES is consistent with prior transportation research (e.g., Corsi and Grimm 1987), it may be problematic because it is an aggregation in the number of miles rather than the number of hauls, which, conceptually, is our unit of analysis. Unfortunately, the data does not contain information on average miles by driver type. Thus, if average miles for company drivers compared to owner-operators varies systematically, results of estimations regressing COMPANY DRIVER MILES on average haul characteristics will be biased.

LTL SHARE is the proportion of a carrier's total revenue that comes from intercity LTL carriage. It is a continuous variable bounded at 0 and 1. Prediction 1 states that carriers are more likely to use company drivers the more they perform LTL carriage due to the greater demands of inter-haul coordination and the greater difficulty of specifying and verifying damages. Therefore we expect the coefficient for LTL SHARE to be positive.

ADVERTISING is the advertising expenditure of a carrier divided by revenue times 100. The Code of Federal Regulations (49 CFR § 1207.1) defines this expenditure as advertising, publishing of tariffs and schedules, and related office supplies "for the purposes of securing traffic." Thus, any advertising aimed at recruiting employee drivers is excluded from this measure. Following common practice (e.g., Balakrishnan and Fox 1993), we rely on advertising expenditures to proxy for reputational capital. Prediction 2 states that increased investment in reputation will lead a carrier to rely more heavily on company drivers, to reduce the hazard of tarnishing the investment. We therefore expect the coefficient for ADVERTISING to be positive.

Prediction 3 states that carriers are more likely to use company drivers the more they carry freight that requires non-standard vehicle configurations for efficient transport. Parameterizing vehicle redeployability is technically complex, but interviewees generally used two dimensions to do so: haul length and freight weight. In crude terms, drive-trains configured for "typical" haul length and freight weight are highly redeployable, in that they can efficiently haul freight even when the freight deviates somewhat from the typical haul. Interviewees suggested that drive-trains configured for short hauls or for light loads offer operating cost advantages over typical configurations when appropriately matched with freight but suffer severe cost penalties if used to transport heavy freight or to transport cargo over long distances. For example, shorter hauls are likely to correspond to proportionately more city traffic. Such hauls can be more efficiently served by vehicles configured more appropriately for city driving than a typical vehicle. These vehicles are also less likely to have "sleeper" cabs, which both add weight, thereby reducing vehicle fuel efficiency, and also make vehicles less maneuverable in city driving conditions. Drive-trains configured for unusually long haul or heavy loads are similarly non-standard.

To test this hypothesis, we construct a set of variables measuring the difference between the characteristics of a carrier's average haul and the typical or most common hauls. Specifically, we define HAUL LENGTH as the average haul length in hundreds of miles for a given carrier.

We construct measures of unusual haul length by assuming that the median HAUL LENGTH in our sample corresponds to a relatively thick vehicle market. Thus, the distance from this median represents unusual hauls—the greater the difference, the more unusual the characteristic. SHORT HAUL is the absolute difference between the carrier's HAUL LENGTH and the median HAUL LENGTH for the sample (median = 1.815) if the former is less than the latter and zero otherwise. Conversely, LONG HAUL is the absolute difference between the carrier's average haul length and the median average haul length for the sample if the former is greater than the latter and zero otherwise. In subsequent runs, we calculate the distance between the carrier's HAUL LENGTH and the mean and modal HAUL LENGTHs as alternate measures of "atypical" hauls. We predict coefficients for SHORT HAUL and LONG HAUL to be positive.

Analogous to the construction of the short and long haul variables, we construct variables HAUL WEIGHT, LIGHT WEIGHT, and HEAVY WEIGHT. HAUL WEIGHT is measured as the average weight in tons of a haul for a given carrier. LIGHT WEIGHT is the absolute difference between the carrier's haul weight and the median haul weight for the sample (median = 12.843) if the former is less than the latter. HEAVY WEIGHT is the absolute difference between the carrier's haul weight and the median haul weight for the sample if the former is greater than the latter. In subsequent runs we also calculate the distance between the carrier's HAUL WEIGHT and the mean and modal HAUL WEIGHTs. We predict the coefficients for LIGHT WEIGHT and HEAVY WEIGHT to be positive.

Several control variables also are included in our analysis. Given that our theoretical unit of analysis is the haul, we include HAULS, the total number of hauls for a given carrier, divided by 100,000, as a measure of firm size.[7] Unionization is widely considered to affect employment mode decisions. For decades, a large number of drivers in the trucking industry were members of the powerful Teamsters union, although the union's power fell dramatically after deregulation (Rose 1987; Perry 1986). "Union shop" carriers typically have much less latitude to outsource

[7] We use total hauls rather than total revenue or total miles because the former may be correlated with our controls (described below) for different types of freight and the latter is used as the denominator for COMPANY DRIVER MILES, which may lead to correlation (in models that we do not report, we found that using total revenue or total miles in place of total hauls yield equivalent results).

activities. To control for this, we include UNION, a categorical variable set to 1 for carriers that contribute to a union pension fund and set to 0 otherwise.

Finally, we include categorical variables to control for effects associated with regional differences and different types of secondary freight. The availability of owner-operators at a given time may be a function of macroeconomic conditions. If different regions of the U.S. were subject to different economic conditions in 1991, then our results could be distorted. Alternatively, firms operating in different regions may have haul characteristics determined by the distance between major population areas in those regions or by variation in terrain such as along the West coast or in the Rocky Mountains. Inclusion of regional variables attempts to control for these possibilities. It is also possible that vehicle ownership choice varies by type of freight carried in ways not captured by our explanatory variables. Even though at least 75% of Instruction 27 carrier hauling revenue is derived from general freight, carriers may carry other secondary types of freight in deriving the remaining 25% of revenue. We include freight variables that indicate the largest type of secondary freight (for the residual 25% carrier hauling revenue) to control for such effects. We rely on the ICC's categorization of regions and secondary freight categories to construct these variables.

[INSERT TABLE 2 ABOUT HERE]

Table 2 reports descriptive statistics for our sample. In addition to the variables used in our estimations, we report carrier REVENUE, HAUL LENGTH, and HAUL WEIGHT in the descriptive statistics. Difference of means tests indicate that the 354 carriers in the sample are larger and derive a greater share of their revenue from LTL carriage than the larger 1485-carrier sample. Approximately 5% of the carriers in this sample relied solely on deploying vehicles owned by others: 60% of the carriers relied solely on company-owned vehicles; and the remainder, approximately 35%, employed some mixture of both company trucks and outsourced vehicles. For COMPANY DRIVER MILES, the percentages are approximately 7%, 44%, and 49%, respectively.

Several patterns can be observed from these descriptive statistics. Table 2 displays the high degree of reliance on COMPANY TRUCKS and COMPANY DRIVER MILES among these firms. More than 80% of trucks are company owned, and company drivers drive more than three-quarters of all haul miles. On average, about one third of revenue is from LTL carriage, and advertising expenditures, about 1.87% of revenue, are relatively low in this industry. Haul length and weight vary substantially, with a sample average length of 336 miles and a sample average weight of 12.8 tons. The average carrier engaged in 242,000 hauls during 1991. The high level of unionization in this industry is apparent—over 60 percent of the sample firms have at least some unionized employees.

Table 3 reports descriptive statistics for three subsamples consisting of companies that used outsourced trucks only, a mix of outsourced trucks and company trucks, and company trucks only. The table indicates that carriers relying exclusively on company trucks have the highest share of LTL shipments, the highest advertising expenditures, the shortest haul length, and the lowest haul weight compared to carriers relying only on outsourced vehicles or a mixture of both. Carriers relying exclusively on outsourced vehicles have the lowest share of LTL shipments, the lowest advertising expenditures, the longest hauls, the greatest haul weight, the greatest number of annual hauls, and are least unionized compared to the other sub-samples. Carriers relying on a mix of outsourced trucks and company owned trucks generally fall in between the other categories except for the annual number of hauls and annual revenue, which are the smallest compared to the other categories. Table 4 reports Pearson correlations for the entire sample. Two correlations are large: LTL SHARE and SHORT HAUL (0.893), and LTL SHARE and LIGHT WEIGHT (0.571). Such levels of multicollinearity among explanatory variables can result in less precise parameter estimates (*i.e.* larger standard errors) for correlated variables but will not bias parameter estimates (Kennedy 1992).

[PLACE TABLES 3 and 4 ABOUT HERE]

Empirical Methodology and Results

To test our predictions we estimated the following model:

$$\text{COMPANY TRUCKS} = \beta_0 + \beta_1 * \text{LTL SHARE} + \beta_2 * \text{ADVERTISING}$$

$+ \beta_3$*SHORT HAUL + β_4*LONG HAUL + β_5*LIGHT WEIGHT + β_6*HEAVY WEIGHT

$+ \beta_7$* HAULS + β_8*UNION + β_i*FREIGHT$_i$ + β_j*REGION$_j$ + ε.

The estimation of β coefficients is complicated by the fact that the dependent variable has a large number of observations censored at 0 (17 observations) and 1 (212 observations) (Maddala 1983: 150). We use a two-sided Tobit model to correct for censoring and assess the statistical significance of our estimated coefficients using a two-tailed test. We replicated all models using OLS, producing coefficients with signs and levels of statistical significance almost identical to those reported in this paper. Although OLS is an inappropriate estimation approach, it provides a check on the robustness of the Tobit results.[8]

[PLACE TABLES 5 & 6 ABOUT HERE]

Table 5 presents two-sided Tobit estimation results for our two different dependent variables—COMPANY TRUCKS and COMPANY DRIVER MILES—and for three different parameterizations of typical haul characteristics. Models 1A and 1B are based on haul characteristics measured as deviations from the median haul length and weight; Models 2A and 2B are based on haul characteristics measured from the modal haul length and weight; and Models 3A and 3B are based on haul characteristics measured from the mean haul length and weight. Model 1A is our primary result. The other models indicate that our results are robust to alternate ways of measuring "typical" haul characteristics.

Coefficients from Tobit estimations are difficult to interpret because coefficients are in terms of an index function.[9] To address this, Table 6 presents the marginal effects of our

[8] An alternative approach would be to use a grouped-data logistic analysis since our dependent variable is based on grouped data. We do not employ grouped-data logistic analysis because a large number of our observations (i.e., the 65% of observations where COMPANY TRUCKS equals 0 or 1) lead to an undefined log of the odds ratio. Hence, a grouped-data logistic analysis can be used to estimate coefficients only for the 125 grouped observations with a mix of outsourced and company trucks. Nonetheless, we ran an analysis for the 125 observations and compared the coefficient estimates to a Tobit analysis of the same subsample, which essentially equates to an OLS. We find that our primary results remain intact and that coefficient estimates are qualitatively consistent with two exceptions. First, the coefficient for the number of hauls (HAULS) is positive and significant for the grouped-data logistic analysis and insignificant for the Tobit analysis. Second, the coefficient for HEAVY is insignificant for the grouped-data logistic analysis and positive and significant for the Tobit analysis.

[9] The two sided Tobit model with censoring at 0 and 1 is usually given in terms of an index function such that: $y_i^* = \boldsymbol{\beta}'\mathbf{x}_i + \varepsilon_i$, $y_i = 0$ if $y_i^* \leq 0$, $y_i = 1$ if $y_i^* \geq 1$, and $y_i = y_i^*$ if $0 < y_i^* < 1$. Tobit coefficient estimates are for an index variable and thus represent the marginal effects for the index variable. Greene (1997, 963) indicates that for such a

explanatory variables on COMPANY TRUCKS and COMPANY DRIVER MILES that correspond to Models 1A and 1B in Table 5. We report the marginal effect of each explanatory variable at its minimum, at its mean, at one standard deviation above the mean, and at its maximum while holding all other continuous variables at their mean and holding binary variables at zero. Finally, since the economic significance of these marginal effects also depends on the magnitude of change in the independent variables, in the text below we provide the estimated change in COMPANY TRUCKS associated with a change in each explanatory variable from its mean to one standard deviation above its mean, holding all else constant.

Model 1A produces a Pseudo $R^2 = 0.299$. The coefficient for LTL SHARE is positive and significant ($p<0.01$). This is consistent with Prediction 1: the more a carrier's business is composed of LTL trucking, the more the carrier relies on company trucks. As an indication of the magnitude of this relationship, we note that an increase in LTL SHARE from its mean to one standard deviation above its mean is associated with a 0.226 increase in COMPANY TRUCKS. As Table 6 shows, the marginal effect of LTL SHARE, at its mean, on COMPANY TRUCKS is 0.140. This marginal effect is positive and significant over the entire range of observed values of LTL SHARE, ranging from 0.161 at LTL = 0 to 0.095 at LTL = 1.

The coefficient for ADVERTISING is positive and significant ($p<0.01$). This is consistent with Prediction 2: the more a carrier invests in reputation, the more it relies on ownership. An increase in ADVERTISING from its mean to one standard deviation above its mean is associated with a 0.343 increase in COMPANY TRUCKS. Similar to LTL, the marginal effect of ADVERTISING is positive and significant, over the entire observable range of ADVERTISING.

The coefficients and the marginal effects for SHORT HAUL and LONG HAUL are insignificant, which causes us to reject Prediction 3 with respect to haul distance. In contrast, the coefficients and marginal effects for LIGHT WEIGHT and HEAVY WEIGHT are positive and significant ($p<0.01$ and $p<0.05$, respectively). An increase in LIGHT WEIGHT from its mean to

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model, the marginal effects for y_i are given by: $\partial E[y_i|\mathbf{x}_i]/\partial \mathbf{x}_i = \boldsymbol{\beta} \times \text{Prob}(0 \leq y_i^* \leq 1)$. We calculated the marginal effects through STATA's mfx command, which calculates dy/dx at the desired values of the independent variables.

one standard deviation above its mean is associated with a 0.155 increase in COMPANY TRUCKS, while a similar increase in HEAVY WEIGHT yields a 0.089 increase in COMPANY TRUCKS. These results are consistent with Prediction 3: the more a carrier's hauls require idiosyncratic vehicles, at least with respect to haul weight, the more it relies on company vehicles.

Turning to the control variables, the coefficient for HAULS is not significant. Truck ownership is apparently unaffected by carrier size as measured by the number of hauls in 1991. In estimations that we do not report here, other measures of carrier size – namely revenue and total miles driven – also generated coefficients that were insignificant. The coefficient for UNION is weakly significant ($p<0.10$) and positive. In runs not reported here, we replaced UNION with a continuous variable calculated as a carrier's contribution to a union pension fund divided by its total revenue. All coefficient estimates were essentially unaffected by the choice of unionization measure except that our alternate union measure is positive and highly significant. We also estimated our model without freight variables. Omission of these variables did not significantly affect the coefficients of the explanatory variables. A likelihood ratio test indicates that the presence of the freight variables does not significantly improve the explanatory power of our model ($\chi^2(6) = 6.09$). We similarly estimated our model without region variables. Omission of these variables did not significantly affect the coefficients of the explanatory variables. A likelihood ratio test indicates that inclusion of the regional variables significantly improves the explanatory power of the model ($\chi^2(8) = 15.66$; $p<0.05$).

Model 2A reports coefficient estimates when the haul length and haul weight variables are calculated based on deviations from the sample mode for haul length (mode = 0.5, or 50 miles, based on 38 bins of 50 miles each, with approximately 31% of the carriers at the mode) and the sample mode for haul weight (mode = 14 tons, based on 36 bins of one ton each, with approximately 7% of the carriers at the mode) for constructing our unusual haul characteristic variables. Model 3A reports coefficient estimates when the haul length and haul weight variables are calculated based on deviations from the sample mean of haul length and haul weight (3.363 and 12.839, respectively) for constructing our unusual haul characteristic variables. Our empirical results do not substantially change when we re-estimate our models using these alternative variable definitions, which indicate that our findings regarding unusual haul characteristics are robust to these variations.

Models 1B, 2B, and 3B report results substituting COMPANY DRIVER MILES for COMPANY TRUCKS as the dependent variable. All three specifications, and the marginal effects associated with Model 1B (which are reported in Table 6), yield nearly identical results to our prior estimations except in three instances. First, the coefficients estimates for HEAVY WEIGHT are smaller and only weakly significant in Models 1B and 3B compared to Models 1A and 3A. Second, in Model 2B the coefficient for SHORT HAUL is significant and the coefficient for LTL SHARE is smaller than in other models. Third, the coefficient estimates for UNION are not significant in Models 1B, 2B, and 3B. In runs not reported here, we again replaced UNION with a continuous variable calculated as a carrier's contribution to a union pension fund divided by its total revenue. Coefficient estimates in all three models were essentially unaffected by choice of unionization measure except that our alternate union measure is positive and highly significant and the coefficient for LONG HAUL is weakly significant. These minor differences notwithstanding, our estimates using either COMPANY TRUCKS or COMPANY DRIVER MILES provide support for our predictions based on data from 1991.[10]

Alternative Explanations

Finally, we re-estimated the model including several measures of seasonal and cyclical variation to control for the possibility that outsourcing offers a way for a firm to reduce adjustment costs associated with changes in demand for motor carriage (Wittekind 1996). To test

[10] Although 1991 offers the most attractive annual data for our estimation, we attempted to replicate our analysis using data from 1985 and 1988 to provide a check on the robustness of our results. Due to less stringent reporting requirements, only the data for 1988 contain enough information to re-estimate the model, and only 85 of the carriers in that year reported advertising data. We found positive and significant coefficients for LTL SHARE and ADVERTISING. All other coefficients for the 85-carrier sample were insignificant. To increase the sample, we omitted ADVERTISING and re-estimated the resulting model, which yielded 640 observations. Coefficients for LTL SHARE, SHORT HAUL, LIGHT HAUL, and UNION were positive and significant and all other coefficients were insignificant. Although SHORT HAUL was significant and HEAVY HAUL was not significant, which differs from our Model 1A results, we believe that these results indicate that our primary findings are not an artifact of data from 1991. LTL SHARE, ADVERTISING and unusual haul characteristics influence ownership in predicted ways.

for business cycle effects, we collected data on the annual revenue of carriers in our sample for each year between 1988 and 1991, and calculated average annual revenue growth rate (3YR GROWTH) and the variance of annual revenue growth rates over this period (3YR VAR). We also collected data on gross state products (GSP) over the same time frame and calculated the average change in GSP (AVE GSP) and variance of change in annual GSP (VAR GSP).[11] All measures of variance are around the trend. Model 4 in Table 5 provides a new baseline by re-estimating Model 1A for the 227 carriers for which we have three continuous years of historical data. The results in Model 4 are broadly similar to those of Model 1A but with several notable exceptions. The coefficient for LTL SHARE is not significant. Also, the coefficient for SHORT HAUL is weakly significant. The coefficient for HEAVY WEIGHT is not significant, but the coefficient for LIGHT WEIGHT is significant. The difference in results for LTL SHARE and SHORT HAUL may be due to the higher level of correlation (0.91) between these two variables in the 227-observation sample. Model 5 adds 3YR GROWTH, 3YR VAR, AVE GSP, and VAR GSP. The coefficient magnitudes and levels of statistical significance remain unchanged in comparison to Model 4, and none of the added variables is significant. These results suggest that recent growth in demand and business cycles do not appear to explain the choice between owner-operators and company drivers.

To test for seasonal variation effects, we collected data on quarter-by-quarter revenue for 1991. We then calculated the variance of quarterly revenue for each firm to proxy for seasonal variation in demand. Unfortunately, many firms are late in submitting their quarterly reports, and the published quarterly data only includes those firms who have responded on time. As a result, we have data on all four quarters of 1991 for only 63 of our 354 firms.[12] We also included

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[11] 3YR VAR had a mean of 0.016 and standard deviation of 0.049. 3YR GROWTH had a mean of 0.044 and standard deviation of 0.104. AVE GSP had a mean of 0.065 and a standard deviation of 0.013, and VAR GSP had a mean of 0.019 and a standard deviation of 0.101. Because some of our firms did not exist in the sample in 1988 and because of missing observations, we have data for 3YR VAR and 3YR GROWTH for 227 of our 354 carriers. A comparison of summary statistics indicates the 227-obersvation subsample is not substantially different from the 354-observation sample. A comparison of correlation coefficients indicates broad similarity except for one notable exception: the correlation between LTL SHARE and SHORT HAUL is higher (0.910) in the 227-observation subsample.

[12] We must interpret with care our analysis of the 63-observation subsample because the summary statistics indicates that these carriers are primarily engaged in LTL carriage. For instance, compared to the 354-observation sample, the

change in GSP for 1991 to account for variations that might be correlated with the local level of economic activity. Again, we found no support for the proposition that outsourcing vehicles through the use of owner-operators offers a way for a carrier to reduce adjustment costs associated with seasonal variation in demand for motor carriage; however, we recognize that this subsample is small and not representative.

4. Conclusion

This paper was motivated by a puzzle: given prior theoretical expectations, why do we see such a high reliance on company drivers and company trucks in the for-hire interstate trucking business? Drawing on the incomplete contracting literature, we proposed three types of contingencies driving the choice of company drivers: the degree of coordination across hauls, the degree of investment in reputation, and the use of idiosyncratic vehicles. We tested these predictions in an empirical study of vehicle ownership and driver employment in the U.S. for-hire interstate trucking industry.

To be sure, the empirical analysis conducted above suffers from several constraints. Limited proxies were available to investigate the effect of investments in reputation and for coordination needs. Moreover, the aggregate nature of the data may obscure haul-level phenomena. Nevertheless, our results suggest several empirical regularities consistent with our predictions. First, the results indicate that characteristics of a motor carrier's operations—notably, the degree to which it performs LTL trucking and the degree to which it invests in reputation—affect its choice of driver employment mode. Carriers tend to rely on company drivers when multiple hauls must be coordinated, or when complementary investments are at risk of devaluation by driver actions. The need for coordination and/or the need to safeguard investments in reputational capital both increase the contracting hazards faced by a carrier and decrease the ex ante specification and ex post verifiability of damages should a driver not meet

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63-observation subsample is more integrated into company trucks (mean = 0.91), is far more engaged in LTL carriage (mean = 0.740), is engaged in shorter (mean = 1.000) and lighter (mean =9.837) hauls, and is engaged in many more hauls (mean = 8.762). Like the prior subsample, correlation between LTL SHARE and SHORT HAUL is high (0.942).

contractual obligations. Second, we find that carriers engaged in hauls involving light or heavy freight are more likely to be integrated, which is consistent with our argument that carriers own non-standard vehicle configurations in the presence of temporal specificities.

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Table 1: Predictions for Proxies

Variables	Predicted Sign	Propositions	Variable Description
COMPANY TRUCK$_i$	Dep. Var.		Proportion of trucks and tractors owned on 1/1/1991 for carrier *i*.
COMPANY DRIVER MILES$_i$	Dep. Var.		Proportion of annual intercity miles driven by company drivers for carrier *i*.
LTL SHARE$_i$	+	H1	Proportion of annual revenue received from LTL hauls for carrier *i*.
ADVERTISING$_i$	+	H2	Advertising expenditure as a percent of total revenue for carrier *i*.
HAUL LENGTH$_i$			Average haul length for carrier *i*.
SHORT HAUL$_I$	+	H3	Median haul length for sample minus average haul length for carrier *i* if average haul length < median haul length; else 0. Reported in hundreds of miles.
LONG HAUL$_I$	+	H3	Average haul length for carrier *i* minus median haul length for sample if average haul length < median haul length; else 0. Reported in hundreds of miles.
HAUL WEIGHT$_i$			Average haul weight for carrier *i*.
LIGHT WEIGHT$_i$	+	H3	Median haul weight for sample minus average haul weight for carrier *i* if average haul weight < median haul weight; else 0. Reported in tons.
HEAVY WEIGHT$_i$	+	H3	Average haul weight for carrier *i* minus median haul weight for sample if average haul weight < median haul weight; else 0. Reported in tons.
HAULS$_i$			Total number of hauls by carrier *i*, divided by 100,000.
REVENUE$_i$			Revenue for carrier *i* in millions of dollars.
UNION$_i$			1 if carrier *i* contributes to a union pension plan in 1991; else 0.
REGION_CAT#$_i$			Regional variables 1 through 9.
FREIGHT_CAT#$_i$			Freight categories 1 through 17.

Table 2: Descriptive Statistics (N = 354)

Variable	Mean	S. D.	Min.	Max.
COMPANY TRUCKS	0.827	0.307	0	1
COMPANY DRIVER MILES	0.769	0.330	0	1
LTL SHARE	0.317	0.391	0	1
ADVERTISING	1.710	1.088	0	8.814
HAUL LENGTH	3.363	3.874	0.025	18.178
SHORT HAUL	0.631	0.713	0	1.790
LONG HAUL	2.180	3.427	0	16.363
HAUL WEIGHT	12.839	6.387	1.037	36.152
LIGHT WEIGHT	2.571	3.529	0	11.806
HEAVY WEIGHT	2.567	3.886	0	23.309
HAULS	2.422	6.465	0.011	48.716
REVENUE	37.335	84.064	0.614	783.024
UNION	0.624	0.485	0	1
FREIGHT VARIABLES[a]				
BULK	0.085	0.279	0	1
GENERAL FREIGHT	0.712	0.454	0	1
MACHINERY	0.008	0.092	0	1
MOTOR VEHICLES	0.011	0.106	0	1
OTHER	0.065	0.247	0	1
REFRIGERATED	0.054	0.226	0	1
TANK	0.065	0.247	0	1
REGION VARIABLES[b]				
NORTHEAST	0.034	0.181	0	1
MID-ATLANTIC	0.147	0.354	0	1
MIDWEST	0.164	0.371	0	1
SOUTHEAST	0.209	0.407	0	1
NORTH-CENTRAL	0.073	0.261	0	1
CENTRAL	0.110	0.314	0	1
SOUTHWEST	0.088	0.283	0	1
MOUNTAIN	0.062	0.242	0	1
WEST	0.110	0.314	0	1

[a] The freight categories are those that are designated by the ICC.
[b] The regional categories are those that are designated by the ICC. A carrier's regional designation is based on the location of its headquarters. The regions are: Northeast: CT, MA, ME, NH, RI, VT; Mid-Atlantic: DE, MD, NJ, NY, PA, WV; Midwest: IL, IN, MI, OH; Southeast: AL, FL, GA, KY, MS, NC, SC, TN, VA; North-Central: MN, ND, SD, WI; Central: IA, KS, MO, NB; Southwest: AS, LA, OK, TX; Mountain: CO, ID, MT, NM, UT, WY; West: AZ, CA, NV, OR, WA.

Table 3: Descriptive Statistics for Each Sub-sample of Carriers

	Outsourced Trucks Only (N=17)				Mix of O.T and C.T. (N=125)				Company Trucks Only (N=212)			
VARIABLE	**Mean**	**S. D.**	**Min.**	**Max.**	**Mean**	**S. D.**	**Min.**	**Max.**	**Mean**	**S. D.**	**Min.**	**Max.**
COMPANY TRUCKS	0	0	0	0	0.646	0.300	0	1	1	0	1	1
COMPANY DRIVER MILES	0.118	0.332	0	1	0.646	0.321	0	1	0.894	0.233	0	1
LTL SHARE	0.102	0.229	0	0.800	0.176	0.322	0	1	0.417	0.407	0	1
ADVERTISING	0.264	0.442	0	1.706	1.741	0.919	0	3.950	1.807	1.135	0	8.814
HAUL LENGTH	6.128	5.370	0.167	18.178	4.306	3.967	0.124	16.642	2.586	3.454	0.025	16.220
SHORT HAUL	0.251	0.530	0	1.647	0.373	0.599	0	1.691	0.813	0.731	0	1.790
LONG HAUL	4.565	5.111	0	16.363	2.865	3.637	0	14.828	1.585	2.967	0	14.405
HAUL WEIGHT	15.684	5.235	7.400	25.000	14.536	5.113	1.772	25.110	11.611	6.851	1.037	36.152
LIGHT WEIGHT	0.942	1.967	0	5.443	1.251	2.306	0	11.072	3.480	3.917	0	11.806
HEAVY WEIGHT	3.782	3.996	0	12.157	2.943	3.660	0	12.267	2.247	3.984	0	23.309
HAULS	3.243	11.673	0.014	48.464	1.603	3.717	0.034	21.793	2.839	7.131	0.011	48.716
REVENUE	42.543	77.045	1.074	302.328	34.203	53.785	1.362	322.749	38.764	98.297	0.614	783.024
UNION	0.294	0.470	0	1	0.576	0.496	0	1	0.679	0.468	0	1
FREIGHT VARIABLES												
BULK	0.059	0.243	0	1	0.120	0.326	0	1	0.066	0.249	0	1
GENERAL FREIGHT	0.706	0.470	0	1	0.608	0.490	0	1	0.774	0.420	0	1
MACHINERY	0	0	0	0	0.016	0.126	0	1	0.005	0.069	0	1
MOTOR VEHICLES	0	0	0	0	0.008	0.089	0	1	0.014	0.118	0	1
OTHER	0.118	0.332	0	1	0.072	0.260	0	1	0.057	0.232	0	1
REFRIGERATED	0.059	0.243	0	1	0.072	0.260	0	1	0.042	0.202	0	1
TANK	0.059	0.243	0	1	0.104	0.306	0	1	0.042	0.202	0	1
REGION VARIABLES												
NORTHEAST	0	0	0	0	0.008	0.089	0	1	0.052	0.052	0	1
MID-ATLANTIC	0.176	0.393	0	1	0.120	0.326	0	1	0.160	0.368	0	1
MIDWEST	0.412	0.507	0	1	0.152	0.360	0	1	0.151	0.359	0	1
SOUTHEAST	0.059	0.243	0	1	0.240	0.429	0	1	0.203	0.403	0	1
NORTH-CENTRAL	0.059	0.243	0	1	0.136	0.344	0	1	0.038	0.191	0	1
CENTRAL	0	0	0	0	0.096	0.296	0	1	0.127	0.334	0	1
SOUTHWEST	0.176	0.393	0	1	0.080	0.272	0	1	0.085	0.279	0	1
MOUNTAIN	0.118	0.332	0	1	0.072	0.260	0	1	0.052	0.222	0	1
WEST	0	0	0	0	0.088	0.294	0	1	0.132	0.339	0	1

Table 4: Pearson Correlation Coefficients (N = 354)

		1	2	3	4	5	6	7	8	9	10
1	COMPANY TRUCKS	1									
2	COMPANY DRIVER MILES	0.715	1								
3	LTL SHARE	0.310	0.263	1							
4	ADVERTISING	0.330	0.398	-0.283	1						
5	SHORT HAUL [a]	0.305	0.236	0.893	-0.280	1					
6	LONG HAUL [a]	-0.274	-0.138	-0.486	0.143	-0.565	1				
7	LIGHT WEIGHT [a]	0.265	0.276	0.571	-0.098	0.514	-0.287	1			
8	HEAVY WEIGHT [a]	-0.097	-0.111	-0.406	0.064	-0.334	0.180	-0.483	1		
9	HAULS	0.071	0.084	0.442	-0.208	0.403	-0.204	0.055	-0.163	1	
10	UNION	0.216	0.185	0.102	0.126	0.124	-0.117	0.106	-0.140	0.095	1

$p < 0.05$ for $|\rho| > .095$
$p < 0.01$ for $|\rho| > .121$

[a] based on deviations from median HAUL LENGTH and HAUL WEIGHT for the sample.

Table 5: Two-sided Tobit Regression Results (standard errors in parentheses)

	COMPANY TRUCKS			COMPANY DRIVERS			ALTERNATIVE EXPLANATION (BUSINESS CYCLES)	
	Model 1A	Model 2A	Model 3A	Model 1B	Model 2B	Model 3B	Model 4	Model 5
Sample Haul Length =	Median	Mode	Mean	Median	Mode	Mean	Median	Median
Sample Haul Weight =	Median	Mode	Mean	Median	Mode	Mean	Median	Median
LTL SHARE	0.577 **	0.567 **	0.551 **	0.562 **	0.398 *	0.529 **	0.066	0.058
	(0.221)	(0.205)	(0.190)	(0.178)	(0.160)	(0.153)	(0.271)	(0.269)
ADVERTISING	0.315 **	0.315 **	0.319 **	0.351 **	0.350 **	0.356 **	0.287 **	0.276 **
	(0.039)	(0.039)	(0.039)	(0.033)	(0.032)	(0.033)	(0.049)	(0.050)
SHORT HAUL	0.069	0.353	0.062	0.050	0.853 *	0.044	0.267 †	0.260 †
	(0.108)	(0.496)	(0.049)	(0.088)	(0.370)	(0.040)	(0.140)	(0.140)
LONG HAUL	-0.017	-0.019 †	-0.012	0.008	0.006	0.015	-0.0005	-0.0004
	(0.011)	(0.011)	(0.013)	(0.009)	(0.009)	(0.011)	(0.015)	(0.015)
LIGHT WEIGHT	0.044 **	0.038 **	0.043 **	0.040 **	0.040 **	0.039 **	0.051 **	0.054 **
	(0.014)	(0.012)	(0.014)	(0.011)	(0.010)	(0.011)	(0.019)	(0.019)
HEAVY WEIGHT	0.023 *	0.028 **	0.023 *	0.013 †	0.018 *	0.012 †	0.014	0.013
	(0.009)	(0.010)	(0.009)	(0.007)	(0.008)	(0.007)	(0.011)	(0.012)
HAULS	-0.004	-0.005	-0.004	0.004	0.004	0.004	-0.002	-0.002
	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)
UNION	0.127 †	0.130 †	0.126	0.048	0.053	0.047	0.164 †	0.156 †
	(0.067)	(0.067)	(0.067)	(0.054)	(0.054)	(0.054)	(0.082)	(0.082)
3YR GROWTH								0.234
								(0.391)
3YR VAR								0.091
								(1.029)
AVE GSP								-4.183
								(4.399)
VAR GSP								-0.224
								(4.101)
FREIGHT CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
REGION CONTROLS	Yes*	Yes*	Yes*	Yes	Yes	Yes	Yes	Yes
CONSTANT	0.190	0.221	0.133	-0.049	-0.045	-0.075	-0.174	-0.097
	(0.122)	(0.127)	(0.123)	(0.105)	(0.107)	(0.106)	(0.152)	(0.335)
SCALE (generated by Tobit estimation procedure)	0.464	0.463	0.463	0.403	0.400	0.402	0.439	0.436
	(0.033)	(0.033)	(0.033)	(0.024)	(0.024)	(0.024)	(0.038)	(0.038)
N	354	354	354	354	354	354	227	227
Log Likelihood	-194.85	-194.92	-194.57	-201.94	-198.87	-201.33	-120.18	-119.51
Pseudo R^2	0.299	0.299	0.300	0.321	0.331	0.323	0.304	0.308
Likelihood ratio test								1.34

** $p < 0.01$; * $p < 0.05$; † $p < 0.10$

Table 6: Marginal effects in proportion of carriage performed by company drivers/trucks
(all other continuous variables held at mean; all binary variables held at 0)

	COMPANY TRUCKS				COMPANY DRIVERS			
Explanatory variable	At minimum	At mean	At 1 std deviation above mean	At maximum	At minimum	At mean	At 1 std deviation above mean	At Maximum
LTL SHARE	0.161 **	0.140 **	0.113 **	0.095 **	0.215 **	0.187 **	0.147 **	0.120 **
ADVERTISING	0.103 **	0.076 **	0.055 **	0.010 **	0.141 **	0.117 **	0.075 **	0.068 **
SHORT HAUL	0.017	0.017	0.016	0.015	0.017	0.017	0.016	0.016
LONG HAUL	-0.004	-0.004	-0.004	-0.005	0.003	0.003	0.002	0.002
LIGHT WEIGHT	0.012 **	0.011 **	0.009 **	0.007 *	0.014 **	0.013 **	0.012 **	0.009 **
HEAVY WEIGHT	0.006 *	0.006 *	0.005 *	0.004 **	0.004 +	0.004 +	0.004 +	0.003 **

** = $p < 0.01$; * = $p < 0.05$; + = $p < 0.10$