Transportation in Low Density Markets: a role for public policy?

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Abstract:

Many jurisdictions continue to regulate transportation services to small communities. These low density transport markets are subject to utilization economies that are lost when the market is fragmented among numerous competitors. This paper uses a simulation model that replicates the actual dispatching procedures used to distribute automobiles in western Canada. Using the actual demand for automobiles, the service levels and productivity of truck service in low density markets are estimated for various competitive scenarios and compared to the actual service and productivity levels achieved. Market performance results are modelled under monopoly and under competitive conditions and explicitly show the trade-off between service and productivity (cost). Market fragmentation is seen to result in significant productivity losses with service held constant, or service declines with productivity held constant. Competitors with the largest market shares have the greatest opportunities to produce the highest levels of service at the lowest cost. The results are consistent with empirical studies of other Canadian truck markets. Implications for public policy regarding transportation in low density markets are developed.

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1. INTRODUCTION

Market forces have replaced government regulation of transportation in many countries over the last three decades. The United Kingdom, the United States, Canada and Japan are among the countries that have deregulated major segments of their trucking industries. Trucking is viewed as an industry that closely approximates the perfect competition model with its low threshold costs, mobility of assets and perceived absence of economies of scale. An area of concern, however, is service to low density markets such as rural communities outside of major urban areas. This issue is still subject to regulation in North America as provincial (state) regulatory commissions in Canada (U.S.) retain residual authority to regulate within their borders. Although many states and provinces have followed federal initiatives to reduce or eliminate trucking regulations, a number of these jurisdictions retain varying levels of control. This control is particularly significant for small communities since many of the movements to these destinations originate and terminate within such jurisdictions.

The economics of low density markets has been relatively unexplored. This paper utilizes a simulation approach to examine the haulage of automobiles in British Columbia in order to explain the service, productivity and competitive relationships that are likely to be encountered in low density markets. The results are found to be consistent with empirical analyses of other, larger trucking markets. Implications for public policy are also developed.

2. TRANSPORTATION AND LOW DENSITY TRANSPORTATION MARKETS

A market is composed of the sellers and buyers of a product. The product in transportation is often referred to as a service which can be defined as the:

> capacity to move a defined commodity from a specific origin to a specific destination at a certain quality of service level.

The concept of quality of service is very significant. The transportation of a product from one point to another produces time and place utility; it adds value to the product by making the product available at the right place at the right time. If the product is damaged or delivered late, the product will have less or no value and the value added by transport will be rendered insignificant. Shippers demand transportation service characterized by a certain transit time and other characteristics. The market is efficient when buyers are able to obtain the quantity and quality of transport service desired at least cost.

Density is normally used to distinguish a high volume transportation market from a low volume market. A low density market would be a transportation market which cannot support frequent and efficient service. We shall use daily service (during business days) as the benchmark for frequent service. Efficiency is achieved when products are transported in the type and size of vehicle appropriate to the market and in full loads. The optimal vehicle size is difficult to pinpoint. The minimum vehicle size varies with the mode of transport but, within a mode, a number of vehicle options exist. For example, the optimal vehicle size for trucks in low density markets depends on distances and stop frequencies. A market with few stops and long distances is most economically served by large over-the-road (OTR) vehicles. In contrast, many stops over short distances are more economically served by smaller vehicles.

Low density transport markets are often synonymous with rural and small community transport markets. Such communities are outside major urban areas and are characterized by:

freight movement routed through the nearest urban centre allowing freight to be consolidated for final delivery rather than direct service;

unbalanced movement, typically inbound movement of consumables and outbound movement of resources, via different modes of transportation; and

low freight density.

A number of before and after studies were conducted to determine the impact of deregulation of trucking in small communities after U.S. deregulation (see Bourlaug, 1981; Interstate Commerce Commission, 1981; and Kidder, 1983). These studies generally found that service to small communities did not suffer or in fact improved after deregulation. Some of the positive impacts could be attributed the entry of United Parcel Service (UPS) whose corporate objective was to provide nationwide service to every location in the U.S. In contrast, UPS entered and then reduced its service to small communities in Canada once it found some of them to be unprofitable. Improved service in the U.S. also resulted from existing carriers being able to expand their service offerings and take advantage of economies of scope. None of the U.S. studies considered the cost of service and the rates charged.

A cross-sectional study of truck service to small rural communities in Western Canada addressed the issue of both costs and service under different regulatory conditions (Chow, 1984). That study observed that the province of Saskatchewan used regulation to enforce low rates but, in return, restricted entry so that carriers had a monopoly on individual routes. In contrast, the province of Alberta regulated neither rate nor entry. The result was lower prices and lower service in the regulated environment, and higher prices with higher service in the unregulated environment.

3. THE AUTOMOBILE HAULAGE INDUSTRY IN BRITISH COLUMBIA

A major hauler of new and used automobiles, Auto Haulaway (AHW) provided information which can be used to address issues concerning economic structure and conduct in low density markets. This section discusses some of the economic features of those markets.

Competition in short distance markets where the dealer is the destination is typically intramodal; that is, between different motor carriers. AHW was the dominant for hire motor carrier of automobiles originating from railheads or port terminals in Vancouver to dealers in B.C. Existing competition includes one 5 vehicle fleet carrier and several used car haulers. Potential competition includes private carriage operations of the manufacturers and expansion of terminal companies into the provision of new trucking services.

The trucking industry is commonly viewed as comprised of at least two industries: the less-than-truckload (LTL) segment and the truckload (TL) segment. Research in the area of economies of scale in trucking has conflicted but studies generally agree that what economies of scale do exist are most likely to be found in LTL trucking than in the TL sector. Economies of scale, density and utilization are unfortunately always measured at the firm level and few studies consider the size of the market served. In many regions or groups of markets, the demand for transportation may only be large enough to sustain one efficient-sized carrier. Economies of scale should be measured for each relevant route since each route represents a true transportation market.

In one sense, the automobile transportation business is an LTL business because cars can be tendered for a specific destination in less-than-truckload quantities and is done so frequently. However, the auto hauling business is best considered a TL business since there is no handling of freight across docks or extensive freight mixing in terminals. Consequently, the fixed costs of running such a business are not high in terms of overheads or terminal facilities. However, many linehaul costs are fixed per trip. The bulk of the driver, fuel and other operating costs are the same whether a truck delivers 2 cars or 10 cars. Thus, there are potential economies of utilization on any particular route. When the amount of traffic is high, i.e. a dense traffic market, many carriers can compete effectively. However, in low volume traffic markets, the fragmentation of traffic may lead to lowered efficiency or decreased service. The relationship between the economics of providing service and the demand for service must be examined to determine whether one or more carriers can operate efficiently in the market.

Automobiles are generally transported between cities in specialized tractor trailer vehicles with the capacity to carry 8 to 11 automobiles depending on the size of the individual automobiles. Unlike other forms of trucking where capacity utilization varies almost continuously, i.e. a 11,600 kg load versus a 12,000 kg load, etc., the load of the auto carrier will decrease or increase in increments of about 10 percent. That is, if a carrier loses the opportunity to carry one more car, about 1/10 of the potential load factor is lost.

Thus, losing the opportunity to transport just one more automobile represents significant losses in operating efficiency.

These route specific economies of scale can be reflected in the quality of transport service as measured by the frequency or speed of service. Ideally, a carrier would dispatch a vehicle load as soon as the capacity of the vehicle is reached. Thus, a carrier can provide daily schedules or dispatch vehicle loads daily if it has access to at least one truckload of traffic for the geographic market in question each day. When the traffic is less than the minimum quantity required to effectively utilize the vehicle, the carrier must make a choice between dispatching the vehicle underloaded or delaying the delivery of existing freight until additional freight is tendered and a more efficient load is consolidated. In dense markets such as the Vancouver to the adjacent Lower Mainland areas, such a tradeoff between cost or load productivity and service is irrelevant except at the margin. It is likely that most automobiles will be tendered along with enough other cars to justify a shipment within a short time of tender. As the number of cars tendered may not be an exact multiple of the capacity of the vehicles used, short delays for some vehicles may result. At the same time, the cost penalty for underloading is minimized because of the short distance and trip time. However, in low density markets, the tender of enough automobiles on any particular day to justify a vehicle dispatch is less likely and thus this tradeoff is real.

4. A SIMULATION STUDY OF THE HAULAGE OF AUTOMOBILES

In 1990, AHW transported approximately 95 percent of all vehicles delivered to dealers in B.C. and virtually 100 percent to areas outside of the Vancouver metropolitan area. AHW provided a complete listing of all automobiles shipped from all Vancouver terminals for the first five months of 1990. The average number of vehicles delivered per month was 15,709 with May being the peak month with 17,889 automobiles delivered. Approximately 36 percent of the automobiles were delivered to Vancouver metropolitan locations--a high-density, short-haul market. About 38 percent of the automobiles were delivered to low density markets within B.C. and the remaining 26 percent were delivered to U.S. and other Canadian markets.

A simulation approach was chosen to analyze the impact of fragmenting this business among several competitors. Such an approach would provide a fair assessment of the effect of new market entry because the same traffic base representing the total vehicles in a market would be used. The simulation approach also reflects the actual demand and distribution of demand over a selected period of time. It avoids the use of averages by accounting for automobiles tendered for delivery on a day to day basis. As it is difficult to replicate the exact dispatching decision rules that would apply to any and every situation, it was necessary to establish our own set of decision rules.

Since these rules are consistently applied, they result in an unbiased estimate of relative service and efficiency produced under alternate scenarios of market fragmentation.

Three separate simulation analyses were performed to study the potential effects of market fragmentation:

> The first analysis determines how *efficient* the *industry* will be under different market fragmentation scenarios given the level of service.
>
> The second analysis determines what *levels of service* will be provided by the *industry* under different market fragmentation scenarios while holding efficiency constant. By using this approach, the effects of market fragmentation can be seen more clearly and are not be confused by simultaneous changes in both service and cost or efficiency.
>
> The third analysis expands the first two simulations in order to examine *efficiency* and *service* for *individual carriers* under different market fragmentation scenarios.

In each of these analyses, the data used to measure *efficiency* is the *average load factor* of delivery trucks. Average load factor (or simply average load) is the *number of automobiles loaded on the truck per trip*. The *average age in days* is used to measure the *customer service level*. Average age in days is the time between tender date of the car by the manufacturer to AHW and dispatch date of the vehicle trip in which the car is delivered. This is an appropriate measure of customer service because the line haul transit time, once a truck is dispatched, should not differ significantly among competing carriers.

Traffic during the month of May was chosen for the analysis because the effects on customer service level and efficiency from fragmenting segmentation will be minimized under the heaviest volume periods. For periods of smaller volumes, the effects of fragmentation would be even worse. This case, therefore, represents a minimal-effect or best case scenario.

The relevant market is route specific and because of the number of markets, it was necessary to choose a sample of markets from which the effects of fragmentation could be measured. Productivity in very dense markets such as the Vancouver Lower Mainland destination area would be least effected by market fragmentation. Very low volume markets would be most affected by market fragmentation. Several medium volume and low volume markets were chosen for this analysis. The effects identified would be worse than would be the case in the high volume markets. The size of the six markets chosen ranged from 407 cars in Market 1 to the smallest market which received only 21 autos in May.

Load performance and service were measured under four scenarios for each of the six markets examined. In addition to the actual performance, fragmentation alternatives were chosen to represent some likely segmentations that would occur if the applicant were allowed to enter the market.

The four scenarios are:

1. Actual performance during May.
2. Simulated performance with all traffic retained by AHW (status quo).
3. Split 1 is the simulated performance assuming that a new entrant captures all of the import car traffic of one major Asian car manufacturer. Thus, AHW retains all domestic traffic and the remaining import traffic.
4. Split 2 is a simple Asian/non Asian split. AHW retains all domestic and import traffic not originating from Asia while the new entrant captures the traffic originating from Asia.

The number of cars that would be diverted to a new entrant under the two split scenarios in May 1990 are displayed in Table 1.

Table 1 Traffic Volume Diverted Under Alternative Split Scenarios: May 1990

	Number of Automobiles		
Market	Part of Imported Volume: Split 1	All Asian Imported Volume: Split 2	Total Volume
1	32	94	407
2	20	63	362
3	24	54	208
4	20	64	214
5	11	26	60
6	2	9	21

Simulation of load factor impact holding customer service constant

The first analysis looks at each of the chosen markets to determine how different fragmentation alternatives affect efficiency. For each market and for each scenario, *customer service level* is held constant to determine the effects of various fragmentation alternatives on the load factors. AHW's desired customer service level of two days aging of the vehicle order is used as the standard for customer service level. Two days aging is defined as dispatching the automobile for delivery within two days of the tender of the vehicle excluding the day of tender. Weekends and holidays are not counted in the service level computation. Truck loads are built and dispatched each day based on this level of customer service. This procedure results in different load factors across trucks as the customer service level is reached. The average load factor for all trucks is calculated for each split in each particular market as well as a frequency distribution of the load factors. The change in load factors over the various splits can then be analyzed.

The actual simulation procedure has the following steps:

1. Identify all automobiles tendered to be delivered to the market in question for the month of May.

2. Sort and arrange this list in chronological order of tender date from the first day to the last day of the month.

3. If the minimum truckload is accumulated, dispatch the truck immediately.

4. If the customer service level of two days aging is reached by one or more cars that have been tendered for delivery, dispatch a truck with as many automobiles as possible.

5. Do not dispatch any trucks if the minimum truckload is not accumulated and no automobiles have reached the maximum age in days criteria.

The detailed results of the simulations holding customer service levels constant and comparing average loads for Market 3 are shown in Table 2. Two hundred and eight automobiles were tendered for delivery to this area and 40 truckloads were dispatched. Actual vehicle trips involved deliveries to points outside of the defined market area so the actual average load is higher than the recorded 5.2 automobiles per truck and actual service performance was slightly better than the 2.5 days from tender to dispatch.

The impact of fragmenting the available traffic among several carriers on the Market 3 route is seen by examining the "Mean Deliveries/Truck" row of Table 2. The market fragmentation scenario represented by Split 1 results in an average load factor for all vehicle trips to Market 3 of only eight cars per truck. This is a reduction of about one automobile per load or an 11 percent (1/9) reduction in load efficiency.

Table 2 Simulation of Load Performance Holding Service Constant

	Market 3			
	Actual	No Split	Split 1	Split 2
Total Vehicles	208	208	208	208
Truckloads	40	23	26	26
Mean Deliveries/Truck	5.20	9.043	8	8
Std. Dev.	2.45			
Mean Age in Days	2.44	2.00	2.00	2.00

Similar calculations of the reduction in load efficiency given the customer service level were made for each market and each market fragmentation scenario. Table 3 shows the percentage decrease in load factors from the No Split to Split scenarios. One can easily observe that there are significant declines in load factors in all markets for all three simulated market scenarios.

Table 3 Load Factor Efficiency Losses Due to Splitting of Traffic

Market	Load Factor		Efficiency Loss Relative to No Split (%)	
	Actual	No Split	Split 1	Split 2
1	6.167	9.927	9.0	4.1
2	7.87	9.78	5.1	7.5
3	5.20	8.83	9.4	9.4
4	6.29	9.30	11.5	11.5
5	5.45	6.67	25.0	30.7
6	3.50	4.20	16.7	28.6

Simulation of customer service impact holding load factors constant

The second analysis holds *load factors* constant and looks at the effect of the fragmentation alternatives on the customer service levels. The average load factor actually observed in each market is used as the standard load factor for that market and truckloads are built to that level. This procedure results in varying customer service levels. The average age in days is calculated for each scenario.

The detailed results of the simulations holding average loads constant and comparing customer service defined as age in days are shown in Table 4 for Market 3. Average load was held constant at 6 automobiles per truckload in the simulation. The actual and simulated no split service performance appear to be inconsistent at first observation with actual service of 2.5 days being significantly worse than the simulated service of 0.28 days. However, interviews with AHW personnel indicate that many automobiles are tendered for delivery towards the end of the day. An examination of the frequency distribution (not shown) underlying Table 4 indicates that none of the Market 3 traffic that was tendered was dispatched on the same day as tendered. Our simulations dispatched the vehicle on the same day as long as the load minimum was met and did not distinguish between automobiles tendered early in the day versus late in the day. Thus, 161 cars were dispatched at least one day earlier in the no split simulation than in the actual situation. In addition, other criterion are used that we could not recognize. For example, there may be multiple dealers in the area so that holding one or more automobiles for an extra day may result in building two separate loads each destined to one location in the overall destination area as opposed to two loads, both destined to several locations in the destination area. These factors explain why we should expect actual age in days to be higher than the simulated age in days for the no split scenario.

Table 4 Simulation of Service Performance Holding Load Constant

	Market 3			
	Actual	No Split	Split 1	Split 2
Total Vehicles	208	208	208	208
Truckloads	40			
Mean Deliveries/Truck	5.20	6.0	6.0	6.0
Std. Dev.	2.45			
Mean Age in Days	2.44	0.28365	0.65385	0.59135

Two measures of the impact on service times are the absolute and percentage amounts that simulated age in days increased when the traffic was fragmented. For example, if Market 3 were fragmented as assumed in Split 1, the average age in days would increase from 0.28 to 0.65 days which is an absolute increase of only 0.37 days but a percentage increase of 132 percent [(0.65/0.28)-1] * 100. These measures of service impact were similarly computed for all other markets and market fragmentation scenarios. The results are shown in Table 5. The absolute increases suggest that delivery would be delayed from 1/2 to 3 days under Splits 1 and 2, with the greatest service declines occurring in the medium as opposed to the light markets since these latter markets are already poorly served.

Table 5 Absolute and Relative Impact on Service From Market Fragmentation

Market	Age in Days		Absolute Increase in Age/ Percentage Increase (%)	
	Actual	No Split	Split 1	Split 2
1	1.5	0.09	0.24/275	0.28/321
2	1.8	0.22	0.05/24	0.32/148
3	2.4	0.28	0.37/131	0.31/108
4	1.8	0.34	0.25/74	0.23/68
5	2.3	0.83	0.39/47	0.39/47
6	1.1	2.10	0.75/36	0.10/5

In summary, the fragmentation of the market in each of the six specific geographic markets examined, result in significant reductions in efficiency holding service constant or in decreased service holding efficiency constant. The simulations purposely controlled for one aspect of performance so that the impact on the other could be clearly seen. Of course, in reality some combination of decreased service and reduced efficiency would result from market fragmentation. The magnitude of the negative effects depends on how the traffic is fragmented. If the split is among more competitors, the maximum achievable performance will be less.

Simulation of the performance of individual firms

The simulation is expanded to observe the impact of market fragmentation on the efficiency of individual carriers serving the market. Table 6 breaks out the load performance simulation described above for each individual carrier under the split market fragmentation scenarios while Table 7 does so for the service performance simulation described above.

Load performance is consistently better for AHW in all but one of the markets. This result is because the majority of the traffic is new domestic car traffic and AHW is assumed to continue transporting these automobiles. The results for Market 6 are an exception because the bulk of the traffic originating out of Vancouver for the area is new import traffic which is assumed to be going to the new entrant.

Service performance follows the same pattern as load performance. AHW service is consistently superior to the potential service of the new entrant in the markets except where the dominant flow is import traffic.

Table 6 Load Performance of Individual Carriers Under Simulated Market Fragmentation Scenarios

		Carrier		
Market	Split	All	AHW	New
1	Split 1	8.66	9.38	4.57
	Split 2	9.25	9.70	7.63
2	Split 1	9.28	9.77	5.00
	Split 2	8.83	9.60	6.30
3	Split 1	8.00	9.20	4.00
	Split 2	8.00	9.06	6.00
4	Split 1	8.23	9.70	3.33
	Split 2	8.23	8.82	7.11
5	Split 1	5.00	6.13	2.75
	Split 2	4.62	4.80	4.33
6	Split 1	3.50	3.80	2.00
	Split 2	3.00	2.40	4.50

In summary, the relationship between individual carrier performance is dependent on how the traffic in a particular market is fragmented. The carrier with the larger share of traffic has the greatest opportunity to build vehicle loads and do so more frequently or quickly. Using Market 3 as an example, the scenario for the new entrant that captures all of the new import car traffic destined to that market results in a load factor of 6 vehicles given a service level of two days aging. This load factor is only 66 percent of AHW's simulated load factor of 9.06. Similar comparisons can be made for other markets and assumptions about the market fragmentation. Alternatively, a new entrant can only achieve a customer service level of 1.48 days versus 0.28 days for AHW or approximately 5 times longer aging with load factors held constant. Again, similar comparisons can be made for other markets and assumptions about the market fragmentation. Of course, the combined performance of all the carriers under various market fragmentation scenarios will be inferior to what could have been achieved without any fragmentation of the market.

Table 7 Service Performance of Individual Carriers Under Simulated Market Fragmentation Scenarios

		Carrier		
Market	Split	All	AHW	New
1	Split 1	0.33	0.19	1.97
	Split 2	0.37	0.27	0.71
2	Split 1	0.27	0.17	1.95
	Split 2	0.54	0.28	1.81
3	Split 1	0.65	0.33	3.17
	Split 2	0.59	0.28	1.48
4	Split 1	0.59	0.36	2.90
	Split 2	0.57	0.40	0.98
5	Split 1	1.22	0.96	2.36
	Split 2	1.22	1.09	1.38
6	Split 1	2.84	2.84	0.00
	Split 2	2.19	2.42	1.89

Likely impact of new entry on the public interest

The market fragmentation scenarios hypothesized in this study will either result in significant increases in transport costs, decreases in service to the buyers or some combination of these negative effects. Holding service constant, losses in line haul efficiency range from 5 to over 30 percent for the markets and market fragmentation scenarios examined and summarized in Table 3. There will be markets in which this loss will be greater (i.e. in less dense markets) and smaller (i.e. in more dense markets). An average loss of line haul load efficiency of 20 percent is used to further develop the implications of market fragmentation as shown in Figure 1. Fragmentation of the market essentially shifts the optimal relationship between service and load factor (solid curve) to the right (dotted curve) so that given a service level, two carriers will be less efficient than one (or, given a load factor, two carriers will provide poorer service than one). Line haul costs account for approximately 80 percent of total costs. Thus, a loss in line haul efficiency of 20 percent will result in an increase in costs of 16 percent which will be reflected in rate increases of approximately the same magnitude.

Should the market be fragmented, there is good reason to believe that the industry will eventually reconsolidate itself in order to regain the economies of route density that were lost with market fragmentation. The analyses summarized in Tables 6 and 7 show that significant differences in efficiency and service between the potential competitors will result in the short run. Such differences cannot exist in any market in the long run. Thus, the market will be thrown into a transition state in which buyers will be confronted with options which may be priced attractively in the short run but are not viable in the long run. Service disruptions may occur as the industry rationalizes itself through entry and exit.

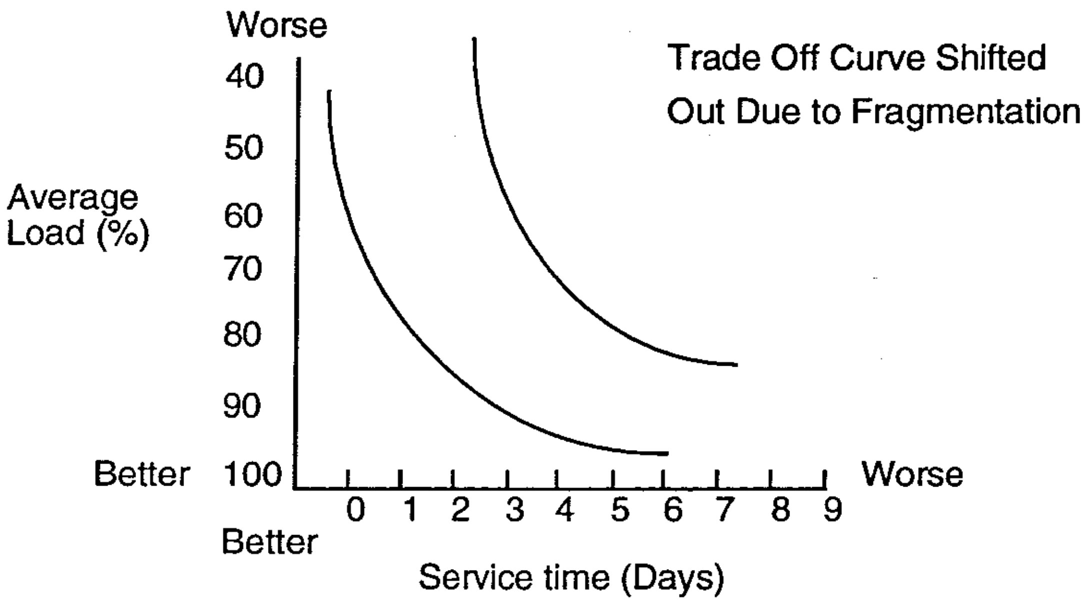

Figure 1 Load Service Tradeoff

Ultimately the choice is between a potential loss in short run efficiency versus a potential gain in long run technical efficiency. The possible operating efficiency losses under a variety of market fragmentation scenarios are significant in the low density markets examined. In the long run, the natural economies of utilization evident in these markets will encourage and ultimately result in the consolidation of competitors serving these markets. Indeed, AHW is a result of this search for market efficiency as it emerged from the consolidation of two auto haulers into one firm in 1987.

Long run technical efficiency results from competitive pressures, either from existing competitors or potential competitors. The threat that new competitors pose to the business of the existing carrier(s) spurs the existing carriers to provide the service demanded by shippers at a competitive price (i.e. a price that reflects costs and a reasonable profit), to continually seek cost reductions, and to take advantage of new technology. If the incumbent carriers ignore the demands made upon them in a competitive market, they will ultimately be replaced by more efficient carriers who will provide shippers with not only what they demand but also at a lower price. These benefits are real and they are in the public interest although they are hard to measure. The critical issues in a regulated environment are whether such long run gains are worth the short run losses and if it is necessary now to increase the number of competitors in the market to achieve these long run benefits.

The long run versus short run tradeoff can be viewed as a breakeven proposition. It was calculated that a loss of 20 percent in line haul efficiency would result in an increase in costs of 16 percent. The price charged by the carrier for a given level of service is basically a function of the cost of inputs (i.e. the cost of labour), productivity (i.e. the load factor), and the profits kept by the carrier (measured by the profit margin or operating ratio). One can use this estimate of short run productivity loss to directly measure what has to be gained or lost in the long run by not admitting the new entrant. It was concluded from the simulations that increased market fragmentation will not improve the productivity of any carrier or the industry as a whole. Since total salaries, wages and fringes are about 40 percent of costs for motor carriers of motor vehicles, these costs would have to rise by 40 percent (0.16/0.40) to offset the productivity savings kept by not fragmenting the market. Assume the current operating ratio of AHW is about 97 percent and its margin (before interest costs) is about 3 percent. This profit margin would have to rise 533 percent (0.16/0.03) to offset the productivity savings kept by not fragmenting the market.

These tradeoff calculations suggest that the short run costs of market fragmentation are high so that it is unlikely that the benefits of competition that result from such fragmentation would offset these costs in the short term. Of course, the long run benefits probably do exceed the short run costs in the long term, so how can the market work to achieve this? The answer lies in the market power of the buyers who are large relative to the suppliers in the market and the threat of potential competition in form of private carriage, a new carrier or intermodal substitution.

The pattern of regulatory decisions of the British Columbia Motor Carrier Commission since 1988 demonstrate how one regulatory authority has sought to achieve a balance between long run benefits and short run costs (see British Columbia Motor Carrier Commission). Over the period from 1988 to 1993, the Commission heard numerous applications for operating authority to transport new and used automobiles. AHW was continuously threatened by potential competitors ranging from small fleet operators to corporate giants which could quickly take away a significant part of AHW's business. The commission consistently looked for indications that AHW was *not* producing the type of service demanded by shippers, was charging exorbitant rates, earning excess monopoly profits or operating inefficiently, or paying wages far above the worth of their employees. Much weight was placed on the appearance or absence of shippers supporting the new applications. The absence of shipper support indicated that there was little evidence to suggest many long run technical gains from new entry. In such situations, the commission concluded that the productivity maintained by avoiding market fragmentation clearly outweighed the benefits of having multiple competitors. The commission, however, did not completely restrict entry. Typically, the new applicant would be granted operating authority to compete with a small number of vehicles with the knowledge that new vehicle authorities could be applied for in the future. The commission would, in one case, deny application for unlimited authority but approve a modified application for 10 vehicles. In other cases, where there was concern about capacity utilization, only one vehicle was approved. This incremental approach towards market expansion appears to have increased competition and vehicle capacity within British Columbia commensurate with traffic growth. The British Columbia policy is in sharp contrast to neighbouring Alberta, which does not regulate truck service, and Saskatchewan, which simultaneously strictly regulates rates and entry.

5. CONCLUSION

The simulation findings are consistent with the empirical research of Canadian less-than-truckload and truckload markets reported in Chow and Caravan (1990, 1991, 1993). Market share is generally correlated with lower rates in both market types suggesting that these lower rates result from cost economies achieved from economies of scale or better capacity utilization. In addition, lower prices were found in the more concentrated markets. This relationship reflects the highly competitive nature of trucking. Since it is the carriers with the largest market shares that have the lowest rates, they are likely to be the price leaders. The source of this price leadership could be the economies of utilization which result from having higher market shares

Many of the individual truck markets in the LTL and TL carrier studies were small enough to justify such an explanation. The total number of vehicle loads in one year could be estimated from the total freight volume in the average market. A comparison between the number of loads available on an average day on an average route, and the number of potential competitors indicates that there was only enough traffic for a few carriers to fully utilize their vehicles. In fact, if the four largest carriers that held the highest shares captured the measured four firm concentration share of daily traffic, they would have about one full load to move daily. In short, the average market size in which Canadian motor carriers compete appears to be quite small relative to the number of competitors in the market. Carriers with larger market shares are able to utilize their capacity more effectively and this productivity is passed on to shippers due to the presence of many competitors.

Low density markets continue to be regulated by provincial and state regulatory authorities in Canada and the U.S. The economic rationale lies in the short run protection of market shares to promote productive efficiency. The long run cost is the potential for x-inefficiency and technical inefficiency resulting from the lessening of competitive pressures that motivate continuous improvement. Jurisdictions that continue to regulate their markets must do so with an understanding of the basic economic relationships that prevail in low density markets. The ability of regulatory authorities to monitor and balance the short and long run efficiencies present a major challenge to regulatory agencies.

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