

Impacts of the Trucking Industry Deregulation on Shippers' Preferences

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In an abundance of literature written before the passage of the Motor Carrier Act (MCA) of 1980, researchers discussed and often debated the anticipated effects of regulatory reform on shippers and carriers. Since the passage of the MCA of 1980, most of the studies have focused on carriers, with little research on the effects of deregulation from the shippers' perspective. The results of this study suggest that service attributes appear to be more important factors than pricing attributes in the selection of national common carriers. The study also indicates that both carriers and shippers were in a period of adjustment following the policy changes.

In an abundance of literature written before passage of the Motor Carrier Act (MCA) of 1980, researchers discussed and often debated the anticipated effects of regulatory reform on both shippers and carriers. Most of the studies have focused on carriers, however, with little research from the shippers' perspective.

Information on service attributes is essential for the design and marketing of services for motor carriers, especially in a deregulated environment. This information can provide guidance on marketing strategies. For example, in an attempt to maintain or expand their market shares, many carriers have offered price discount programs. However, some shippers may find other strategies, which emphasize service attributes other than price, more effective. This is the basic argument for less government regulation of the trucking industry; that is, carriers should emphasize their own strengths, such as relative rate discounts or relative special delivery/pickup services for targeted shippers. At the same time, shippers have more options than under the regulated environment to select carriers.

The carrier-selection decision is part of a specialized process whereby a firm purchases the services of a carrier to provide the necessary and vital link among logistics nodes. Usually cost and service are the two basic factors considered in the carrier-selection decision. Winston found that lower rates were more important than services in attracting traffic between mode choices (1). As mentioned by Bardi (2), "Much has been done with respect to carrier prices and pricing practices and the carrier selection decision. Measurement and evaluation of the logistic implications of the carrier cost determinant is much easier than that of carrier service performance."

The work dealing with carrier service performance in the carrier-selection decision has been directed toward the evaluation of service performance of one mode versus another mode, with emphasis upon the heterogeneous nature of the service supplied by the different modes (1). Most carrier-

selection analyses present criteria for assessing modal service and cost differences, but do not consider explicitly the selection of a specific carrier within a mode. One of the important questions in the deregulated environment from the carrier's point of view is how carriers can maintain or expand their markets more effectively.

DATA

The data used in this paper were gathered as part of a broader project conducted by a leading private management corporation in the trucking industry. The sample used in the analysis was a survey undertaken in the first half of 1983. Approximately 10,000 questionnaires were mailed, with about a 25 percent response rate, or 2,300 usable replies. In the questionnaire, each shipper was asked for his or her perceptions (images) of seven major national common carriers with respect to their various service and price characteristics.

CROSS-CLASSIFICATION ANALYSIS

The initial analysis involved the computation of relative frequencies of 11 selected shipper perceptions of the service characteristics of the seven national common carriers. The resultant frequency table was very useful in understanding the data structure and in building a baseline statement on the strengths and weaknesses of each carrier.

After the computation of relative frequencies, cross-classification analysis was performed between each of the 11 selected shipper perceptions and the share of shippers. The share of shippers was measured by determining which carriers were most frequently used.

A summary of the analysis is presented in Table 1. Overall, the service categories had the highest positive ratings for frequent users, led by Broad National Coverage, Expanded Terminal Coverage, and Prompt Pickup/Delivery. Surprisingly, the pricing attributes such as Aggressive Discounting and Tailored Prices had the highest negative ratings among frequent shippers.

For each carrier, the data were ranked from highest to lowest among those shippers who used that carrier frequently. For example, approximately 54 percent of shippers that used Carrier A frequently characterized Carrier A as having aggressively expanded terminal coverage since 1980 and 52 percent said that Carrier A offers prompt pickup and delivery.

One interesting finding of this analysis was the relatively lesser importance of pricing attributes such as Innovative Pric-

TABLE 1 SUMMARY OF CROSS-CLASSIFICATION ANALYSIS OF SHIPPERS' IMAGE OF SEVEN NATIONAL COMMON CARRIERS

Category	Shipper Response (%) by Carrier ^a						
	A	B	C	D	E	F	G
Broad National Coverage	32.2 ^b	70.9	29.3	42.9	74.3	33.7	61.2
Aggressively Expanded Terminal Coverage	54.2	41.6	26.0	22.4	48.5	26.5	36.9
Low Loss/Damage	38.2	42.8	34.2	30.9	42.4	31.9	40.6
Fast Claim Resolution	27.9	29.6	25.0	22.2	30.6	23.3	31.7
Good Tracing System	36.3	52.2	30.4	37.8	49.2	35.1	48.5
Consistency of Service	36.5	45.4	31.6	30.9	49.6	37.4	44.4
Prompt Pickup/Delivery	51.7	53.7	44.3	43.6	55.3	45.7	58.1
Expedited Service	41.4	46.1	37.5	35.6	48.3	36.2	49.1
Innovative Pricing Programs	31.3	31.0	25.0	27.6	32.6	28.8	39.2
Aggressive Discounting	26.4	24.4	21.4	17.5	26.2	21.9	31.1
Tailored Prices	19.4	23.4	16.7	14.6	20.7	15.0	21.8

^aCarriers' names have been disguised for this analysis to protect the proprietary interest of the firms.

^bInterpret as "among those shippers who use Carrier A frequently, 32.3 percent said Broad National Coverage was very descriptive."

ing Programs and Aggressive Discounting as compared with service attributes.

ORDERED-RESPONSE MODEL

How can carriers prepare their marketing strategies for various types of shippers? Should carriers be treated the same and if not, what should the differences be? A model was built to test possible answers to these questions using the ordered response approach.

Three ordered categories in the data set exist. 1. Frequent users, 2. Occasional users, and 3. Nonusers. It is assumed that the responses are ordered from 1 to n . Furthermore,

$$Y_i = X_i \cdot \beta_i + \varepsilon_i \quad (1)$$

where

Y_i = dependent variable of interest,
 X_i = independent variables, and
 ε_i = error term.

Then within the model, the individual shipper falls into the following categories:

Category 3 if $\varepsilon_i < X_i \cdot \beta_i$,
 Category 2 if $X_i \cdot \beta_i < \varepsilon_i < X_i \cdot \beta_i + c$, and
 Category 1 if $\varepsilon_i > X_i \cdot \beta_i + c$,

where $c > 0$. It is also assumed that

$$\varepsilon_i \sim N(0, \sigma^2) \quad (2)$$

Also assumed is that the variable of theoretical interest is the interval level (3–5). In this case, only an ordinal variable Z_{ij} is observed such that $Z_{ij} = 1$ if Y_{ij} falls in the j th category, and $Z_{ij} = 0$ otherwise, where $i = 1, 2, \dots, n$, and $j = 1, 2, \dots, m$.

Y_{ij} is not observable, but it is known to which of the m categories it belongs. Thus, if Y_{ij} is observed such that

$$\alpha_{j-1} < Y_i < \alpha_j \quad (3)$$

it is known that it belongs to the j th category.

From Equations 1 and 3, the probability function of the observed dependent variable Z is written as follows:

$$\alpha_{j-1} < Y_i < \alpha_j = \alpha_{j-1} < \beta' \cdot X_i + \varepsilon < \alpha_j \quad (4)$$

If $\beta' \cdot X_i$ is subtracted from the right-hand side of Equation 4 and the result is divided by σ , then Equation 4 becomes

$$\alpha_{j-1} - \beta' \cdot X_i / \sigma < \varepsilon_i / \sigma < \alpha_j - \beta' \cdot X_i / \sigma \quad (5)$$

From Equation 2, in which the error term is assumed to be multivariate normal, the following results:

$$\text{Prob}(Z_{ij} = 1) = \phi(\alpha_j - \beta' \cdot X_i) - \phi(\alpha_{j-1} - \beta' \cdot X_i) \quad (6)$$

where ϕ is the cumulative standard normal.

The likelihood function for the model is

$$L = \prod_i \prod_j [\phi(\alpha_j - \beta' \cdot X_i) - \phi(\alpha_{j-1} - \beta' \cdot X_i)]^{Z_{ij}} \quad (7)$$

and the log-likelihood function is

$$L^* = \ln L = \sum_i \sum_j Z_{ij} \ln [\phi(\alpha_j - \beta' \cdot X_i) - \phi(\alpha_{j-1} - \beta' \cdot X_i)] \quad (8)$$

The ordered probit and logit models differ only in the specification of the distribution of ε_i , namely, the cumulative normal distribution for the probit model and the logistic distribution for the logit model. Also, the latent variable Y_i is interpreted as susceptibility, and α_i as a threshold (6).

The maximum likelihood estimate of the parameters can be obtained by maximizing Equation 8 with respect to β and α_k . In this case, CRAWTRAN was used (7).

Finally, the variables were ranked as follows. The dependent variable, degree of frequency, was ranked by shippers as

1. if used frequently,
2. if used occasionally,
3. if used very infrequently.

The independent variables Prompt Pickup/Delivery, Aggressive Discounting, Expedited Service, Consistency of Service,

Innovative Pricing Programs, and Tailored Prices were ranked by shippers as

1. if very distinctive (excellent),
2. if distinctive (good),
3. if not very distinctive (fair),
4. if not distinctive (poor).

Table 2 shows the results of the ordered-response model for carriers A, C, E, and G. The overall statistical results for the ordered probit model were significant. Service attributes such as Consistently Good Service and Prompt Pickup/Delivery are all statistically significant, as well as of great magnitude

compared with the other attributes for selected national common carriers. The pricing attributes such as Aggressive Discounting are statistically significant for Carriers A, C and G; however, the Innovative Pricing Programs category is significant for Carriers E and G.

Another major question was whether the results in Table 2 would be the same for all shippers, regardless of the shipper's special characteristics, such as different levels of annual spending for freight, different lengths of haul, and different types of commodities shipped.

Table 3 shows the separated sample in terms of the shipper's annual spending for freight. The selected sample of relatively small shippers consisted of those who spend under \$100,000

TABLE 2 PARAMETERS OF ESTIMATES FOR ORDERED-RESPONSE PROBIT MODEL: ALL SHIPPERS

Category	Coefficients by Carrier ^a			
	A	C	E	G
Consistency of Service	0.2867 (4.18) ^b	0.7084 (6.68)	0.5493 (5.28)	0.6534 (6.49)
Prompt Pickup/ Delivery	0.2674 (3.93)	0.4230 (4.15)	0.4767 (4.50)	0.6467 (6.53)
Expedited Service	0.1198 (1.90)	0.0845 (0.81)	0.2711 (2.76)	0.1249 (1.30)
Innovative Pricing Programs	0.0494 (0.74)	0.1861 (1.67)	0.2224 (2.16)	0.3008 (2.98)
Aggressive Discounting	0.2769 (4.06)	0.2196 (2.06)	-0.0083 (-0.24)	0.2407 (2.45)
Tailored Prices	0.0000 (-0.58)	0.1733 (1.75)	0.2292 (2.38)	0.0688 (0.75)
Threshold	1.0366 (18.41)	1.9705 (26.60)	1.4426 (22.89)	1.8675 (28.01)
Log-likelihood	-737	-876	-840	-961
Observation	772	940	975	1149

^aCarriers' names have been disguised for this analysis to protect the proprietary interest of the firms.

^bNumbers in parentheses are *t* statistics.

TABLE 3 PARAMETERS OF ESTIMATES FOR ORDERED-RESPONSE PROBIT MODEL: SMALL SHIPPERS AND LARGE SHIPPERS

Category	Coefficients for Small Shippers by Carrier ^a				Coefficients for Large Shippers by Carrier ^a			
	A	C	E	G	A	C	E	G
Consistency of Service	0.4717 (4.32) ^b	0.4078 (1.89)	0.3312 (1.57)	0.5336 (2.14)	0.3218 (3.36)	0.7107 (4.49)	0.6091 (3.91)	0.7750 (5.32)
Makes Prompt Pickup/Delivery	0.1430 (1.38)	0.4322 (2.10)	0.4794 (2.47)	0.6189 (2.97)	0.3065 (3.70)	0.4567 (2.97)	0.3910 (2.35)	0.6739 (4.36)
Expedited Service	0.2250 (2.09)	0.2892 (1.33)	0.1026 (0.49)	0.2746 (1.36)	0.2502 (3.08)	0.1025 (0.66)	0.4629 (2.99)	0.1411 (0.94)
Innovative Pricing Programs	0.1769 (1.59)	0.3294 (1.39)	0.3246 (1.53)	0.2312 (1.08)	0.2449 (3.02)	0.1529 (0.94)	0.1431 (0.95)	0.4903 (3.16)
Aggressive Discounting	0.0538 (0.48)	-0.0305 (-0.33)	0.1051 (0.53)	0.3759 (1.76)	0.0069 (0.10)	0.4433 (2.95)	0.0182 (1.22)	0.1876 (1.22)
Tailored Prices	0.0204 (0.19)	0.3833 (1.94)	-0.0037 (-0.19)	0.0469 (0.23)	0.0042 (0.05)	-0.0121 (-0.07)	0.3731 (2.52)	0.0713 (0.49)
Threshold	1.1449 (11.85)	2.2001 (14.39)	1.6101 (12.91)	2.1043 (15.01)	1.0539 (14.34)	1.7627 (16.56)	1.3285 (14.26)	1.7218 (17.36)
Log-likelihood	-276	-208	-216	-225	-417	-408	-373	-428
Observation	298	220	235	266	190	140	237	217

NOTE: Small shippers are those who spend less than \$100,000 annually for freight. Large shippers spend more than \$500,000 annually for freight.

^aCarriers' names have been disguised for this analysis to protect the proprietary interest of the firms.

^bNumbers in parentheses are *t*-statistics.

annually for freight. The results indicated that the small shippers were more sensitive to service attributes such as prompt pickup and delivery and consistency of service than pricing attributes such as aggressive discounting.

The sample of relatively large shippers (those who spend over \$500,000 annually for freight) revealed mixed results. For Carrier A, both service and pricing attributes were equally critical. However, the service attribute was the major factor for Carrier E. Service attributes were significant for Carriers C and G; however, the pricing attributes were split between these carriers (i.e., aggressive discounting for Carrier C and innovative pricing programs for Carrier G).

Conclusions

One implication of this paper is that carrier management can determine how a particular shipper or group of shippers evaluates various goals in purchasing freight transportation services. The evidence of this study indicates that the relative importance of service and price attributes can be estimated and that these weights may vary by market segments. The service categories were more important variables than the pricing categories for small carriers. The findings for big shippers were mixed.

Some caution is needed before these results are evaluated.

1. The shippers' perceptions (images) may or may not reflect the carrier's actual performance. A carrier may discover that many shippers perceive its performance on certain

characteristics as being inferior to their competition when the actual performance is comparable or superior. In this event, the carrier can initiate marketing efforts designed to bring shipper perceptions in line with actual performance.

2. The data used in this study are somewhat dated, but the general approach of this analysis may well be suitable for more recent information on the trucking industry.

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