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Economies of Density and the Structure of the Less-than-Truckload Motor Carrier Industry Since Deregulation

*Mark Keaton**

ABSTRACT

We argue that changes in the LTL industry since deregulation have been driven by three major factors: (1) a carrier must serve an area of sufficient size to be anything more than a minor niche player; (2) there are modest economies of density, in terms of both cost and service quality, so there will never be a large number of "atomistic" carriers in any geographic area; and (3) carriers serving regional and national markets need different types of service networks, and this prevents either group from eliminating the other. As a result, carriers with very short hauls have all but vanished; the regionals have become the fastest growing and most profitable group; and a handfull of national carriers has survived. Although there may be modest economies of scale, we contend that these three factors are sufficient to explain changes in the industry.

INTRODUCTION

The increasing size of the largest less-than-truckload (LTL) motor carriers since deregulation in 1980, and the increasing share of the market captured by these firms, have come as a surprise to some observers. Since most econometric cost studies concluded that there were constant returns to scale in the industry, many scholars expected that small carriers could easily survive in a deregulated environment, and some predicted that small carriers would dominate. Nevertheless, as shown below, the number of small carriers has declined dramatically since 1978. Large carriers have also shrunk in number, but at a much more modest rate.

Constant returns to scale impies only that large firms have no cost advantage, and does not prevent these firms from achieving other advantages. For example, it has long been recognized that large carriers can more easily offer service to a wider geographic area. Hence shippers needing to reach a wide range of destinations can reduce transactions cost by dealing with only a few large carriers. Carriers are typically classified by the trade press today on the basis of their geographic scope, either as national, inter-regional, or regional carriers.

Even within each regional market, the largest three or four carriers usually account for over half of total revenue (see data in Hoffman, 1993). Consequently it is hard to believe that larger carriers haveno cost advantages. Recently Ying (1990) has reported econometric evidence that scale economies are emerging in the LTL industry. Harmatuck (1992), and Allen and Liu (1993), both find that there are scale economies when output measures are adjusted for service levels. These findings, however, seem somewhat inconsistent with the survival of the regional

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carriers. Since the revenues and ton-mileages of the national carriers are typically ten times those of the regionals, one would expect that economies of scale, of the magnitude reported by the researchers above, would give the nationals a significant advantage. In fact, the regionals are generally growing faster, and have lower operating ratios than the national carriers (again see Hoffman, 1993).

Furthermore, there are many carriers much smaller than the regionals, although admittedly far fewer of them than in past years. Some of these small firms are quite profitable. For example, Stott and Davis Motor Express, in upstate New York, achieved an operating ratio of 92.5 while handling 204 thousand shipments in 1991. This represents a mere 1.3 percent of the shipment volume, and .13 percent of the ton-miles, of industry leader Yellow Freight, whose operating ratio was 98.9. Although annual labor cost per employee was lower for Stott and Davis--roughly $45K versus $54K for Yellow--the difference does not appear to be sufficient to protect it from a carrier the size of Yellow, assuming that scale economies exist. Successful sub-regional carriers have undoubtedly found market niches not well served by their larger competitors. Nevertheless, the enormous difference in size between the largest and smallest carriers seems hard to reconcile with the existence of economies of scale, in terms of either cost or service. As shown in Figure 3, there were quite a few carriers in 1991 which handled even fewer shipments than Stott and Davis.

Keaton (1993) has argued that there are economies of traffic density in LTL operations, independent of any possible economies of scale. As shipment volume over a given service area grows, average cost will fall, and service levels will probably increase as well. This conclusion is derived from a model of the basic elements of LTL operations--pickup and delivery, terminal handling, and linehaul--rather than statistical analysis of historical data, and is thus somewhat hypothetical.

However, it does explain why there is both a wide range in the absolute size of surviving LTL carriers, and simultaneously a decline in the number of carriers in each size range. If the market served by a small carrier is suitably limited in area, the carrier can achieve a level of density comparable to the nationwide firms with vastly larger traffic volumes. As explained below, it may even be able to provide better service in its territory than a nationwide carrier. If scale economies in terms of overall size are modest or nonexistent, small carriers with sufficient density could offer rates comparable to the national carriers for traffic moving within their service area. Within a given service area, economies of density would imply that only a few carriers could simultaneously obtain enough traffic to survive. The actual number would depend on the total amount of traffic available within the area, and the extent of economies of density. That is, how much traffic is needed to reach a survivable density?

A carrier connecting only two points is not likely to attract many customers. To survive, a carrier's service area must undoubtedly exceed some threshold size, and this threshold may vary in different parts of the country. If there is to exist a range in the size of carrier service areas, from perhaps intrastate to sub-regional, regional, multiregional, and national, shippers must precieve benefits from dealing with distinct carriers in each service area. In other words, carriers must be able to segment the LTL market in terms of contiguous areas of increasing geographic size. To do this, carriers serving each size/segment would presumably pursue some combination of (a) finding a sufficient number of customers who do not routinely ship outside this area, and/or (b) offering lower rates or better service within this area than carriers with a

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broader geographic coverage. As argued below, existing LTL carriers appear to be competing in geographically segmented markets.

This paper examines some of the changes which have occurred in the LTL industry since 1978, the end of the era of regulation. The goal is to see if these changes can be explained as a result of economies of density. An econometric test for economies of density is difficult. However, we do find that the current structure of the industry is consistent with the existence of economies of density, along with geographic market segmentation. We also examine several other factors which seem to be driving changes in the industry.

LTL OPERATIONS AND ECONOMIES OF DENSITY

Rather than summarize Keaton's (1993) arguments for economies of density, we will illustrate this phenomenon using Stott and Davis as an example. This carrier has an average haul of 135 miles, so it is clearly not operating nationwide. To understand the importance of density, assume that S & D's current shipment volume was spread over the entire continential U.S. Based on 250 working days per year, S & D would then originate about 800 shipments on a typical day, an average of 16 per state. This could range from over 100 in populous states like California, to 1 or 2 in Wyoming and North Dakota. The typical shipment fills only a small fraction of the capacity of a standard trailer. The operating problem facing S & D is to pick up these shipments at their origins, in many cases only one shipment per point of origin, and transport them to their destinations. This must be done at a cost comparable to that of competitors, and with comparable service levels (transit time, in particular).

The nationwide carriers handle this problem by having a large number of local (or end-of-line) terminals, often 600 or more, which serve as a base for pickup and delivery vehicles which stop at individual customers, several on each trip out and back. Increasing the number of local terminals reduces the length of pickup and delivery (PD) routes, and reduces PD costs. Shipments are then sent to breakbulk (or hub) terminals, where they are sorted for final destination. If there is sufficient traffic volume, shipments can then go directly to a local terminal for delivery; otherwise they will go through a second breakbulk. The breakbulks are needed because direct connections between all pairs of local terminals would entail an excessive number of linehaul vehicle-miles, most of them by nearly-empty vehicles. Large national carriers have 20 - 25 breakbulks, but short-haul regional carriers need few, if any (see Braklow et.al. for a thorough discussion of the operating practices of large LTL carriers).

If S & D had 600 local terminals, each would originate only 1.33 shipments on average per day, far too few to make efficient use of terminal and PD resources. Linehaul trucks from local to breakbulk terminals would be almost empty. Waiting until full vehicle loads accumulate would mean weeks between departures and excessive transit times. By comparison, the large national carriers average about 100 originating shipments per local terminal per day. With this average, S & D would need only 8 terminals, but PD costs would increase substantially since many customers will now be located hundreds of miles from the nearest terminal.

Although one could imagine alternative operating practices which might be more economical for a low-volume carrier than copying the hub-and-spoke networks of the large firms (for example, "gypsy" trucks which wander over the country picking up and delivering, without

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transfering shipments in terminals), these networks do provide an efficient means for moving LTL shipments over a widely dispersed area, provided that there is sufficient traffic density. All but the shortest-haul LTL carriers use some variant of this system (see Braklow, 1992; and Harmatuck, 1992). A low density carrier, however, will inevitably suffer from some combination of (a) low utilization of terminal and linehaul capacity, (b) long PD routes, and (c) long transit times. All other things being equal, carriers with higher density should logically have lower average costs. Transit times will probably be faster as well, since there will be more frequent vehicle movements between terminals, and a larger fraction of traffic can be routed through only one breakbulk (or even none). Keaton (1993) provides numerical estimates of cost and service levels, as a function of density, for hypothetical LTL operations.

LENGTH OF HAUL, SIZE OF SERVICE AREA, AND TRAFFIC DENSITY

The LTL carriers reporting to the U.S. Interstate Commerce Commission (ICC) have lenths of haul ranging from less than 50 miles to about 1500 miles. There is no public data on size of service area. However, we would expect a modest but positive correlation between length of haul and the size of service area; a significant difference in length of haul should imply a noticable difference in size of service area. Since we know the lengths of haul for each carrier, we can use this information to approximate size of service area, as discussed below. Since we also know shipment volumes, we can obtain measures of traffic density for each carrier.

The continental U.S. stretches approximately 2600 miles in the east-west (E-W) direction, and about 1250 miles from north to south (N-S). We estimated the average haul for a "simulated" carrier serving the entire U.S. We first generated a large number of origin and destination (O-D) locations, assuming that both were uniformly distributed along the E-W and N-S axes of a 2600 mile-by-1250 mile rectangle. In other words, assuming that traffic originates and terminates uniformly across the service area. We then calulated the Euclidean distance for each O-D pair, and averaged over all pairs. Average hauls for carriers serving fractional portions of the U.S. were estimated in a similar manner. The results are shown in Table 1.

The simulated haul for the entire U.S., 1042 miles, is somewhat less than the actual hauls reported by the three largest national firms (Yellow, Roadway, and Consolidated, the "big three"), which are around 1200 miles. The explanation is probably that (a) some of the major traffic-generating points in the U.S. are on opposite coasts, so the assumption of uniformly distributed traffic is not quite accurate, and (b) regional carriers are capturing some of the short-haul movements.

To model service areas for regional carriers, we can subdivide the nationwide rectangle into equal-sized regional rectangles. Depending on how the national "pie" is sliced, we obtain regional slices with varying degress of elongation, and consequently varying lengths of haul. For example, we can obtain 16 equal-sized regions by first dividing the N-S distance by two, and then splitting each 2600-by-625 mile rectangle into eight sections from east to west. The simulated average haul for each of these 325-by-625 mile regions is 246 miles. A carrier serving the coastal states in the Southeast might have a network of this size and shape.

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TABLE 1

Size of Service ARea and Length of Haul Assuming Shipments Originate and Terminate Uniformly Over Service Area

	Shortest Possible Haul				Longest Possible Haul			
	E-W Distance Miles		N-S Distance Miles	Haul Miles	E-W Distance Miles		N-S Distance Miles	Haul Miles
Continental U.S.A. 3.25M sq. mi.	2600	x	1250	1042	same		same	same
One-half U.S.A. 1.625M sq. mi.	1300	x	1250	668	2600	x	625	903
One-fourth U.S.A. .812M sq. mi.	650	x	1250	512	2600	x	312.5	900
One-eighth U.S.A. .406M sq. mi.	650	x	625	333	1300	x	312.5	469
One-sixteenth U.S.A. .203M sq. mi.	325	x	246	246	162.5	x	1250[1]	404

[1]Longest possible haul is actually 825 miles with 2600 mi. x 78.125 mi. region, but this extremely elongated shape seems highly unrealistic, and is ignored here.

We could also divide our original rectangle into 16 slices in the east-west direction, and obtain 162.5-by-1250 mile regions, with average hauls of 404 miles. Carriers with north-south operations on either coast might have this type of service area. The longest haul, 825 miles, would be obtained from making 16 slices in the N-S direction, giving 2600-by-78.125 mile regions. It seems unlikely that a carrier would adopt this orientation in practice, so we have ignored it in Table 1.

As shown in Table 1, there is a noticeable difference in the shortest and longest possible hauls for regions of equal area. If the region is perfectly square, the simulated haul is slightly greater than one-half of the length of each side; examine the 650-by-625 mile region in Table 1. As the shape becomes more elongated, the haul increases. However, both the shortest and longest possible hauls decline as the area of the region declines, as one would expect. As long as traffic originates and terminates uniformly over the region, we can safely conclude that, if carrier A has a significantly shorter haul than carrier B, it also serves a smaller territory. Furthermore, if both carriers handle the same number of shipments, the carrier serving the smaller area, carrier A, will have the higher traffic density.

In reality traffic does not originate uniformly, but the general conclusion that size of region and length of haul are correlated should remain valid as long as (a) carriers are actually

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serving all points within the perimeter of their service area, and (b) as long as the areas themselves are approximately rectangular. If service areas are "gerrymandered," and zig-zag in narrow bands over large areas, or include islands of unserved territory, the concept of "service area" loses meaning. In the era of regulation, when carriers often obtained operating authorities in piecemeal fashion, this situation may have been common. Today the public declarations of service area given by most carriers imply service to all points within contiguous areas.

One final point should be noted. If a carrier is serving a square region, and both the length and width of the region are doubled, the carrier's length of haul doubles. The area of the region increases by a factor of four, however. Even if the region is not perfectly square, this pattern generally holds. For example, compare the shortest possible hauls for one-sixteenth, one-fourth, and for the entire U.S. in Table 1. We will define traffic density to be the ratio of (a) number of shipments to (b) area served. As a consequence, if a carrier's haul doubles because it expands the size of its service region, it needs roughly a four-fold increase in shipment volume to maintain a constant density. We will use this property below.

LENGTH OF HAUL AND SHIPMENT VOLUME: AN INDICATION OF DENSITY

Our objective is examine public data for LTL carriers for evidence of economies of density, using length of haul as a proxy for size of service area. A convenient way to visualize traffic density is to plot length of haul against shipment volume for each carrier, which we do for 1978, 1985, and 1991 in Figures 1 through 3. We will first discuss the data, and then the interpretation of these Figures. For simplicity we have chosen not to include any statistical analysis of this data. We intend to provide this analysis in the future; at this point a visual investigation is most useful.

All data are taken from the annual reports compiled by the American Trucking Associations (Motor carrier Annual Report), and all carriers are Class I "Section 27" carriers. Only carriers with a predominance in LTL, as opposed to full truckload (TL), were included. These were defined to be carriers with (a) less than 40 per cent of revenue from TL, and (b) less than 10 per cent of total shipments being TL. As is well know, most carriers have focused almost exclusively on either TL or LTL operations since deregulation, but in 1978 most had a mixture. Carriers with incomplete data, and very small LTL shipment sizes (300 lbs. and less) were excluded. The year 1978 was one of the last "normal" years of regulation. By 1985, the impact of deregulation was clearly being felt in the industry. The most recent data we have is 1991.

In the plot for 1978 we identify firms which were no longer in our data set in 1985, and in the 1985 plot we show the dropouts by 1991. Most of the firms which disappeared are thought to have gone out of business, but a few were either absorbed by other surviving carriers, were reclassified as Section 28 carriers, or shifted to a TL orientation. Similiarly, a few new firms entered the set in 1985 and 1991. Most were in operation in previous years but did not meet our criteria for being predominantly LTL carriers, but a few, such as the Conway carriers, are new entrants. Our purpose in identifying the dropouts is simply to give a rough indication of how the industry has changed, and not to provide a thorough analysis of these changes.

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Figures 1 and 2

FIGURE 1: Length of Haul and Shipment Volume - 1978

314 carriers

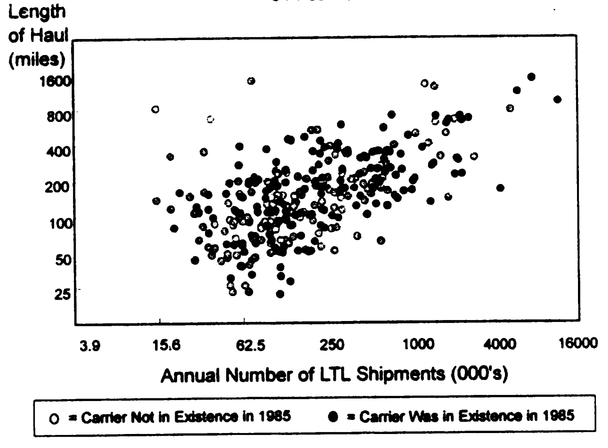

FIGURE 2: Length of Haul and Shipment Volume - 1985

205 carriers

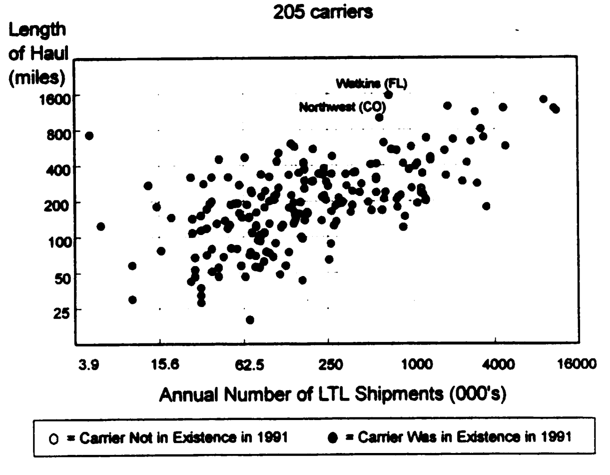

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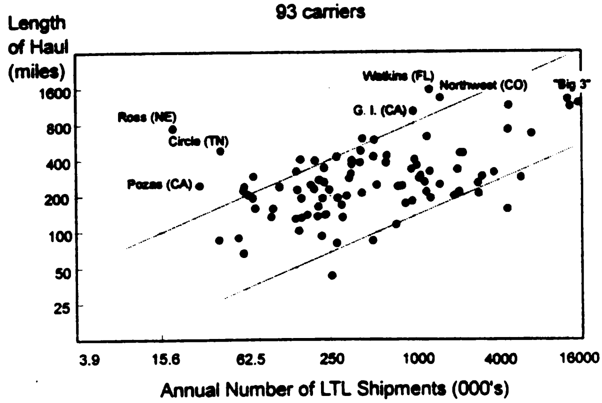
FIGURE 3: Length of Haul and Shipment Volume - 1991

93 carriers



Note that each successive increment on the shipment scale represents a four-fold increase in number of shipments over the previous value, and each increment on the haul scale represents a doubling over the previous value. Consequently carriers with constant traffic density will lie on a straight line rising with a slope of one from left to right.

What conclusions can be drawn from these plots? First, most firms in all three years are clustered about a diagonal from lower left to upper right. Higher shipment volumes are generally associated with longer hauls, and vice versa. There are no observations at the bottom right side of the plots; that is, no short haul carriers with high shipment volumes. This is to be expected, whether there are economies of density or not. To obtain the highest shipment volumes, carriers must serve the largest possible area, and therefore will have long hauls. To put it differently, if Yellow Freight has to serve the entire country to get 15 million shipments, a carrier with a 100 mile haul obviously will not have access this much traffic.

There are also few observations above and to the left of the diagonal, and the numbers have declined since 1978. If there were no economies of density, carriers serving large territories, with long hauls but with low shipment volumes, would face no cost or service disadvantages compared to carriers with large shipment volumes. One way for a carrier to grow is to expand its service area, and if there were no cost or service penalties for doing so, we would expect to see examples of this in a deregulated marketplace. Thus, in the absence of economies of density, there is no reason why we would not expect to find long haul, low volume carriers. In fact, as Figure 3 shows, there are hardly any examples of this in 1991. There were a few more observations in 1978, but most of these carriers did not survive until 1985. In would be expected that a low density carrier would have a better chance of survival in a regulated environment.

The virtual absence of long haul but low volume carriers is clearly consistent with the existence of economies of density. Even with the protection of rate regulation and restrictions on entry, few such carriers existed before deregulation. Furthermore, if we take a closer look at the carriers which were well above the diagonal in 1991, those identified in Figure 3, several

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appear to be abberations, and several have unique circumstances. Circle Delivery, headquartered in Tennessee, is not listed as a general freight LTL carrier in the TTS Blue Book (TTS, 1993), and so presumably has a specialized traffic base. Ross Transfer, headquartered in Nebraska, was firmly on the diagonal in 1985, so its current operations may be in transition. Pozas, headquartered in the Los Angeles area, was not in the data base in 1985, and it too may be undergoing change. Both Ross and Pozas had operating ratios well above 100, so neither is making money with their current operating practices.

Northwest Transport, headquartered in Colorado, operates across the great plains/rocky mountain area, an area of low traffic density. G. I., out of California, was recently acquired by Carolina, a much larger carrier, and has apparently expanded its operations in the west. Watkins, headquartered in Florida, is a non-union carrier which has expanded rapidly since deregulation (it was not a section 27 carrier in 1978). Comparison of Figures 2 and 3 shows that traffic volumes for both Northwest and Watkins increased substantially from 1985 to 1991, and their densities increased correspondingly.

With these qualifications in mind, we have drawn upper and lower boundries in Figure 3 that inclose the bulk of the observations. All points on each boundry correspond to haul/shipment combinations with equal density. Carriers with a 200 mile haul appear to require a minimum of about 60 thousand shipments per year to survive. For a 400 mile haul, the minimum climbs to about 250 thousand, and for an 800 mile haul, one to two million. Carriers with high cost structures, or those with high-density competitors, may face substantially higher thresholds, however.

Table 2 shows the number of carriers in various length-of-haul categories, and the total number of shipments handled by these carriers. The total shipment volume in each haul category is substantially greater than the minimum needed to survive, as given above. As Figure 3 shows, there is a substantial range in shipment volume for carriers with comparable hauls. Consequently, economies of density appear to be rather modest, and do not fully explain the decline in the ranks of LTL carriers since deregulation. Of course, carriers with hauls under 800 miles will be serving regional markets, and there will be far fewer shipments available in each region than the national totals shown in Table 2.

TABLE 2

LTL Shipment Volume and Carrier Size in 1991

Carrier Length of Haul	Number of Carriers	Total No. of Shipments Handled by all Carriers (000's)	Average No. of Shipments Per Carrier (000's)
Less than 200 miles	29	13,108	452
201 - 400 miles	42	41,500	988
401 - 800 miles	15	21,414	1,428
Over 800 miles	7	49,673	7,096
Totals	93	125,695	1,352

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Why do carriers with a variety of lengths of haul exist? Obviously shippers need to reach a variety of destinations, but why are they willing to simultaneously use national, regional and sub-regional carriers, when a single nationwide carrier could handle all their traffic? The explanation appears to be that the operating networks of the regionals and nationals must be configured differently. The best configuration for one environment does not work well in the other, and as a result, each type of carrier has cost and service advantages in different lengths of haul. We examine geographic focus in the following section.

CHANGING GEOGRAPHIC FOCUS: SHORT-HAUL, REGIONAL, AND NATIONAL CARRIERS

One of the most striking changes in the LTL industry from 1978 to 1991 has been the decline in the number of short haul carriers. There were 99 carriers with hauls of 100 miles or less in 1978, and 222 with hauls of less than 200 miles--71 percent of all carriers in 1978.!!23(!!). By 1991 there were only 29 carriers with hauls of 200 miles or less. By comparison there were 7 carriers with hauls of 800 miles or more in 1978, and the same number in 1991 (not the same seven, of course). Presumably the geographic markets served by these short haul carriers were too small to attract shippers in a deregulated environment. Over the same period, however, the regional carriers, with hauls in the 200 to 800 mile range, emerged as a distinct segment in the industry.

Figures 4 and 5 show the percentage of interline traffic as reported in 1978 and 1991 (defined as the percentage of tonnage which did not both originate and terminate on the reporting carrier). Again the pre- and post-deregulation patterns are dramatically different. In 1978 even long haul carriers interlined over 20 percent of their traffic, on average (a surprising number of short haul carriers, however, interlined very little traffic). By 1991, interline traffic was less than ten percent of the total, on average, for carriers with hauls as short as 200 miles.

Presumably interlining was more common in 1978 because operating authorities did not allow carriers to provide single-line service to all locations. Many short haul carriers in 1978 appear to have been little more than pickup and delivery (PD) operations. A large fraction of carriers with hauls of 100 miles or less reported no line haul expenses, but a large PD component. After deregulation, these carriers were probably not well suited to perform line haul operations, while their larger connections could easily do PD on the shipments which they had previously been forced to interline. As a result, most of the short haul carriers probably lost their traffic base. Those that survived, like Stott and Davis, have somehow managed to keep short haul customers.

Over this same period, the successful national carriers were developing hub-and-spoke operations as described above (see Harmatuck, 1992). A large number of local terminals are needed to reach a nationwide market with minimum PD costs. To fill linehaul vehicles to capacity, a major concern for long haul carriers, the number of links in the network must be kept to a minimum. Consequently almost all shipments must pass through one breakbulk, and many go through two (see Starvo, 1986; and Quinn, 1989). This is an efficient system for handling long haul traffic, but it is slow and less efficient for short haul traffic (see Harrington, 1987).

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Figures 4 and 5

Figure 4: Length of Haul and Percentage of Interline Traffic - 1978
314 carriers

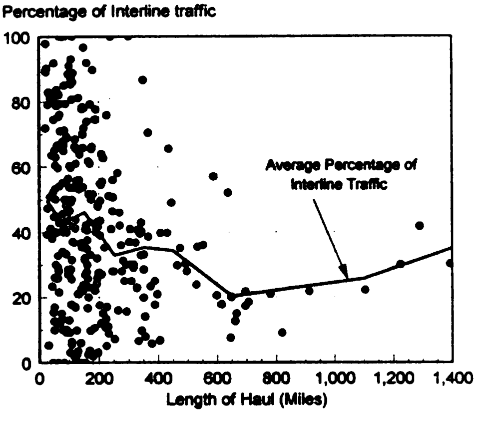
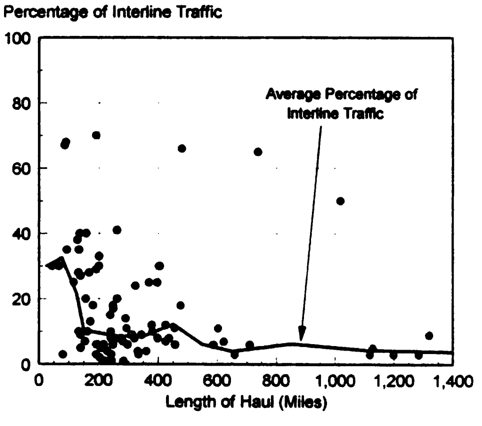


Figure 5: Length of Haul and Percentage of Interline Traffic - 1991
93 carriers



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The networks of the successful regionals are somewhat different, although the evidence is rather circumstantial. The average local terminal of the "big three" national carriers originates 84 shipments per day (based on 250 days per year). The author was able to determine the number of terminals for nine prominent regional carriers; each originates an average of 180 shipments.1 Compared to a national carrier, the typical regional has fewer terminals over a smaller territory, each originating a larger volume of shipments. This should mean that regionals have higher PD cost, but in return they can route much of their traffic directly from origin to destination (again see Harrington, 1987; Quinn, 1989). This may be done even when traffic between pairs of terminals is not sufficient to fill a trailer. Because their linehaul routes are shorter and more direct--no breakbulks--there is less of a cost penalty when vehicles are not full. Any traffic which cannot move direct usually requires only one intermediate handling. As a result, regionals generally advertise next-day, or at most second-day, service. According to a recent Distribution (1990) feature on regional New Penn Motor Express:

> "For a regional, multi-terminal carrier, our revenue per terminal is extremely high," says [President Edward H.] Arnold. This high density of freight per terminal enables New Penn to provide better, more cost-effective service. "We do virtually no breakbulk, except for a small amount of interline freight. We load direct, which also improves service, lowers damage, and reduces costs," he says.

One would think that regionals could interline and be able to compete with with the national carriers. Figure 5 shows that carriers with hauls of 200 to 600 miles interline no more than 10 percent of their traffic, so this practice is apparently not common. There are probably few pairs of local terminals, on two different regionals, which exchange enough traffic on a typical day to justify a direct line-haul connection. Most interline traffic would have to be sorted at an intermediate point; see the quote by Mr. Arnold above. Without networks of breakbulks, the regionals apparently have no comparative advantage over the nationals for long-haul traffic. Similarly, the regionals seem to have a natural advantage in their service areas. The big three have all started or bought regional carriers to gain access to this market (MacDonald, 1993), which implies that their existing operations were not up to the task. This strategy has also allowed them to obtain non-union labor, of course.

We have calculated average PD, terminal, line haul, and total cost per shipment as a function of haul, shown in Figure 6. The ATA apparently did not publish data for these cost categories in 1991, so we have used 1989. Although PD cost is slightly higher for carriers with hauls in the 200 to 400 mile range, the difference is less than would be expected if the local terminals of the regionals pickup and deliver over larger areas. On the other hand, many of the regionals have lower labor costs. Terminal costs increase with haul, as expected, since shipments must pass through more terminals. Line haul cost increases far less than in proportion to distance, since long haul carriers are able to obtain heavier vehicle loads, as shown in Figure 7. One reason is that longer haul carriers have a higher proportion of their truck miles over-the-road, as opposed to pickup and delivery. Another likely reason is that, since line haul is a large component of cost for these carriers, they have designed their networks to obtain high-volume links to maximize vehicle loads.

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Figures 6 and 7

FIGURE 6: Cost per Shipment and Length of Haul - 1989

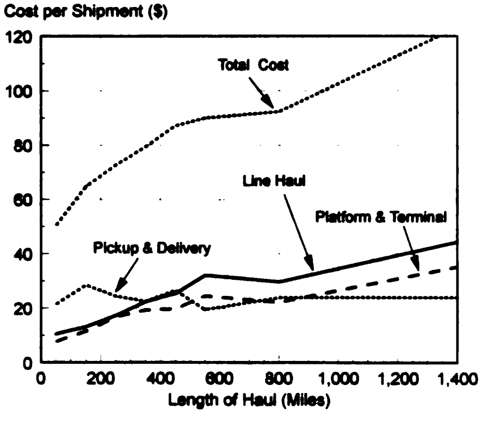
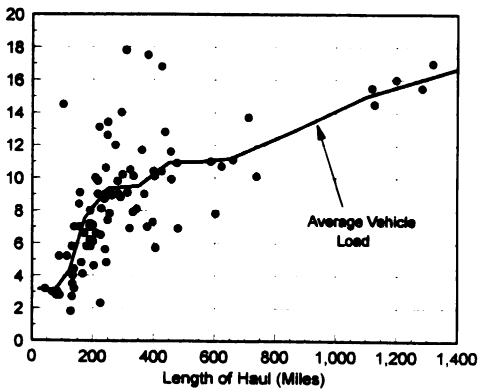


Figure 7: Haul and Average Vehicle Load - 1991

93 carriers



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CONCLUDING REMARKS

We would argue that changes in the LTL industry since deregulation have been driven by three major factors: (1) a carrier must serve an area of sufficient size to be anything more than a minor niche player (although there is room for niche players); (2) there are modest economies of density, in terms of both cost and service quality, so there will never be a large number of "atomistic" carriers in any geographic area; and (3) carriers serving regional and national markets need different types of service networks, and this prevents either group from eliminating the other. As a result, carriers with very short hauls have all but vanished; the regionals have become the fastest growing and most profitable group; and a handfull of national, and almost-national, carriers has survived. Although there may be modest economies of scale, we would contend that these three factors are sufficient to explain the changes.

We do not believe that these changes will stiffle competition. The total number of carriers with hauls of over 250 miles has not declined much since 1978, although many individual firms disappeared. Even though the big three have captured a substantial fraction of total LTL ton-miles, profits have been elusive (see Trunick, 1994). Contrary to popular wisdom, there has effectively been entry in the industry. Major regional carriers such as Viking and American (formerly Arkansas) Freightways were minor players in 1978. So was Watkins, now a force at the national level. The Conway group of regional carriers was started entirely from scratch by Consolidated Freightways. Although the cost of entry in the LTL industry is undoubtedly higher than in many segments of the TL industry, United Parcel Service should have the expertise and resources to enter if it chose to. In short, the LTL industry will remain competitive.

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ENDNOTES

* The author is with Integrated Logistics Systems.

1. The carriers are Advance, Arkansas (now called American) Freightways, Carolina, including G.I. and Red Arrow, Old Dominion, Viking, Preston, and St. Johnsbury. Carolina is sometimes considered to be an interregional, but G.I. and Red Arrow are regionals. All shipment data is from the 1991 ATA report. Sources for number of terminals include Harmatuck (1992), corporate annual reports, and Moody's (1991). The same sources were used for the "big three" calculations.

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