Market Access Decisions in Regulated and Unregulated Markets

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UGPTI Department Publication No. 96

June 1993

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in

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by

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Disclaimer

The data, methods and findings presented herein do not necessarily reflect the views or policies of either agency, and are the sole responsibility of the authors.

ABSTRACT

This study examines the effect of regulatory reform in the interstate trucking industry. In our model, carriers travel in round trips and choose to serve different markets corresponding to each leg of the trip. Some carriers have the regulatory authority to haul freight subject to regulation while other carriers do not. Unlike previous studies that focus on decisions to serve one leg of a trip, our model applies to firm decisions across *multiple legs*. As in previous studies, regulatory status, distance, location, and other attributes affect the likelihood that a carrier travels empty or loaded. However, we also find significant differences in the determinants of market access *across markets*. Entry regulation has a significant influence only in markets dominated by regulated traffic, whereas location has a significant influence only in markets dominated by unregulated traffic.

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INTRODUCTION

The Motor Carrier Act of 1980 significantly eased regulatory restrictions on entry and pricing in the interstate motor carrier industry. A number of recent studies indicate that regulatory reform has had dramatic and positive effects on competitiveness and productivity [e.g., McMullen (1987), McMullen and Stanley (1988), Keeler (1989), Ying (1990a; 1990b), Ying and Keeler (1991), and Boyer (1993)]. However, still other studies suggest that remaining restrictions continue to detract from economic efficiency by limiting the access carriers have to markets [e.g., Beilock and Kilmer (1986) and Wilson and Dooley (1993)]. The latter studies focus on the effects regulatory reform has had on carrier decisions to serve markets in which the Interstate Commerce Commission (ICC) has historically been active in restricting entry. However, carriers often operate in both regulated and unregulated markets. In this study, we model decisions of motor carriers to access multiple legs of a trip. We find that ICC regulation significantly influences decisions to serve markets characterized by a high proportion of traffic subject to regulation, but does not significantly influence decisions to serve markets characterized by a high proportion of traffic not subject to regulation. The regulatory implications of our findings are straightforward: Remaining regulatory barriers to entry do, indeed, significantly affect access in the motor carrier industry, producing higher rates and excess capacity.

In interstate trucking, there are two general classes of traffic -- regulated and unregulated. Regulated traffic consists of the transportation of goods subject to ICC jurisdiction. Since passage of the Motor Carrier Act of 1935, for-hire motor carriers have been required to have ICC operating licenses (Authorities) to haul freight subject to regulation. However, not all freight is subject to regulation. Freight may be exempt from regulation if it is hauled by the firm holding title to the property (i.e., private carriage) or if it is a commodity exempt from ICC regulations (e.g., unprocessed agricultural commodities). Until the late 1970s it was

relatively difficult for a carrier to obtain authority and many carriers operated without authority by specializing in unregulated freight or by accessing regulated markets indirectly (e.g., by leasing to carriers holding authority). The Motor Carrier Act of 1980 reduced but did not entirely eliminate the requirements for obtaining Authorities.[1] Since the passage of the Act, the percentage of successful applications has steadily risen with over 90 percent of applications now being granted. This does not mean, however, that ICC regulation no longer restricts entry in the motor carrier industry. Many carriers still operate without authority.[2] There are a variety of possible explanations for the observation that many carriers do not have authority. Interviews with carriers and industry analysts and other research suggest an aversion to regulation, a preference for driving, and a perception (perhaps a misperception) that the costs of authority are high relative to benefits [Horn (1984; 1986), Felton (1989), Beilock and Freeman (1991), and Wilson and Dooley (1993)].[3]

In transportation studies, origin-destination pairs typically define a market. Freight moves between locations and carriers travel in round trips between locations. In the simplest example, freight moves from A to B and from B to A and every carrier serves both the A to B

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[1] Under regulation, the value of these authorities was significant and often viewed as representing monopoly profit. Under deregulation, the value of authorities has fallen to almost nothing, pointing to a dramatic reduction in the total costs of obtaining authority for carriers seeking authority. We maintain that while the direct costs of obtaining authority are lower, direct and indirect costs of regulation and other factors discussed later still prevent some carriers from seeking authority and that regulation continues to restrict access to markets. See Breen (1977), Frew (1981), Moore (1978; 1986), Horn (1984), and Mabley and Strack (1982) for related discussions.

[2] For example, in the present study of traffic in and out of Florida in 1991-92, 85 percent of carriers hold authority. In Beilock and Kilmer (1986), analyzing the same traffic in 1982-83, 31 percent of carriers held authority. In Wilson and Dooley (1993), analyzing traffic in and out of North Dakota in 1986, only 40 percent of carriers held authority. Rodriguez (1991), documenting the same population in 1991, reports that about 50 percent of carriers held authority.

[3] To obtain an Authority, a carrier must comply with Department of Transportation safety standards, document shipper support, satisfy insurance requirements, have an agent in each state in which they have the authority, file tariffs, notify the states in which it operates of its operations, etc. While the impediments to obtaining authority, especially those from existing carriers are lower than before partial deregulation, these costs remain nontrivial for many carriers. Felton (1989), summarizing comments from Reese Taylor in 1982 (the ICC chairman), suggests that relatively few owner-operators applied for and received authority in the first two and one-half years following the Motor Carrier Act of 1980. The limited response was due to the "lack of information on application procedures, misperceptions as to the cost of acquiring a certificate, and difficulty in obtaining insurance." Felton also notes that, given these costs, leasing might be a preferable mode of access into regulated markets.

and B to A markets. A number of researchers, including Nicholson (1958), Miklius and DeLoach (1965), Kahn (1970), Mohring (1976), Felton (1981), and Wilson (1987) have studied this model and its variants under the assumption that regulation is absent. They find that round trip revenues must (at least) compensate the round trip costs of the carrier, that rates for each leg of a trip are directly related to relative demand conditions, and that there are no empty trips unless prices on one leg are bid to access costs. Regulation, however, creates important differences across regulated and unregulated carriers. Regulated carriers may acquire both regulated and unregulated freight directly. Unregulated carriers have direct access only to unregulated freight, but may acquire regulated freight indirectly by, for example, leasing their services to other carriers that hold the requisite Authorities, pointing to higher costs in accessing markets.[4] Wilson and Dooley (1993) develop a model that recognizes the differences in costs for regulated and unregulated carriers. In that model, revenues from the trip must compensate the costs of *unregulated carriers* for both unregulated and regulated carriers to coexist. The presence of regulation in some markets means higher rates in both regulated and unregulated markets, and restricted access to carriers without Authorities. If regulatory restrictions were removed, both rates and the number of empty trips would fall.

Previous studies that examine the effects of entry regulation on market access use data that pertain to only one leg of a trip. In those studies [Beilock and Kilmer (1986), Wilson (1987), and Wilson and Dooley (1993)] the authors examine carrier decisions to access markets having a preponderance of regulated traffic. Using different specifications and data, Beilock and Kilmer (1986) and Wilson and Dooley (1993) each find that carriers with Authorities have an

[4] Unregulated carriers searching for an unregulated load likely have higher search costs for a load than regulated carriers which can haul both regulated and unregulated freight. Unregulated carriers operating under lease arrangement receive only a percentage of the freight rate paid by the shipper/receiver. In a 1990 survey of owner-operators, Shell (1991) reported a leasing discount averaging 19.9 percent of the freight rate suggesting unregulated carriers receive, on average, 80.1 percent of the freight rate paid.

advantage over carriers without Authorities in accessing markets. As already noted, these studies focus on carrier access decisions in one market even though carriers can, and typically do, serve multiple markets on any given trip.

Our examination of access makes two contributions. First, we examine access decisions in two markets (successive legs of a trip). One market is characterized by a preponderance of regulated, rather than unregulated, freight, while the reverse holds in the other market. If ICC regulations restrict market access, positive and significant effects regarding access from holding Authorities would be expected in the predominantly regulated markets, but not in the predominantly exempt market. Earlier studies suggest that carriers with authority are more likely to be loaded in markets characterized by a high proportion of regulated traffic than carriers without authority [Beilock and Kilmer (1986) and Wilson and Dooley (1993)]. However, it is possible that carriers holding authority also tend to have better marketing skills and lower access costs than carriers without authority. While previous studies simply reflect this possibility, this study controls for it. The second contribution is in providing what we believe to be the first examination of market access in unregulated markets. The distinction is important: we find considerable differences in access across markets dominated by regulated versus unregulated traffic.

After controlling for carrier and traffic characteristics, we find authority significantly improves access in primarily regulated markets but not in primarily unregulated markets. These results suggest that further deregulation aimed at increasing access (e.g., removal of the requirement that a carrier has Authority to haul regulated commodities) would reduce rates and excess capacity.

CONCEPTUAL FRAMEWORK

The model developed in this section pertains to vehicles traveling in round trips. That carriers travel in round trips follows from the fact that vehicles typically return to their base of operations for maintenance, driver rest, or to acquire loads. Profit-maximizing carriers choose the number of round trips (T) and the specific legs of the trip to access. Key to these decisions are two distinct types of costs -- capacity and access costs. Capacity costs are the costs of traveling empty between the locations which comprise the round trip. The main components of these costs include expenditures on labor, fuel, use-related equipment depreciation (i.e., 'wear and tear') , etc. We assume these costs are given by C(T) with $\partial C(\bullet)/\partial T > 0$ and $\partial^2 C(\bullet)/\partial T^2 > 0$.

Access costs are the costs associated with finding and securing loads. For each leg i, access costs have a distance-unrelated component (a_i) and a distance-related component (d_i). The distance-unrelated component (a_i) includes costs associated with search, loading, and unloading. The distance-related component (d_i) is the additional cost, over the ith leg, related to moving a vehicle with a load, rather than an empty vehicle. These costs include additional fuel expenditures, wear and tear, and time to periodically check the integrity of the load (i.e., to ensure that the load is securely braced, the cooling or heating unit is within specified limits, etc.) In modelling the market access decisions, let δ_i take a value of 1 if the carrier chooses to access leg i, and a value of zero otherwise. Profits then are

$$(1) \qquad \underset{\delta_i, T}{\text{Max}}\ \pi = \Sigma_i \delta_i (P_i - a_i - d_i)T - C(T)$$

Returns from accessing a market, access returns (v_i), are the difference between the freight rate and access costs, $v_i = P_i - a_i - d_i$. For profit-maximization, a carrier will only choose to access a market if the associated access returns are non-negative. Let Ω be the set of markets for which

the access condition holds. The profit-maximizing number of trips for the carrier then is the solution of the first-order condition

$$(2) \qquad \partial\pi/\partial T = \Sigma_{i\epsilon\Omega} (P_i - a_i - d_i) - \partial C(T)/\partial T = 0.$$

From equation (2), round trip revenues net of access costs associated with the legs of the trip for which the access condition is satisfied $\Sigma_{i\epsilon\Omega} (P_i - a_i - d_i)$ must compensate the marginal round trip "capacity" costs. In equilibrium, rate levels across legs of the trip are interdependent. The simplest example is a two-leg trip (e.g., A to B and B to A). If only one market in the trip satisfies the market access condition for all carriers (i.e., traffic moves in only one direction), rates in that market must compensate access costs in that market as well as capacity cost. On the other hand, if each leg of the trip satisfies the market access condition for all carriers, then freight moves in all directions. The number of loaded trips in each direction are the same. Rates, net of access costs, share the costs of capacity in proportion to relative demand conditions -- rates in the relatively high demand market are higher than in the relatively low demand market. Vehicles are often observed moving *empty and loaded in each direction,* suggesting that carriers face different prices, incur different access costs, or both.

The central assertion of this study is that access returns $v_i = P_i - a_i - d_i$ vary systematically across carriers. In particular, it is maintained that, despite regulatory reform, there are systematic differences across carriers owing to differences in regulatory status. In terms of regulatory status, if on any one leg of a trip, there is only regulated traffic available, then regulation places a direct constraint on Ω. However, in actuality both regulated and unregulated traffic are normally present for any origin-destination pair, but the amounts of each may vary dramatically across markets. Thus, carriers are able to access both regulated and unregulated markets, but accessing one or both may be more difficult (i.e., access costs are higher). Regulated carriers may directly access both regulated and unregulated markets.

Unregulated carriers can access unregulated markets directly but regulated markets only at higher costs (e.g., the added cost of a leasing arrangement). Thus, in markets characterized by a high proportion of regulated traffic, we expect the access costs of unregulated carriers to be higher than for regulated carriers. If deregulated, it follows that the costs of unregulated carriers would fall causing them to access markets more often, reducing the number of empty trips in the market and the rates of the previously unregulated commodities.

EMPIRICAL MODEL

The empirical model explains carrier decisions to access markets corresponding to two successive legs of a round trip. Let

$$(3) \qquad \begin{aligned} v_{1i} &= \beta_1' X_{1i} + \varepsilon_{1i}, \text{ and} \\ v_{2i} &= \beta_2' X_{2i} + \varepsilon_{2i} \end{aligned}$$

represent access returns on the two successive legs of the trip for the ith carrier with characteristics X_i. We do not, however, observe v_{1i} or v_{2i}; rather, we only observe if a carrier is loaded on leg 1 and leg 2. Returns consist of deterministic components ($\beta_1' X_{1i}$, $\beta_2' X_{2i}$) and random components (ε_{1i}, ε_{2i}) which may be correlated. The ith firm is loaded on leg 1 if $\varepsilon_{1i} > -\beta_1' X_{1i}$ and on leg 2 if $\varepsilon_{2i} > -\beta_2' X_{2i}$.

After defining the outcome that a firm is loaded or unloaded on leg 1 with $\delta_{1i}=1$ and $\delta_{1i}=0$, respectively, and on leg 2 similarly ($\delta_{2i}=1$ and $\delta_{2i}=0$, respectively), estimation could proceed by assuming a logit or probit model. However, unobserved variables are likely to be common across equations. For example, suppose the unobserved characteristics of a carrier in one market results in high returns (high prices, low access cost) from the leg indexed by 1; the opportunity cost of the time required to search (search costs) in the second market may be higher as a result. Therefore, the carrier may forgo search operations in the second market and would be less likely to be loaded in the second market. Thus, we expect that the correlation between ε_{1i} and ε_{2i} is negative. Given this correlation, we assume that ε_{1i} and ε_{2i} are bivariate normal with $E[\varepsilon_{1i}] = E[\varepsilon_{2i}] = 0$, $Var(\varepsilon_{1i}) = Var(\varepsilon_{2i}) = 1$, and $Cov(\varepsilon_{1i},\varepsilon_{2i}) = \rho$. Estimation proceeds by maximum likelihood.[5]

Included as explanatory variables (X_{1i} and X_{2i}) are a set of dummy variables indicating whether a carrier has an Authority, the carrier's base of operation vis-a-vis the origin and destination defining the market, and the carrier type (whether the carrier is an owner-operator,

[5] Greene (1984; 1993) discusses and provides an example of the bivariate probit.

a fleet carrier or a private carrier). Following both Beilock and Kilmer (1986) and Wilson and Dooley (1993), the distance of the leg (DIST) is included as an explanatory variable. Finally, as discussed later, the data were drawn at four different points in time. Dummy variables are included for each point in time.

The central assertion in this study is that what remains of the interstate regulatory system, after the Motor Carrier Act of 1980, may continue to impede the efficient movement of freight by limiting access. As with all previous studies, this hypothesis is investigated by comparing the performance of carriers holding and not holding Authorities. Unlike previous works, however, we control for the possibility that possession of Authorities may be correlated with other characteristics which may affect access returns. As with previous research, we expect AUTH to positively influence the likelihood of being loaded in markets with predominantly regulated traffic. However, we maintain that this effect is clearly attributable to regulatory restrictions only if AUTH's influence is non-positive in markets dominated by exempt traffic.

Another determinant of access returns is the state or province of the carrier's base of operations relative to the origin and destination of the movement.[6] We define dummy variables to capture one of three possibilities: the carrier's base is at the origin of the movement (ORIG); the carrier's base is at the destination of the movement (DEST); and the carrier's base is at neither the origin nor destination of the movement (VEER). We use DEST as the base dummy. If there are spatial cost advantages to market access associated with being located near the shipper, then it would be expected that the coefficient on ORIG is positive. However, if such advantages are more important with regard to being located near the receiver, the coefficient on ORIG would be negative. If a carrier is not traveling from its base

[6] Drivers were asked for the base state or province of their vehicle, rather than for the carrier as a whole. For smaller carriers, these are likely to be the same. For larger carriers, the driver's base facility and corporate headquarters are likely to be separate. However, the authors believe that the former is more likely to be the center for day-to-day service marketing and dispatching.

or to its base, we expect it to be loaded -- the coefficient on VEER is positive. While such a vehicle might be empty simply to reposition itself for a load, we expect that such vehicles are likely to be traveling loaded to a location to drop off a load. Finally, there were a few instances of intrastate trips with the carrier being based in that state (ORIG and DEST would both equal one). To prevent this from confounding the interpretation of the results, an additional binary variable (FLOR) was included.

We used binary variables to control for carrier type. FLT equals one if the carrier is a for-hire fleet, a firm with multiple trucks which are engaged primarily in hauling another party's cargos for hire. PVT equals one if the carrier is a private carrier, a firm with trucks which primarily haul cargos owned by that firm. The omitted category is owner-operators, small (normally one truck) for-hire carriers with the owner regularly acting as driver. Access costs may differ across carrier types because owner-operators and some private carriers are unlikely to be able to support dedicated, in-house marketing staffs, as is typical with for-hire fleets. In addition, the opportunity cost of accessing a market may be different for private carriers because they often have commitments to proceed to other markets (to haul their firms' goods). Because of these factors, there may be differences across carrier types in access rates unrelated to the regulatory system. To investigate these possibilities, both FLT and PVT are included as explanatory variables.

A portion of access costs is distance-related: namely d_i, the additional costs associated with moving a loaded, rather than an unloaded, truck. If the two following conditions are met, access probabilities would be expected to increase with the distance of the movement in a market:

1. There are differences across carriers in per mile costs associated with operating a loaded truck, rather than unloaded, truck; and

2. Freight rates adjust to compensate the marginal carrier for the cost of serving the market or, at least, the rates are higher than the least cost carrier (with regard only to d_l). As such, there would be a per mile premium earned by lower cost carriers (again, with regard only to d_l).

These conditions are considered plausible and, indeed, likely in most markets. Therefore, distance (DIST) is included as an explanatory variable and is expected to have a positive influence on the probability of being loaded in each market.[7]

We include a final set of variables to capture changes in market conditions over time. As described in the next section, we draw the data from four different points in time (November of 1991 and January, March and May of 1992). Binary variables for the first three periods are included (NOVEMBER, JANUARY, and FEBRUARY). Due to known seasonal movements in freight rates for the primarily exempt market, we have
specific expectations regarding signs and relative magnitudes for these variables. The data are for movements of refrigerated trucks into and out of Florida. The inbound movements are known to be primarily regulated freight. Seasonal variations in the volume of, and freight rates paid for, this freight are believed to be slight. On the other hand, there are dramatic seasonal swings in the volume of freight leaving Florida and it is known that the freight rates are correlated closely with this volume [e.g., Beilock, Kohburger, and Morgan (1984)]. Therefore, the opportunity costs associated with the delays entailed in seeking Florida-destination and Florida-origin loads should also vary seasonally, ceteris paribus. Moreover, the higher (lower) Florida-origin rates are, the lower (higher) the influence of the opportunity costs of delays in entering Florida-destination markets due to the time required to access Florida-origin markets. If correct, we expect the signs of the seasonal dummies to be positive for

[7] For a more detailed discussion of the influence of distance on load acquisition rates, see Beilock and Kilmer (1986).

traffic into Florida and negative for traffic out of Florida. For outbound traffic, we expect the magnitudes of parameters to decrease with time. For inbound traffic, we expect the highest value in November and the lowest value in January. Table 1 summarizes these relationships.[8]

Table 1. Seasonal Variation

	November	January	March	May
Rate Level[a]	4	3-4	2	1
Trend in Rates	Slow Increase	Slow Decrease	Steady	Rapid Decrease
Inbound Traffic:[b]				
Expected sign and Relative Magnitude	+1	+3	+2	n.a.[c]
Outbound Traffic:[b]				
Expected sign and Relative Magnitude	-1	-2	-3	n.a.[c]

[a] The numbers indicate relative rate levels, with 1 being the highest and 4 the lowest.
[b] A + (-) indicates that the anticipated parameter estimate will be positive (negative). The numbers indicate the relative magnitudes, with 1 being the largest and 4 the smallest.
[c] Omitted category.

[8] We assume that the trend in Florida-origin freight rates is the primary determinant of market condition-related opportunity costs for inbound loads. In particular, the faster these freight rates are rising (falling), the less (more) the opportunity cost associated with delays from accessing inbound markets. Both Florida-origin freight rate levels and trends influence opportunity costs associated with accessing outbound markets, but that the former tends to dominate. The influence of trends is the same as just described, though weaker [due both to the additional time necessary to travel away from and back to Florida, and possible uncertainty regarding a return to Florida]. The higher the outbound freight rate level, the greater the incentive to access the outbound market.

DATA

The data were drawn from personal interviews with drivers of refrigerated tractor-trailers. The interviews took place at *outbound* Florida Agricultural Inspection Stations. These stations are located on the three Interstate highways connecting the Florida Peninsula with the rest of the nation (U.S. I-10, I-75, and I-95). The interviews took place during November of 1991, and January, March and May of 1992. Rejection rates were low at each site and during each survey period, normally under 10 percent. There are a total of 2,332 surveys represented in the data. Some of the respondents, however, did not provide complete information, reducing the number of usable observations to 2,163.

Drivers were questioned regarding the current movement out of the Florida Peninsula and the movement which brought them into the Peninsula. The data used in the analysis are summarized in Table 2.

Table 2. Data Summary

Firm Characteristics (N=2163):	% of Firms	Firms with Authority	Firms without Authority
For-Hire Fleet	39%	95%	5%
Private Carrier	23%	92%	8%
Owner-Operator	38%	70%	30%
All Carriers	100%	85%	15%

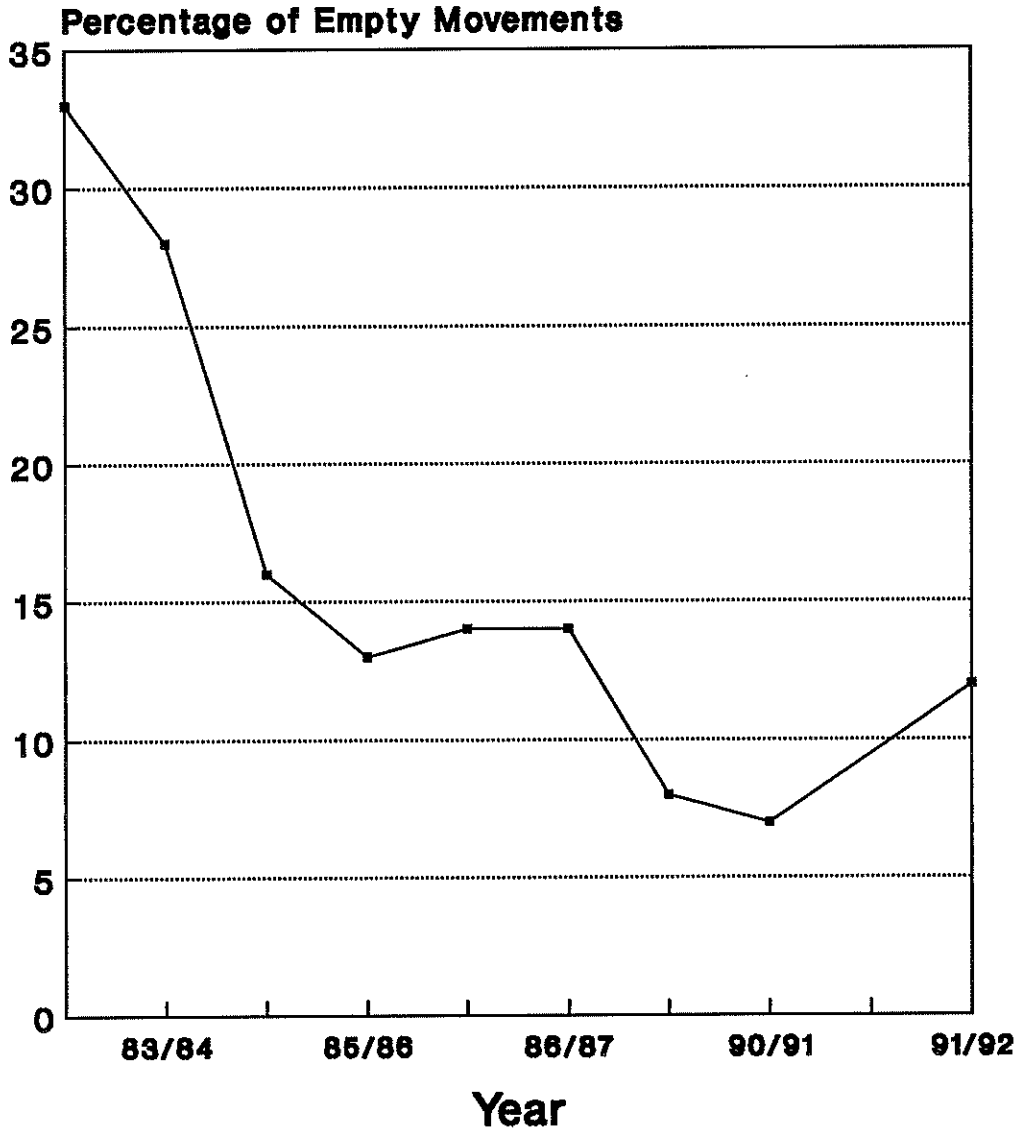
Trip Characteristics:	Inbound	Outbound
Percentage of carriers loaded	93%	92%
Percentage of regulated commodity loads	70%	22%
Average distance (in miles)	1,120	1,143
Percentage of carriers based in origin state/province	33%	22%
Percentage of carriers based in destination	22%	28%

The data consist of for-hire fleet carriers, private carriers, and for-hire owner-operators, representing 39, 23 and 38 percent of the carriers, respectively. About 85 percent of all carriers have Authority; over 90 percent of for-hire fleet carriers and private carriers have Authority while only 70 percent of owner-operators have authority. Two items are of particular note. First, our approach depends crucially upon using activities of carriers in a market dominated by exempt commodities as a control for activities by the same carriers in one dominated by regulated freight. Such markets clearly are represented in the data. Regulated commodities account for 70 percent of inbound loads, but only 22 percent of outbound loads.[9] Second, the absolute percentages of empty movements, both in and out of Florida, are small, seven and eight percent, respectively. It is our belief that the high degree of success that carriers now have in acquiring loads is, in large measure, due to regulatory reform. Indeed, it is our contention that the Motor Carrier Act of 1980 greatly lowered, but did not totally remove, effective barriers to access. In Figure 1 we present the empty inbound movement percentages for the years 1982/83 through 1991/92.[10] By the mid-1980's, the percentage of vehicles travelling empty into Florida dropped to a third of its 1982/83 level. These data are consistent with the hypothesis that the regulatory reforms of the Motor Carrier Act of 1980 improved access to regulated markets, but that a three or four year adjustment period was required to exploit the reforms fully.

[9] Exempt cargos include primarily produce and ornamental plants, fish, poultry, hay, and peat. Regulated cargos include processed foods, general freight, beef, pork, and bananas.

[10] These data are from similar surveys one of the authors has conducted over a number of years. More information is available in Beilock (1991). Unfortunately, comparable data on outbound loadings are unavailable for the same time period. On the basis of recent data barely one-fifth of traffic out of Florida is subject to ICC regulation, between six and eight percent of vehicles leave Florida without a load and no trend is evident.

Figure 1
Empty Movements into Florida



EMPIRICAL RESULTS

We use maximum-likelihood methods for all estimation.[11] Univariate probit estimates for whether the trucker was loaded in and out of Florida provide starting values for the bivariate probit model.[12] Table 3 provides the results.[13] The results are generally consistent with *a priori* expectations and fit the data well, as indicated by comparison of the unrestricted and restricted log-likelihood values and the percentage of correctly classified observations. As is clear from Table 3, there are striking differences between traffic into and out of Florida. We tested the equality of coefficients pertaining to traffic in and out of Florida using a Wald test. The resulting chi-square statistic is 145 which is dramatically larger than the 5 percent critical value (with 10 degrees of freedom) of 18.3. We therefore cannot accept the hypothesis that there are no differences in the parameters pertaining to movements into and out of Florida. Again, traffic into Florida is dominated by regulated traffic while traffic out of Florida is dominated by unregulated traffic. These results are consistent with the hypothesis that accessing regulated markets is different from accessing unregulated markets. Finally, there is strong evidence that unobserved factors influence the likelihood of travelling loaded in either direction. The estimated correlation across equations is negative (as expected) and significant. This finding is consistent with the hypothesis that high returns in a market may cause a firm to forego operations in the other market with the result that the firm travels empty.

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[11] In the estimation we use the Davidon, Fletcher, Powell algorithm and evaluate the hessian using first derivatives.

[12] The univariate probit model for traffic in and out of Florida yield nearly identical parameter estimates as the bivariate probit model, The main advantage of using the bivariate as opposed to univariate models applying to traffic in and out of Florida is the ability to control for unobserved characteristics that may be common across the two legs of the trip.

[13] We also examined a variety of interactions and alternative functional forms. In addition, if trucks not based at either the origin or terminal locations represent carriers that choose (on the basis of total access returns) to operate in the market, there may be a sample selection problem. For this reason, we excluded those carriers from estimation (and removed the now redundant locational dummy variables). The results yield the same qualitative results and are numerically similar. We also examined multinomial logit models in which parameters vary across three alternatives -- loaded in each direction, loaded into and empty out of Florida, and empty into and full out of Florida. Again, the results are comparable to those reported in the paper. Carriers with authority are more likely to be loaded in each direction and into Florida than carriers without authority. Finally, we examined multinomial logit model based on the joint probability of being loaded into Florida and having Authority and a corresponding model pertaining to traffic out of Florida. The probability of being loaded conditioned on having and not having authority yield results similar to those reported.

Table 3. Coefficient Estimates and Estimation Summaries

	INBOUND[a]	OUTBOUND[a]
CONSTANT	0.1433 (0.1842)	-0.2505 (0.1891)
AUTH	0.4024* (0.1146)	-0.2031 (0.1570)
FLT	0.1842 (0.1146)	0.0490 (0.1210)
PVT	0.1052 (0.1277)	0.0823 (0.1335)
DIST	0.0007* (0.0001)	0.0021* (0.0001)
VEER	-0.0351 (0.1371)	0.3188* (0.1117)
ORIG	-0.1057 (0.1411)	0.3589* (0.1479)
NOVEMBER	0.7519* (0.1438)	-0.2615** (0.1495)
JANUARY	0.5644* (0.1220)	-0.4202* (0.1473)
MARCH	0.6769* (0.1354)	-0.1525 (0.1533)
FLOR	-0.5257 (0.3528)	0.0856 (0.2896)
Log-Likelihood (β=0)	-1101	
Log-Likelihood	-857	
Correlation across equations	-.287894*	
Standard error of correlation	(0.1212)	
Percent Correctly Classified	86%	

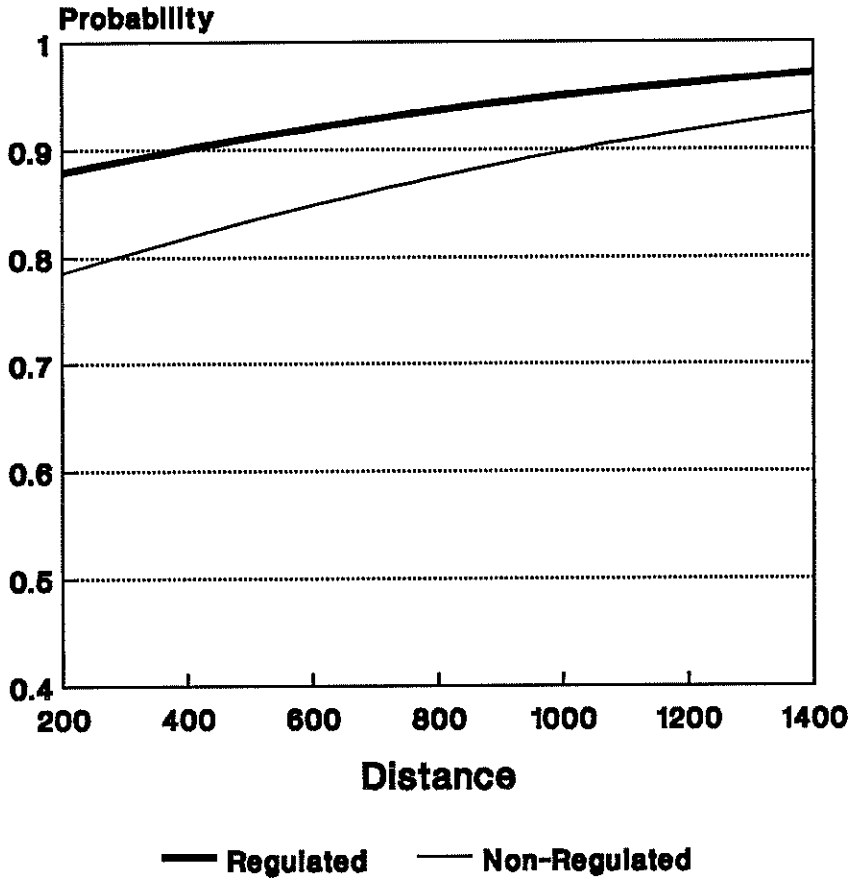
[a] A * and a ** indicate significance at the 5 and 10 percent levels, respectively.

As discussed in detail above, we assert that 1) if AUTH captures differences in access costs due to ICC restrictions, and NOT due to correlations between AUTH and other carrier characteristics, and 2) if ICC restrictions continue to impede access, then the parameter estimates associated with AUTH should indicate a positive and significant impact on load probabilities for the largely regulated movements into Florida, but NOT for the largely exempt traffic out of Florida. Indeed, if possessing Authorities imparts an advantage in regulated markets, the impact of AUTH on access in exempt markets may be negative (due to the higher opportunity associated with delaying return to a regulated market). This is the pattern we found. Authority has a positive and statistically significant result on the probability of being loaded into Florida. Authority has an estimated negative (but not statistically significant) effect on the probability of being loaded out of Florida. These results are consistent with the hypothesis that the regulatory structure remaining after the Motor Carrier Act of 1980 continues to impact negatively on carrier access.

To evaluate the potential benefits of further deregulation we plot the probability of access against distance, controlling for other firm attributes (Figure 2).[14] Since AUTH is statistically significant only for traffic into Florida, Figure 2 pertains only to that traffic and we do not present any results for traffic out of Florida. Figure 2 depicts the inbound movements of predominantly regulated goods. For inbound movements of 200 miles, carriers with Authorities are 14 percent [(.9/.79 - 1)*100] more likely than other carriers to acquire loads. This advantage gradually diminishes, but does not entirely disappear, for longer inbound movements. For outbound movements authority has a negative but insignificant effect on the probability of having a load.

[14] For all Figures containing probability schedules, we use the same methodology. We first calculate for each firm type in the data probabilities at the observed distance. We then calculate weighted probabilities using observed frequencies of firm types.

Figure 2
Authority and Access
Inbound Traffic



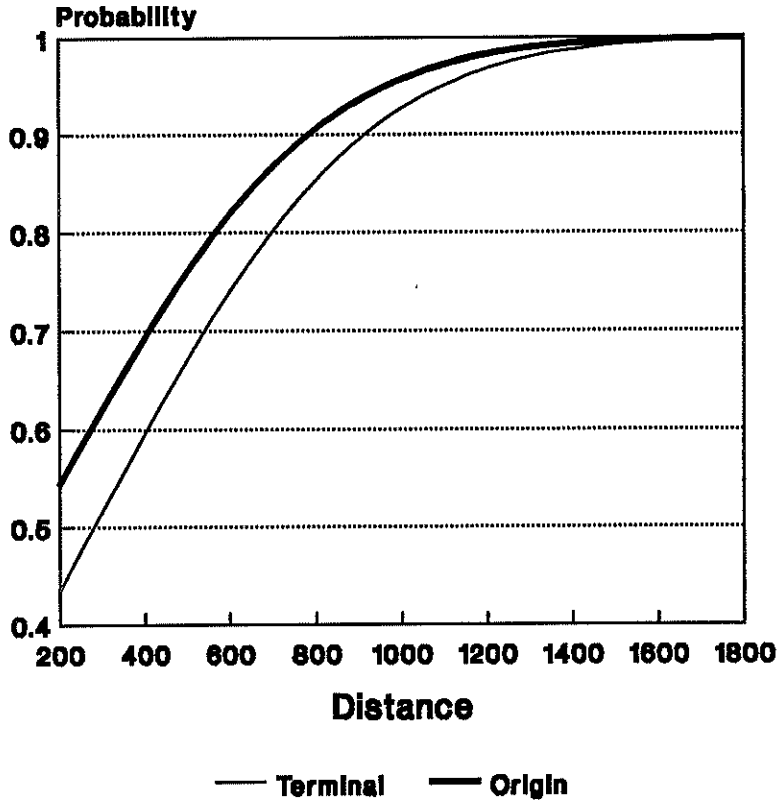
The results are mixed with respect to advantages in acquiring loads due to the truck's base location. For traffic into Florida, no statistically significant relationships were found. However for outbound movements, truckers based in the destination state are less likely than others to acquire loads. This finding suggests that the opportunity costs related to delaying

the outbound movement (to acquire a load) tend to be higher for those heading toward their base state than for others. This seems reasonable. Those heading toward their base may be doing so due to some requirement, such as a scheduled pickup or required maintenance or rest.[15] These obligations may increase the opportunity cost of delaying the return to the base in order to acquire a load. Thus, it is clear that there are access costs differences across carriers operating out of Florida. But, it is unclear whether these cost differences are due to higher opportunity costs of carriers located at the terminal or if it is due to lower access costs of carriers located at the origin. It is not clear why a similar relationship was not found with respect to the inbound load. It may be that for the Florida-destination markets, marketing advantages from having a base near the receiver offset the just-described opportunity cost disadvantages associated with searching for homebound loadings. Figure 3 summarizes the effect of location and distance on market access. From this figure, distance again increases the probability of access. For outbound movements of 200 miles, carriers located at the origin are 25 percent [(.545/.435 - 1)*100] more likely than carriers located at the terminal to acquire loads; this likelihood dissipates with greater distances.

As expected, and consistent with previous studies, access probabilities and distance are positively related (Figures 2 and 3). However, distance has a more pronounced effect on market access in outbound, rather than inbound movements. This difference may be due to differences in the patterns of population and production which, in turn, affects haulage demand levels. Outbound loadings are primarily unprocessed foods and plants. The primary destinations for these products are the large metropolitan areas of the U.S. Northeast, Eastern Canada, and the states bordering the Great Lakes. Outside of Atlanta and New Orleans, there

[15] It could be argued that those not headed to their base state may be equally likely to have scheduled pickups at their destination. However, those heading to their base state are more likely to have the additional obligations of maintenance, rest, crew change, etc.

Figure 3
Location and Access
Outbound Traffic

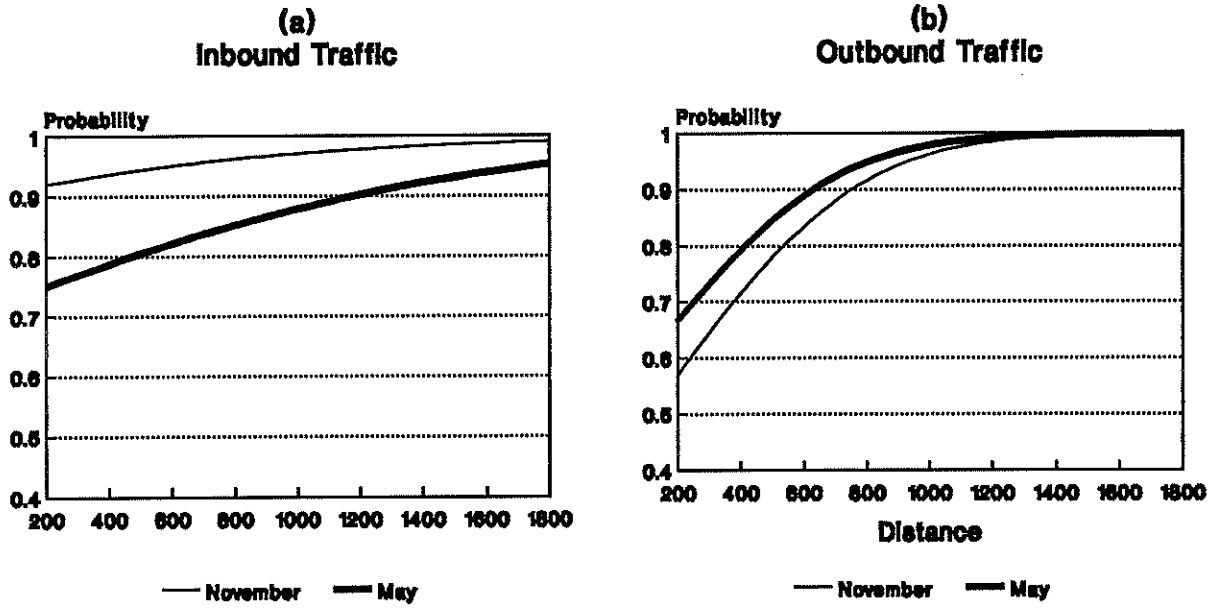


are no major metropolitan areas within 900 miles of South Florida (where the very large majority of outbound loads originate). On the other hand, production and distribution centers for the loads typically hauled into Florida exist throughout the South, as well as in more distant locations.

The parameter estimates associated with the binary variables controlling for seasonal changes in market conditions (NOVEMBER, JANUARY, and MARCH) conform with expectations with regard to sign and, in all but one case, relative absolute magnitudes. For outbound

movements, the magnitude of the parameter estimate associated with NOVEMBER was predicted to be largest, followed by that for JANUARY. In the results, these are the two largest parameter estimates; however, the one associated with JANUARY is the larger. This exception to our expectations seems minor. These results suggest that carriers are quite sophisticated regarding market access decisions, taking into account rate levels and trends, both in the market they are currently in (i.e., where the vehicle is located) and in markets they will be able to access sooner or later, depending upon the current access decision. In Figure 4, these relationships are illustrated for November and May. In November, carriers are more likely to be active in accessing inbound markets than in May, but the reverse is true with respect to accessing outbound markets. This is as we conjectured in Section 3. When outbound rates are low and expected to rise (November), carriers are more likely to forgo search and have their vehicles travel empty from Florida in order to increase their availability in other markets. On the other hand, when Florida-origin rates are high and expected to fall rapidly (May), carriers are very active in accessing outbound markets and likely to forgo search in inbound markets in order to increase availability in Florida-origin markets.

Figure 4
Seasonal Variation in Access



CONCLUDING REMARKS

Improving the efficiency of the nation's transportation system was a primary objective of the regulatory reforms of the late 1970s and early 1980s. To reach this goal, the reformers of interstate motor carrier regulation sought to reduce eligibility requirements and procedures for carriers seeking to acquire authority to haul regulated commodities. The reformers had considerable success in persuading Congress to ease entry restrictions in the Motor Carrier Act of 1980 and in persuading ICC Commissioners to administratively facilitate the Authority application process. However, despite the relative ease of acquiring Authorities, thousands of interstate carriers have not done so. Studies using data from the early and mid-1980s indicated that those without Authorities were more likely to have empty movements in markets dominated by regulated freight [Beilock and Kilmer (1986) and Wilson and Dooley (1993)]. While disturbing, these findings do not point conclusively to inefficiencies owing to the remaining regulatory structure. The reason for this lack of closure is the possibility that carriers holding Authorities may tend to have higher load-acquisition and handling skills (e.g., better marketing and/or lower loading/unloading costs) than carriers without Authorities. Indeed, it seems reasonable that carriers with less use for Authorities would be less likely to acquire them.

In the current study, closure has been achieved by examining the same population of carriers operating in both a market dominated by regulated freight and in one where exempt cargos are the rule. If carriers possessing Authorities have lower load-acquisition costs (apart from those associated with benefits of having Authorities) they should have lower empty-movement frequencies in both markets. On the other hand, if the regulatory structure itself continues to restrict entry, carriers with Authorities should have lower empty movement rates only in the market dominated by regulated freight. Our evidence supports the latter position and suggests that further deregulation would reduce the costs of unregulated carriers in

accessing markets, causing them to travel empty less often reducing rates and excess capacity in the industry.

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