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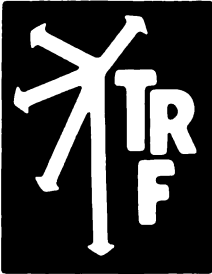
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An Evaluation of Motor Carrier Performance in Moving Washington Fresh Fruits and Vegetables

by Jonathan Newkirk and Kenneth Casavant*

ABSTRACT

The performance of the agriculturally exempt sector of the motor carrier industry has been of interest to economists since the regulation of the motor carrier industry. This paper measures the economic performance of motor carriers hauling exempt agricultural commodities, comparing it to earlier findings in the literature. Recent studies were drawn upon to evaluate whether the competitive performance standards were still being met by haulers of exempt perishable agricultural commodities. Pacific Northwest truckers of perishables served as the focus for rate and cost information for this current evaluation.

The paper concludes that motor carriers of apples, for the movements evaluated in this study, were found to operate in markets exhibiting the performance associated with a competitive structure. Motor carrier revenues do generally cover average costs of transportation and the pricing behavior responds well to seasonality and competition.

INTRODUCTION

The performance of the motor carrier industry has been a recurrent theme in the transportation literature. The performance of the agriculturally exempt sector of the motor carrier industry has been of interest to economists since the regulation of the motor carrier industry in 1935 (Cornelius; Miklius). Although the regulatory differences between the regulated and exempt sectors of the motor carrier industry have been reduced significantly with the passage of the Motor Carrier Act of 1980, the production and marketing characteristics of agricultural commodities, many who provided support for the agricultural exemption in 1935, have changed little. Due to the seasonality, perishability, and relatively rapid and wide fluctuations in prices of many agricultural commodities, there is need for transportation services which provide flexibility and speed in reaching markets (Miklius). A transportation industry with characteristics of the competitive norm was evidently seen, by 1935 policymakers, as best serving agriculture's needs.

This paper will measure the economic performance of motor carriers hauling exempt agricultural commodities, comparing it to earlier findings in the literature. Recent studies will be drawn

upon to evaluate whether the competitive performance standards are still being met by haulers of exempt perishable agricultural commodities. Pacific Northwest truckers of perishables serve as the focus for rate and cost information for this current evaluation.

CONCEPTUAL APPROACH

Economic performance is usually measured against the competitive market dimensions which imply fairly specific structure and conduct in terms of economic theory. The assumptions of the competitive market are: (1) homogeneous products; (2) atomistic market conditions; (3) perfect information; (4) resource mobility; and (5) freedom of entry and exit in the market. These dimensions often require proxies to judge the economic performance of the motor carrier industry. Miklius (1969) measured the performance of the exempt market by looking at decision making of exempt truckers, rate-cost relationships, rate-distance relationships, and indicators of excessive competition within the exempt sector. He found that exempt truckers seemed to be performing satisfactorily against the competitive market standard.

Cornelius (1977) studied the performance of motor carriers in the exempt market by identifying and measuring four anticipated dimensions of performance which best combined the theoretical and desired performance of exempt agricultural carriers. They were: (1) responsiveness to demand; (2) profitability; (3) capacity utilization; and (4) stability of operation. Cornelius's work, based upon 8,982 valid responses from a national survey of motor carriers hauling agriculturally exempt commodities, served as the investigative framework for this study.

Responsiveness to demand was measured by the entry rate of truckers over time in response to changes in the volume of agricultural marketings. Profitability was measured indirectly by using stability and growth rates in the agricultural exempt industry. Capacity utilization was identified as a proxy for technical operating efficiency and was evaluated in terms of percentage of empty miles incurred by a firm. Stability was assessed by looking at the cumulative mortality function derived from trucker entry and exit rates.

Cornelius concluded that the agricultural exempt carrier industry while strongly competitive,

was not destructively so. Firms were responsive to demand, relatively stable in their economic livelihood, likely to incur normal profits, and they utilized their equipment in a reasonably efficient manner. As a result, the agricultural exemption was operating in the manner for which it was designed and therefore was serving the needs of the agricultural industry.

INVESTIGATIVE FRAMEWORK

The Cornelius model served as the analytical framework for this study. Specific attention is paid to the motor carriers hauling perishable fruit and vegetables from the Pacific Northwest to representative markets. Rates on representative origin-destination movements are compared to the costs of providing that service.

RESPONSIVENESS TO DEMAND

Responsiveness to demand (mobility of resources) is necessary in the agricultural industry to assure an adequate supply of carrying equipment in various shipping areas, particularly to meet seasonal peak demands. During times of peak seasonal shipment volumes, the quantity of transport demand exceeds that supplied at the prevailing freight rates. Higher freight rates then are expected to serve as the attraction for additional carriers to move into the market to handle the peak demand. During the off season, freight

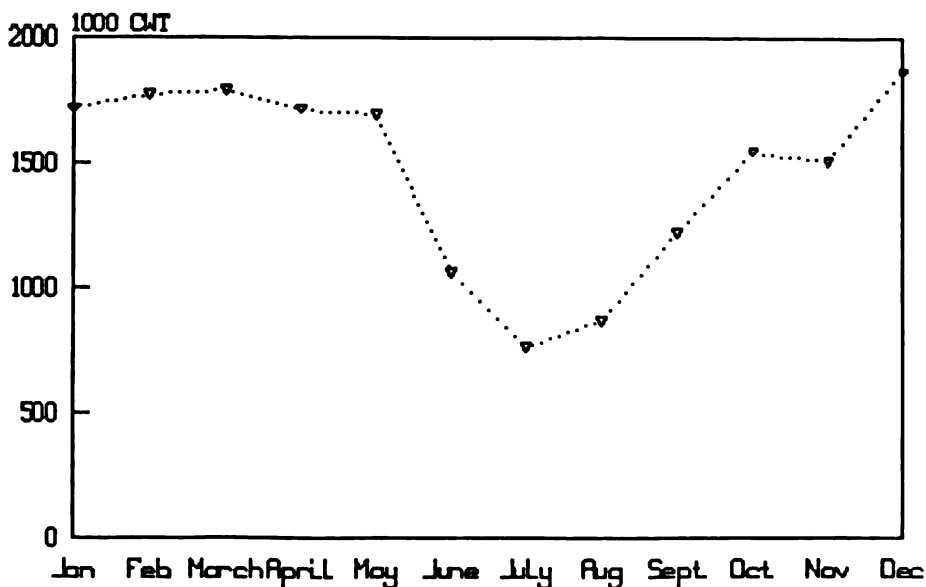
rates fall with the oversupply of transport services, causing carriers to shift to other markets or out of the industry completely (Miklius).

Cornelius tested responsiveness to demand by looking at regional service coverage of exempt truckers. This was done by measuring the correlation between regional agricultural production and the carrier state of domicile. He also looked at firm entry rates over time into agricultural commodity markets. He could not support the hypothesis that carriers were unresponsive to shipper demand and concluded that carriers were in tune to shipper demand.

Another indicator of market competitive response to shipper demand is to see if changes in transport rates correspond to changes in demand. Apples are shipped in sizeable volumes by motor carrier the year around from the State of Washington (Figure 1). Los Angeles represents the largest major market for Washington Apples (U.S. Department of Agriculture-b:c).

Comparing truck rates for apples to Los Angeles, Figure 3, to the market demand for transportation services to the Los Angeles market, Figure 2, during calendar year 1987 shows rates moved generally upward into April, as measured by the midpoint of the reported rate ranges, then declined into August and September and then moved upwards in October, a pattern similar to apple shipments to Los Angeles. While the correlation is not exact, it is clear when quantity demanded is highest, rates are higher and when demand is lower, rates are generally lower. This suggests that rates respond to shipper demand as economic theory of competitive markets suggests, at

FIGURE 1
Washington Apple Shipments via Truck, Calendar Year 1987



Source: U.S. Department of Agriculture—c

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TABLE 1
Total Estimated Annual Short Run Fixed Costs
per Truck Unit For a Representative Pacific
Northwest Fresh Fruit and Vegetable Trucking
Firm, 1987

Fixed Cost Category	Amount
Depreciation	\$19,600
Return on Investment	\$7,369
Licenses and Taxes	\$3,834
Insurance	\$7,649
Management, housing, etc.	\$18,096
TOTAL	\$56,548

Source: Newkirk and Casavant.

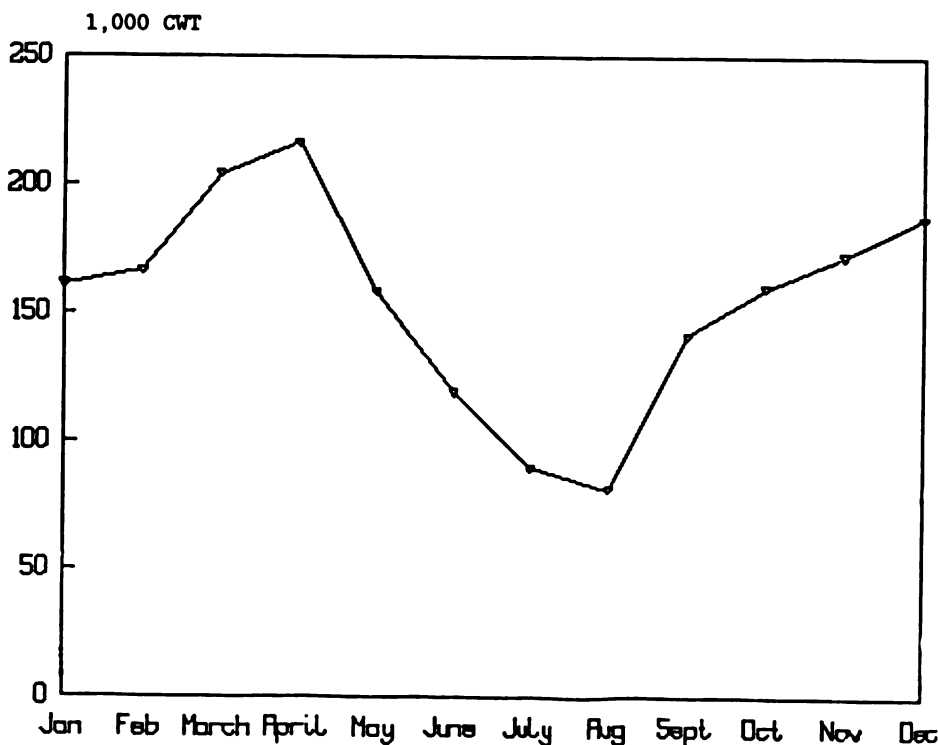
least in the Central Washington to Los Angeles market. Thus the incentives (disincentives) necessary to create carrier entry (exit) from that particular market are created.

PROFITABILITY AND STABILITY

The competitive model leads to results in which

the market price (P) just equals the marginal costs (MC) of each firm in the market place. This results in normal economic profits and a stable market. When competitive market conditions exist, if profits rise above normal, a condition caused if $P > MC$, new entrants will be drawn into the market and prices will be forced towards $P = MC$. And conversely, if profits fall below normal profits, a condition where $P < MC$, firms will leave the market and prices will rise to $P = MC$. This process would force the price to an equilibrium level which in the long run will equal long run average total costs and revenues will equal total costs if competitive market conditions exist (Leftwich). Deviations of P from MC , in any direction, over extended periods of time indicates that competitive forces are not working (Wilson). Cornelius chose to focus on entry and exit rather than costs and revenues to analyze the profitability conditions of exempt agricultural carriers. Cornelius tested a profitability hypothesis that profits in the exempt agricultural carrier industry were depressed due to the excessive competition created by a chronic oversupply of carriers which would lead to cut rate pricing schemes where P would be less than MC . The hypothesis was tested using three evaluatory criteria: (1) firm

FIGURE 2
Washington Apple Arrivals via Truck to Los Angeles, Calendar Year, 1987



Source: U.S. Department of Agriculture—a and b

entry and exit rates; (2) the incidence of ownership transfers; and (3) firm growth. The hypothesis was rejected on all three of the criteria.

Cornelius used a similar hypothesis to test the stability of exempt agricultural carriers. The null hypothesis tested was that freedom of entry into the agricultural exempt transportation market has created an unstable industry characterized by chronic over capacity and over investment in transportation resources, resulting in a high turnover and exit rate among exempt agricultural carriers. To test the hypothesis he evaluated three facets: (1) the entry rate of firms, (2) the survival of firms from previous time periods; and (3) the exit of firms from the industry. This hypothesis was also rejected.

COST DERIVATION

In this study revenue and cost of Pacific Northwest perishables shippers were directly compared to evaluate profitability and stability. A specific model for fresh fruit and vegetable (FFV) haulers was developed by Casavant and Dooley (1983) using information provided through a survey of PNW perishables haulers. The Casavant and Dooley model was updated to 1987 via interviews with truckers, equipment dealers, financial lenders, and others knowledgeable about the FFV industry (See Newkirk and Casavant for details). Economic engineering was used to estimate long run average costs for a representative Pacific Northwest FFV trucking firm. Factor prices for 1987 were utilized in the model.

The average PNW FFV trucking firm operated 20 trucks and was 100 percent self owned. The owner usually drove one of the trucks as well as managing the fleet. The primary investment was in the trucks. Most firms operated out of the home of the owner and had minimal investment in shops or terminals. Average annual mileage per truck was 130,000 miles. Seven percent of those miles were empty.

Long-run average costs were modeled and were broken into short-run fixed and variable cost components. Short-run fixed costs include: depreciation on capital investment; interest charges on debt or return on investment; license fees and taxes; insurance; and management, overhead, or housing expenses. Combining the various short run fixed cost categories results in the total annual short run fixed cost of \$56,548, as summarized in Table 1. By dividing the annual short run fixed costs by 130,000 annual miles, per mile fixed costs of \$.435 was estimated.

Variable costs are the costs directly related to output, in this case, mileage. They are the costs the firm must recover if it is to stay in operation in the short run. Included in variable costs are: tires; fuel; maintenance and repairs; and driving labor.

The summation of per mile tire cost, per mile fuel cost, per mile maintenance and repair cost, and per mile driving labor cost returns the total per mile variable cost of \$.538 per mile (Table 2).

Total per mile costs are determined by adding the short run fixed costs per mile to the variable costs per mile. Washington FFV truck transportation costs in 1987 are estimated to be \$.973 per

mile at an average annual mileage per truck of 130,000 miles. The truck load costs of shipping apples, the major perishables commodity shipped from Washington, to the selected destination cities are reported in Table 3. The truck load cost for a load of apples to a destination city, the fifth column in Table 3, is the fully allocated front haul truck costs.

These costs are the per mile truck costs of the front haul with refrigeration fuel costs, plus the costs associated with the expected empty miles travelled during the round trip.

REVENUE-COST ANALYSIS

Revenues used were based on rates for shipping apples as apples are shipped in significant volumes throughout the year and rate information was readily available (U.S. Department of Agriculture-d). Estimated truckload costs were compared to truckload rates for shipments to four markets from Central Washington, the major Pacific Northwest source of fresh apples.

Revenues not being equal to long run average total costs would be an indication that competitive market forces are not present. The high and low truck rates as well as average total cost for each week in which truck rates for apple shipments from Central Washington were reported during calendar year 1987 are shown in Figures 4 (Atlanta), 5 (Chicago), 6 (Los Angeles), and 7 (New York). The costs shown are long-run average total costs. Average variable costs are not reported since those rates which fall below total costs in these four markets are still well above variable costs in all instances.

In the Atlanta market, truckload costs fall within the spread of rates for all weeks reported (Figure 4). Truckers appear to be pricing in a manner such that revenues will approximately equal costs. Prices to Atlanta do appear to slightly firm up in the September-October period, when movements are the highest (Figure 4). Los Angeles is the only market in which all rates quoted, irrespective of season, are above costs (Figure 5). However, rates to Los Angeles appear to respond to quantity demanded as pointed out earlier in the paper (Figure 2; Figure 3). It may be that the estimated long run average costs used do not represent all of the costs incurred by a trucker when deliveries are made to Los Angeles. The search costs, whether time (due to congestion) or

TABLE 2

Estimated Per Mile Variable Costs for a Representative Pacific Northwest Trucking Firm Hauling Fresh Fruits and Vegetables, 1987

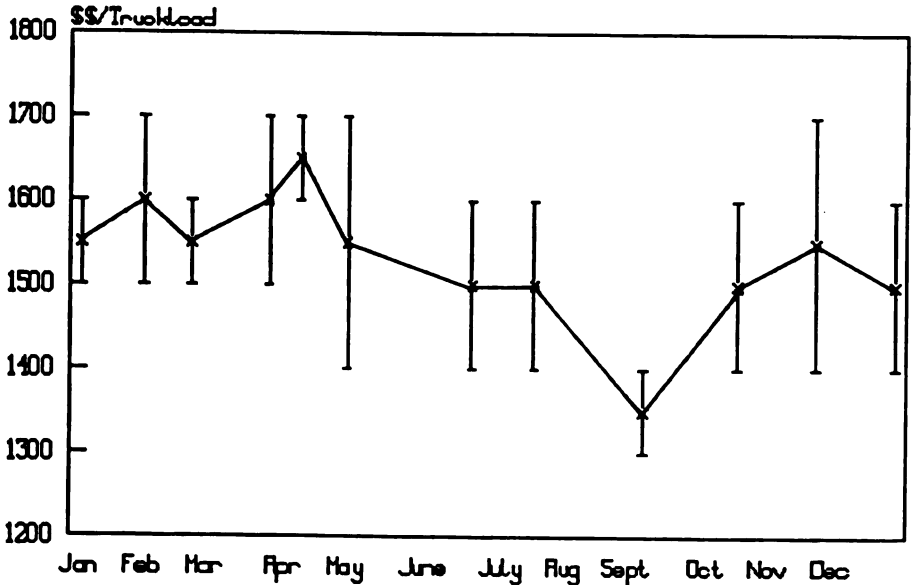
Variable Cost Category	Amount Per Mile
Tires	\$.037
Fuel	\$.183
Maintenance	\$.153
Labor	\$.165
TOTAL	\$.538

Source: Newkirk and Casavant.

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FIGURE 3

WA—Los Angeles Truck Rates for Apples, Rate Spread with Midpoint, Calendar Year 1987



Source: U.S. Department of Agriculture—d

Note: Each verticle bar represents week in which high and/or low rate changed from previous rate.

empty miles, for a return load may be greater when serving Los Angeles than the overall average used in the model. Miklius found that a trucker would be only willing to undertake a trip if total expected revenue for the round trip were to cover or exceed the costs of the round trip. Another factor that may contribute to the relatively higher rates is that Los Angeles is the only one of the four markets in which there is no intermodal competition for apple moves (Newkirk and Casavant). Rates in the Chicago market fall generally below average total costs although during times of higher demand the upper bound of rates is above total costs (Figure 6). Although rail

lost considerable market share in 1987 to truck (down from 43.9 percent in 1986 to 7.6 percent in 1987), rail service to Chicago is very cost competitive with truck (Newkirk and Casavant). This could be a factor in the generally lower rate-cost structure.

Rates to New York are generally above costs although they appear quite responsive to demand. Again, there is significant rail competition in the New York market for apple movements. In 1987, 26.8 percent of apple movements were by truck with the remainder moving by rail (U.S. Department of Agriculture-c). Because of the delays in rail movements getting through Chicago and New

TABLE 3

Truck Transportation Costs of a Representative Pacific Northwest Fresh Fruit and Vegetable Trucking Firm for a 44,000 lb. Load of Apples from Yakima to Selected Cities, 1987

Destination City	Fronthaul Miles	Truck Costs ^a	Refrigeration Fuel Costs	Costs Per Truckload
Los Angeles	1,103	\$1,224	\$29.61	\$1,254
Chicago	2,018	\$2,238	\$47.12	\$2,285
New York	2,807	\$3,114	\$62.21	\$3,178
Atlanta	2,591	\$2,874	\$58.08	\$2,932

Source: Newkirk and Casavant.

^aCost per mile * Fronthaul miles * (1 + $\frac{\text{Empty Miles}}{\text{Fronthaul Miles}}$)

York/New Jersey rail yards, service characteristics to New York by rail are significantly lower than truck (Newkirk and Casavant).

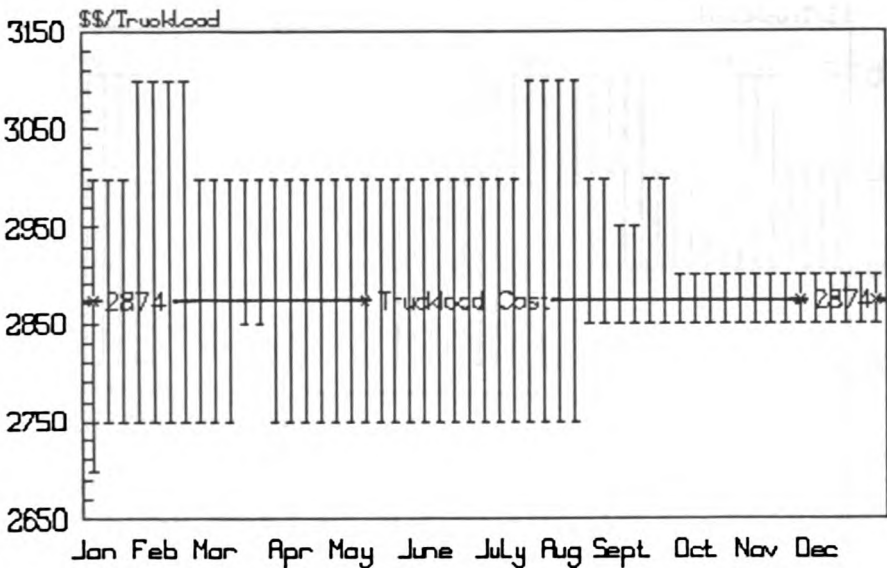
The comparison of rates to costs in the Atlanta, Chicago, Los Angeles and New York apple transportation markets to measure profitability would indicate that there is evidence of competitive market forces in these markets. Rates are somewhat greater than costs in the short haul market where intermodal competition is less. Rates though are generally in line with costs and normal profits appear to be available to firms serving these markets. There is no indication of cut throat or destructive pricing as all rates are well above variable costs and in all cases are closer to total

conclusion that with normal profits being experienced in a market, relative stability of entry and exit of firms in that market should exist.

CAPACITY UTILIZATION

The economic consideration of capacity utilization is not so much the absolute level, but rather the relation of the level of capacity utilization to optimal capital investment and/or operating costs that is important (Cornelius). Cornelius looked at percent of empty mileage as one of the measures for the criterion. He found that fruit and vegetable haulers experience a comparatively low

FIGURE 4
WA—Atlanta Truck Rates for Apples with Truckload Transportation Cost



Source: Newkirk and Casavant; U.S. Department of Agriculture—d

Note: Each verticle bar represents the spread between the high and low rate as reported in a given week.

costs than variable costs. Firms in these markets appear to be making rational economic decisions in response to market conditions by pricing above variable costs and in fact are pricing near long-run average costs.

This finding corresponds with the 1984 analysis by Corsi, Agar, and Roberts. They reported revenues were 6 cents per mile higher than costs for owner-operators operating refrigerated vans, and for all refrigerated vans, on a per truck basis, costs were one cent more than revenues. Exempt carriers in general had revenues 3 cents per mile higher than costs on a per truck basis. While no evidence about entry and exit rates was presented in this paper, economic theory leads to the con-

level of empty mileage. Fruit and vegetable haulers in 1974, the year of the Cornelius survey, were experiencing 20 to 30 percent empty mileage. While Cornelius did not determine a singular optimum rate of capacity utilization, he did conclude that while utilization could be improved (primary restrictions to improvement at the time of the study were regulatory in nature), the influence on capacity utilization by the variables measured in his analysis, including percent empty miles, did exhibit predictable associations consistent with the expectations of a competitive, relatively stable industry.

In a study (Casavant and Dooley) prior to this analysis, fresh fruit and vegetable truckers oper-

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ating out of the Pacific Northwest had 7 percent empty miles, a considerable improvement over the 20 to 30 percent reported by Cornelius. Corsi, Agar, and Roberts reported that in 1984, refrigerated vans had 9.6 percent empty miles and exempt carriers generally had 20.5 percent empty miles. Neither of these findings would indicate any deterioration of capacity utilization since the Cornelius study and in fact utilization rates have improved.

CONCLUSIONS

It is apparent that motor carriers of apples, for

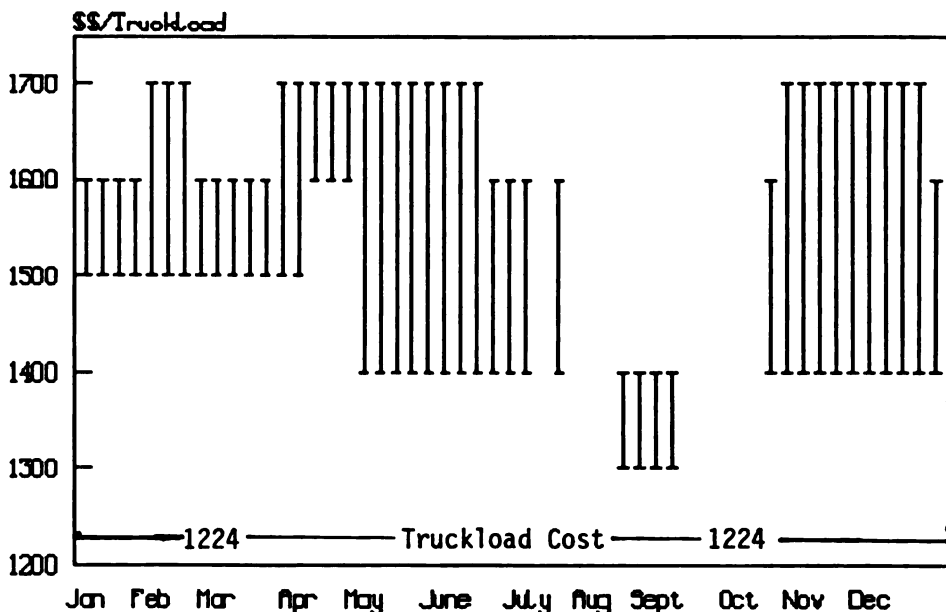
evaluation of motor carrier performance is appropriate.

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FIGURE 5

WA—Los Angeles Truck Rates for Apples with Truckload Transportation Cost 1987



Source: Newkirk and Casavant; U.S. Department of Agriculture—d

Note: Each verticle bar represents the spread between the high and low rate as reported in a given week.

the movements evaluated in this study, do operate in a market exhibiting the performance associated with a competitive structure. Motor carrier revenues do generally cover average costs of transportation but the pricing behavior responds well to seasonality and competition. In periods of strong demand and product movement, prices (rates) move above average total costs of production and, in low demand periods, prices are driven to or below average total costs. Further, in competitive markets, rates remain closer to costs of production while value of service pricing appears in the less competitive market. In sum, cost considerations appear to provide the economic floor to pricing decisions, suggesting a positive

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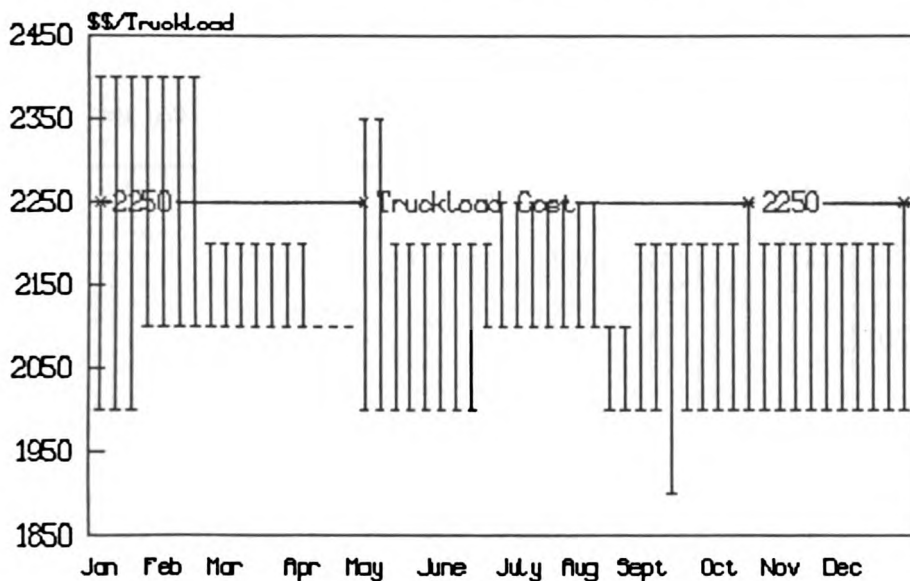
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FIGURE 6

WA—Chicago Truck Rates for Apples with Truckload Transportation Cost 1987



Source: Newkirk and Casavant; U.S. Department of Agriculture—d

Note: Each vertical bar represents the spread between the high and low rate as reported in a given week.

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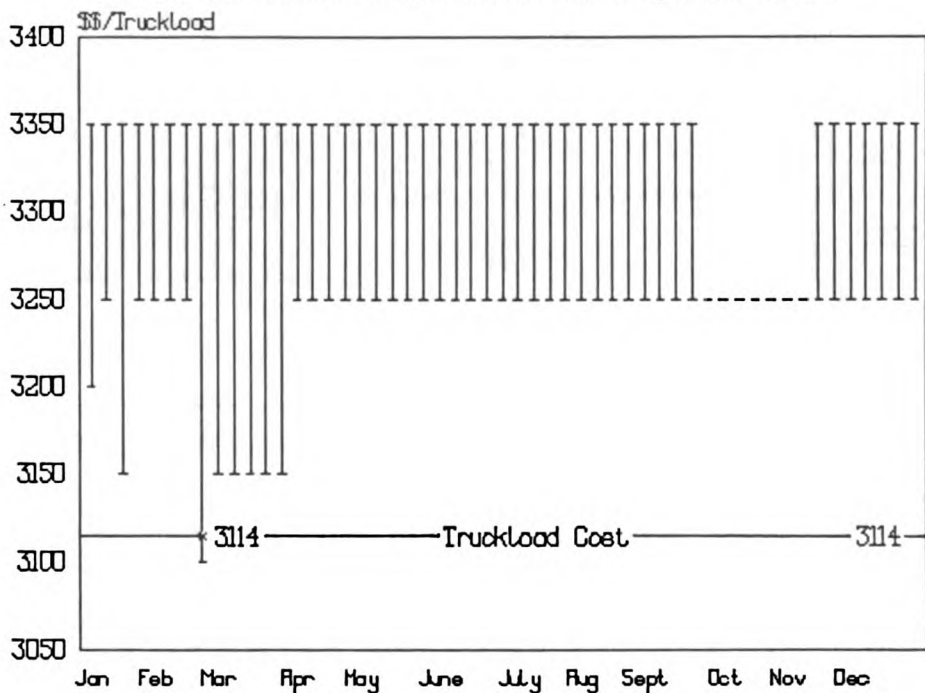
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ENDNOTES

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FIGURE 7

WA—New York Truck Rates for Apples with Truckload Transportation Cost, 1987



Source: Newkirk and Casavant; U.S. Department of Agriculture—d

Note: Each verticle bar represents the spread between the high and low rate as reported in a given week.

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