Trends in the Use of Large Trucks by Truckload and Less-Than-Truckload Motor Carriers in the 1990s

Using information from the Economic Census, Motor Carrier Financial and Operating Statistics, and the Vehicle Inventory and Use Survey, trends are examined in specialization and in vehicle use in the truckload (TL) and less-than-truckload (LTL) segments of the for-hire trucking industry. The VIUS data show that capacity, output, and intensity of use vary significantly by segment. TL firms have almost three times as many large trucks as LTL firms and operate more than three times the annual total miles, a consequence of the fact that TL firms use their vehicles more intensely (mean annual miles) than LTL firms. This gap, however, closed slightly during the 1990s. Both types of operations shifted vehicles away from local toward long-haul service in the 1990s, but LTL, which is less specialized in this regard, shifted more sharply.

by Stephen V. Burks, Kristen Monaco, and Josephine Myers-Kuykindall

INTRODUCTION

This paper examines trends in the use of large trucks by firms in two of the most important parts of the for-hire trucking industry, the truckload (TL) and the less-than-truckload (LTL) segments. The *Economic Census* and the *Motor Carrier Financial and Operating Statistics* are used to define these two segments and to outline their evolution from 1977 through 1997. Information from the *Vehicle Inventory and Use Survey* (VIUS) is then employed to describe the 1990s patterns of capacity, output, and intensity of vehicle use for the two segments by three geographic ranges of operation.

The story presented here about the evolution of these segments is standard: the specialization of firms into primarily TL and primarily LTL carriers was inhibited by economic regulation, but proceeded swiftly after deregulation in 1980. However, this study highlights a fact that is sometimes still not fully appreciated today: while LTL carriers were one of the largest groups within the industry before deregulation, by the 1990's TL firms dominated, having by far the largest share of revenue and employment outside the parcel segment of trucking.

This paper also details the manner in which the patterns of capacity, output, and the intensity of vehicle use (measured by mean annual miles per vehicle) vary significantly by segment within for-hire motor freight. TL firms have almost three times as many trucks as LTL firms and operate more than three times the total annual miles. As a consequence, TL firms utilize their vehicles more intensely than LTL. However, during the 1990s LTL firms slightly narrowed the gap with TL firms on all three measures.

The balance of the paper is structured as follows. In the second section the primary dimensions along which the for-hire trucking industry can be divided into segments are discussed, and the results from the 1997 *Economic Census* are used to characterize these segments. In the third section, data from the *Motor Carrier Financial and Operating Statistics* (1977-1992) is employed to identify the long term trends in speciali-zation by segment, which led to the pattern of firm revenues and employment observed in the 1997 *Economic Census*. In the fourth section,

the 1992 and 1997 VIUS data is used to analyze the patterns of vehicle use across the TL and LTL segments in the 1990s. In the fifth section, the focus is on comparing how the two segments utilize truck-tractors that are operated in long-haul service. The final section offers concluding remarks.

FOR-HIRE TRUCKING SEGMENTS

There are a number of distinct segments separated by three cross-cutting dimensions within the for-hire trucking industry. Within each segment inter-firm competition is significant, but across segments it is muted, or in some cases even absent. The first broad-scale distinction within for-hire trucking is between firms that use general purpose equipment (i.e. standard enclosed van trailers) to handle general commodities and those that use specialized equipment to handle special commodities. Examples of the latter would be firms using automobile rack trailers to haul new cars to dealers, or drop-deck flatbeds with A-frame racks to haul 10 foot by 20 foot sheets of architectural glass to window fabrication plants or construction sites.

A second broad scale distinction is between firms that make long distance intercity hauls and those that specialize in operations in and around a particular metropolitan area. The 1997 Economic Census, because of its use of the relatively new North American Industrial Classification System (NAICS), which is based on production process characteristics, gives a good overview of the structure of the for-hire trucking industry at this level of segmentation (Table 1). For-hire truck transportation (NAICS 484) generated $136.8 billion in revenue in 1997, or about 1.65% of that year's GDP.[1] For-hire truck transportation can be divided into general freight ($86.30 billion annual revenue) and specialized freight ($50.50 billion) classi-fications. The bulk of revenues in general freight stem from long distance hauls ($74.6 billion or 84.6% of total trucking annual revenues) with local hauls generating $11.70 billion annually.

A third broad scale distinction is based on the size of the typical shipment hauled. It is easiest to understand this distinction by considering the two extremes: parcel service and full-truckload service. Parcel service aggregates shipments, composed of small packages (up to 150 pounds, typically with an average weight of 50 pounds or less) collected by local drivers at local terminals into full loads for inter-terminal movements in tractor-trailers on fixed routes. Parcel shipment flows are very dense (on the order of one billion total shipments in the U.S. during 1997).[2] Parcel carriers such as UPS have correspondingly dense networks of local terminals and frequently use specialized handling equipment (e.g. conveyor belts) in the terminals, and specialized (drop frame) van trailers to haul them. At the other end of the spectrum, the archetypal full truckload (TL) carrier sends a driver with a tractor-trailer to a shipper's dock to fill up the trailer with a load weighing from 10,000 to 48,000 pounds. The driver takes the loaded trailer wherever in the United States the shipment is destined, and unloads at the consignee's dock. The driver is then dispatched empty, possibly after waiting for a while, to the next location where a full load is available for pick up. TL carriers may use specialized equipment for special commodities, but if they haul general commodities they use general purpose equipment to maximize the chance of backhauls. TL shipments are much less dense than parcel shipments (on the order of 150 million in 1997 by the same method as the parcel estimate), but each shipment represents the movement of a truck. Since TL carriers do not normally re-handle freight once it is loaded, they do not typically require terminals, nor regular route patterns, for cost-competitive operations.

In between the two shipment-size extremes of parcel service and TL operations lies the less-than-truckload (LTL) segment. This segment is like parcel service in that it aggregates smaller shipments collected at local terminals by local drivers into full trailer loads for inter-terminal movement on fixed routes. However, LTL shipments can run the gamut from 50 pounds to 48,000 pounds, with a typical average in the range of 1,000 pounds. Shipment flows in this segment are also less

Table 1: For-Hire Trucking in the 1997 Economic Census (firms that operated at least 10 months of the year)

NAICS Code	NAICS Name	Number of Firms	Number of Establish-ments	Number of Employees	Annual Revenue (billions)
48-49	All Transportation and Warehousing	115,213	144,929	2,844,837	$310.20
484	*All Truck* Transportation	70,044	81,272	1,255,752	$136.80
4841	*General* Freight Trucking	27,985	35,783	799,028	$86.30
48411	*General* Freight Trucking, *Local*	11,057	11,856	129,526	$11.70
48412	*General* Freight Trucking, *Long Distance*	17,037	23,901	669,465	$74.60
4842	*Specialized* Freight Trucking	42,194	45,483	455,822	$50.50
48421	*Used Household and Office Goods Moving*	6,781	7,596	118,259	$12.30
48422	*Specialized* Freight Trucking (except HHG), *Local*	25,423	26,273	177,487	$18.30
48423	*Specialized* Freight Trucking (except HHG), *Long Distance*	10,076	11,609	159,972	$19.90

Source: 1997 Economic Census, U.S. Census Bureau

dense than in the parcel segment (about 360 million in 1997 by the same method as the parcel estimate).[3] LTL carriers are like general commodity TL carriers in that they use general purpose equipment to handle a wide range of shipment sizes, shapes, and densities.

The 1997 *Economic Census* does not allow the parcel segment to be classified separately,[4] but the NAICS categories do distinguish TL from LTL (Table 2). In 1997 the TL segment dominated the general freight portion of (non-parcel) for-hire trucking, with 61.2% of the total employment, and 66.9% of the total revenue. If the segments of specialized freight that are primarily TL by shipment size are added to the mix (essentially, this means adding all specialized freight except household goods moving; see Table 1 for the data), then TL's share of the total employment of 1.137 million jumps to 72.8%,

and its share of the total revenue of $124.50 billion rises to 77.1%.[5] This dominance is a relatively new phenomenon, historically speaking, and we next turn to what the data can tell about how it occurred.

TWENTY-YEAR TRENDS IN FOR-HIRE TRUCKING: TL VERSUS LTL

The VIUS surveys did not separately classify for-hire vehicles according to TL and LTL service types until 1992. So to examine the growth of for-hire industry composition from 1977 to 1992 the historical predecessor of today's *Motor Carrier Financial and Operating Statistics* is used. These data are presently collected and published by the Bureau of Transportation Statistics (BTS), but until 1995 were collected by the Interstate Commerce Commission (ICC).[6]

Economic regulation played an important role in the development of TL and LTL segments. The ICC administered the regulations of the trucking industry from 1935 until

Table 2: TL versus LTL Trucking in the 1997 Economic Census (firms that operated at least 10 months of the year)

NAICS Segment Code		NAICS Segment Name	Number of Firms	Number of Establishments	Number of Employees	Annual Revenue (billions)
48412		*General* Freight Trucking, ***Long Distance***	17,037	23,901	669,465	$74.60
	484121	**TL** segment of 48412	15,278	18,270	411,805	$49.70
	484122	**LTL** segment of 48412	1,835	5,625	257,649	$24.80
48411		*General* Freight Trucking, ***Local***	11,074	11,863	129,484	$11.69
	4841101, 4841103	**TL** segments of 48411, with & w/o storage	7,920	8,197	77,494	$8.01
	4841102, 4841104	**LTL** segments of 48411, with & w/o storage,	3,154	3,666	51,990	$3.67
LTL versus TL Segments Comparison		Share of LTL in All General Freight	17.1%	26.0%	38.8%	33.1%

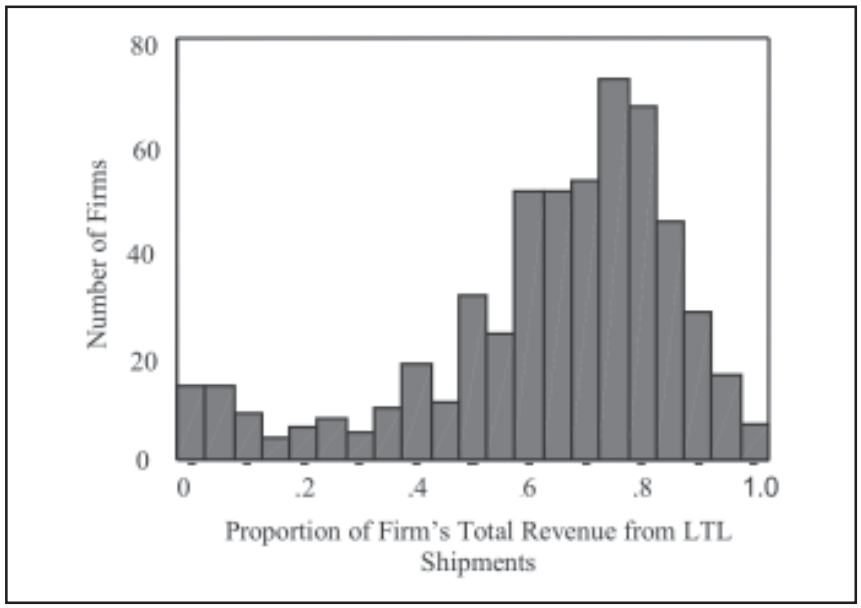
Source: 1997 Economic Census, U.S. Census Bureau

1995. Routes and commodities of incumbent firms were frozen in their 1935 configuration by a grandfathering process. Entry by new firms into for-hire trucking and expansion by incumbent firms into new routes or into different commodities was, in practice, significantly inhibited. A side effect of the specific regulatory details was that regulation made it much more difficult for the pre-1980 predecessors of today's TL firms to grow and expand with the changes in the economic geography of the United States from 1935 to 1980 than it did for the predecessors of today's LTL firms (Rothenberg 1994). As a result, a large amount of full truckload freight was hauled by carriers that used the LTL-type organization of production, with freight-handling local terminals and fixed routes (Figure 1).[7] As David Stubblefield, the retiring CEO of national LTL carrier ABF, recently put it when discussing the changes deregulation had brought, "When I reflect back on what our life was like in the trucking business prior to deregulation, it was such a different world. In the first place, there were very few truckload carriers. Essentially, the LTL carriers handled all the truckload freight because they had the operating rights." (Cook 2003)

In addition, the wages of trucking labor were substantially above the level of other blue collar jobs requiring similar human capital because of the Teamsters Union's National Master Freight Contract, which was based on conditions set in the regulatory-era prede-cessors of LTL firms (Belzer 1995, Rose 1987). Because prices were set collectively through the institution of rate bureaus, trucking firms were for the most part able to pass these costs to customers (Rose 1985, United States Senate 1980).

When deregulation removed barriers to entry and route adjustments in 1980 and made individual firm pricing possible, the industry had a sharp restructuring (Belzer 2000, Burks 1999, Glaskowski 1990, Perry 1986). Incumbent TL-type firms expanded and thousands of new small TL firms entered the

Figure 1: Frequency Distribution of General Freight Long Distance Motor Carriers by Proportion of Total Revenue from LTL (versus TL) Shipments in 1977



Source: Authors' calculations from Motor Carrier Financial and Operating Statistics, American Trucking Association; see Endnotes 6 and 7.

industry. Without the overhead costs of a terminal system, and paying much less than Teamster wages, entering TL firms sharply cut the cost of TL transportation. This new and vibrant TL segment took most of the truckload freight that firms using LTL-type production had been hauling and began taking market share from both railroads and private carriage (Campbell 1987). LTL firms scrambled to adjust and expand route structures, while coping with the loss of the majority of their TL freight. The result was the specialization of individual carriers into the TL and LTL types reflected in today's NAICS categories. This specialization was fully in place by 1992 (see Figure 2).[8]

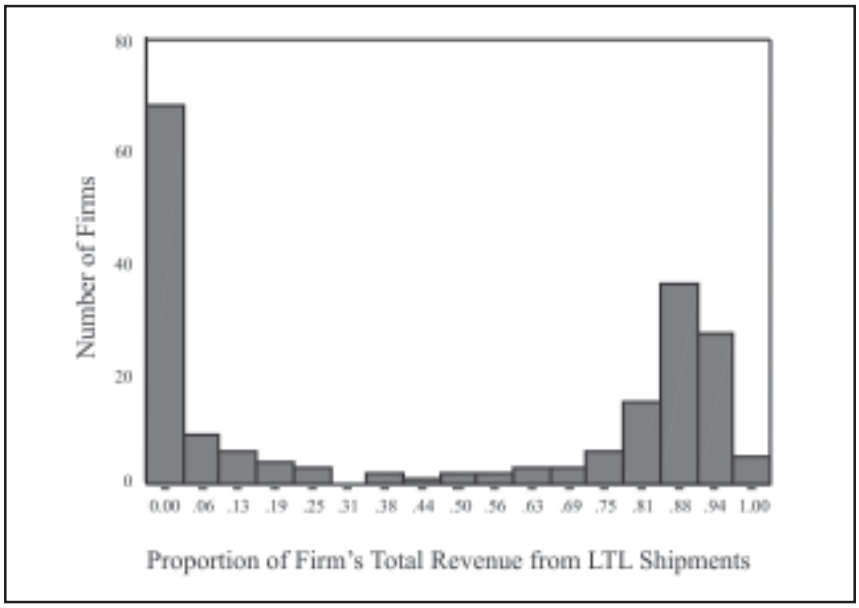
USING THE VIUS TO EXAMINE TRENDS IN LTL AND TL IN THE 1990s

With the background on the segments in place, TL and LTL trends in the 1990s are next examined using data in the *Vehicle Inventory and Use Survey*. Sampling weights are used to infer population values.[9] Looking first at capacity as measured by the number of vehicles, as expected from the Economic Census data, TL dominates LTL (Column 2, Table 3). In 1992 the TL capacity of 422,500 trucks was 74.8% of total for-hire capacity, while the LTL fleet of 142,000 trucks was 25.2%. The imbalance in capacity seems to have stabilized, however. In 1997 the shares were nearly the same. The 527,800 TL vehicles made up 73.2% of for-hire capacity in that year, as compared to 26.8% for the 192,800 LTL vehicles.[10]

Intensity of use, as measured by average miles per year per truck, is higher in both years in TL, but it grew more quickly in LTL (Column 3, Table 3). In 1992 the average truck at a TL firm operated 79,100 miles, which was 24.4% more than the 63,600 miles of the typical LTL unit. By 1997 the TL average had increased to 85,800 miles, but this was only 16.7% higher than the LTL figure of 73,500 miles.

Examining output as measured by total annual miles, one can observe the combined

Figure 2: Frequency Distribution of General Freight Long Distance Motor Carriers by Proportion of Total Revenue from LTL (versus TL) Shipments in 1992



Source: Authors' calculations from Motor Carrier Financial and Operating Statistics, American Trucking Association; see Endnotes 6 and 7.

Table 3: Number of Vehicles, Total and Mean Annual Miles by Segment

	Year	Number of Vehicles	Mean Annual Miles	Total Annual Miles
Truckload	1992	422,500	79,100	33.4 billion
	1997	527,800	85,800	45.3 billion
Less-than-Truckload	1992	142,000	63,600	9 billion
	1997	192,800	73,500	14.2 billion

Source: Authors' calculations from 1992 and 1997 TIUS/VIUS Microdata Files, U.S. Department of Commerce, U.S. Census Bureau.

effect of the slight shift in vehicle share towards LTL and the narrowed gap in annual miles per truck (Column 4, Table 3). The 33.4 billion miles TL units operated during 1992 was 78.8% of for-hire miles, while LTL trucks accounted for 21.2%. In 1997 the shares were similar, but LTL had gained slightly in percentage terms. TL units operated 45.3 billion miles, a 76.1% share, while LTL vehicles accounted for 14.2 billion, or 23.9% of the for-hire total.[11]

The differences in intensity of use are closely related to the differences between TL operations and LTL operations in the distribution of capacity and output by geographic range (see Table 4). LTL capacity is more oriented toward local and short-haul movements than is TL capacity. In 1992, only 44.2% of LTL vehicles were dedicated primarily to long-haul service, while 59.6% of TL units were dedicated to long-haul service (Table 3). However, both types of operations shifted their capacity allocation toward long-hauls during the 1990s. By 1997 TL's long-haul share had risen to 63.8%, while LTL's had risen even more strongly, to 55.7%.[12] A qualitatively similar pattern is observed in output levels by geographic range (Figure 3).

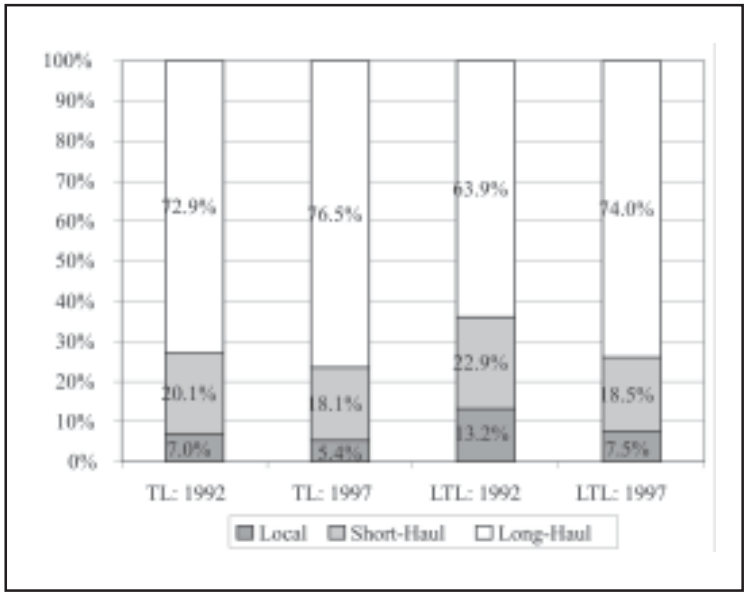
The very sharp change in the 1990s in the geographic shares of the LTL fleet, away from employment in local areas and towards employment in long-hauls, is perhaps a little surprising. Eleven percentage points of LTL vehicle share essentially shifted from local to long-haul use, reflecting an 18.8% drop in vehicles dedicated to local use, and a 71.1% increase in those used in long-hauls (Table 4). However, for reasons of historical comparability, the boundary between regional and long-haul service in the VIUS data, at 200 miles, is relatively short by industry standards, and even one-day, or overnight, LTL lanes have longer hauls than this. So the increase in the over-200-mile share could well reflect the strong growth in overnight and two-day regional LTL movements consistently mentioned in the trade press over the course

Table 4: Geographic Specialization of Vehicles by Segment: Local (within 50 mi.), Regional (50-200 mi.), and Long Haul (>200 mi.)

Truckload (TL)				**Less-than-Truckload (LTL)**			
	1992	1997	Growth		1992	1997	Growth
Local	**64,612**	**64,521**	-0.1%	Local	**40,928**	**33,239**	-18.8%
Share	15.3%	12.2%		Share	28.8%	17.2%	
Regl	**106,111**	**126,508**	19.2%	Regl	**38,317**	**52,286**	36.5%
Share	25.1%	24.0%		Share	27.0%	27.1%	
Long	**251,772**	**336,797**	33.8%	Long	**62,733**	**107,321**	71.1%
Share	59.6%	63.8%		Share	44.2%	55.7%	
Total	**422,495**	**527,826**	24.9%	Total	**141,978**	**192,846**	35.8%

Source: Authors' calculations from 1992 and 1997 TIUS/VIUS Microdata Files, U.S. Department of Commerce, U.S. Census Bureau.

Figure 3: TL vs. LTL Output: Mileage Shares by Primary Geographic Range of Use



Source: Authors' calculations from 1992 and 1997 TIUS/VIUS Microdata Files, U.S. Department of Commerce, U.S. Census Bureau.

of the 1990s, rather than growth in longer-distance LTL movements, which have been growing relatively slowly (Bearth 2001, Gose 1993, Trunick 1996).[13]

The fall in the LTL within-50-mile share could be due to a different cause. We cannot observe which trucks in our sample share an affiliation with individual firms and which do not, so we can say little directly about the pattern of firm specialization by geographic range from these data. But comparing patterns of geographic specialization of vehicles evident in the VIUS data to the patterns in the geographic specialization of firms observed in the *Economic Census* of 1997 may reveal something. The connection is complex in LTL, however, because of the fact that long distance LTL firms generally employ a network of terminals and have some vehicles that specialize in local work attached to each terminal. Also, the employment totals reflect the fact that some LTL firms employ functionally specialized dockworkers at local terminals in addition to drivers.

The *Economic Census* shows that 3,200 (63.2%) of the total of 5,000 LTL firms primarily operated locally, and these firms had 52,000 (16.7%) of the total LTL employ-ment of 309,600. The VIUS shows that only 33,200 (17.2%) of all LTL vehicles operated within 50 miles of their home base, while another 52,300 (27.1%) operated more than 50 miles but less than 200 miles from their base. This reflected an increase of 36.5% in vehicles used in the 50-200 mile range between 1992 and 1997, along with the 18.8% decline in the number of LTL vehicles dedicated to local operations during the same period (Table 4). So the two data sources indicate that there are too many employees at local firms to match the number of local trucks, and some of the local trucks must belong to long-distance firms anyway, as noted above. These facts suggest that the typical service area for an LTL terminal, whether operated by a local or a long-distance LTL firm, grew in the 1990s. This is perhaps the simplest hypothesis that would explain the changes in the relative size of the under-50-mile and 50-to-200-mile truck groups, in conjunction with the 1997 local versus long-distance firm patterns.

A parallel examination of the patterns of geographic specialization of TL vehicles in the VIUS and that of TL firms in the *Economic*

Census is more straightforward. From the *Economic Census* it is known that in 1997 7,920 (or 34.1%) of the total of 23,198 firms primarily operated locally, and these firms had a 77,494 (15.8%) of the total TL employment of 489,289 (Table 2). It is a rule of thumb that in TL service one truck requires approximately one driver, and it is also true that drivers make up by far the largest employment category at a pure TL firm. The local/regional boundary is at 50 miles, and some locally-specialized firms operating in a large metropolitan area would operate some of their vehicles on movements more than 50 miles from home base. Combining this with the fact that the total heavy vehicle capacity dedicated specifically to local hauls in the TL segment in 1997 was 64,521 (12.2%) the data is consistent with the view that most of the short haul vehicles in TL were operated by firms that were geographically specialized in quite short haul local operations (Table 4).

The organizational differences between TL and LTL operations produce significant cost differences: LTL service is on the order of five times more costly to produce per ton-mile of freight movement than is TL service (Burks 1999). This in turn produces large price differences to shippers. These are large enough that while competition between the two segments may be muted by their service differences, it is not absent by any means. When a shipper has a full truckload, a TL firm is both inexpensive and fast. When the shipper has a single LTL shipment that requires a short transit time, LTL is likewise the clear choice. But when the shipper has multiple LTL shipments going in similar directions or is not sensitive to transit times, then there are other options available. These might include a TL carrier willing to make multiple delivery stops or a freight consolidator that groups LTL shipments together for movement by TL firm, either directly to the consignee, or to a local cartage (LTL) firm at the destination.

The general trend in competition between the TL and LTL segments in the 1990s was perceived by industry analysts to be generally in favor of TL firms on longer service lanes (Malloy 2003, Schulz 2003, Logistics Management 2004). However, the new hours of service regulations for commercial vehicle operators that came into effect in January of 2004 (FMCSA 2003) affected TL firms differentially by putting some limits on the amount of delay time their drivers could spend at shippers and consignees. This produced a market trend back in favor of LTL firms (Wlazlowski 2004). While the new regulations were (at least initially) overturned in July, 2004, the text of the court decision made it clear that the long term prospect is for the same or even greater restrictions to affect TL firms in the future (U.S. Court of Appeals 2004).

THE INTENSITY OF USE OF LONG-HAUL TRUCK TRACTORS

Because longer hauls have become relatively more important over time, an appropriate further focus for the analysis of the VIUS data is on truck tractors operated in long-haul service by for-hire firms. Truck tractors are the dominant powered vehicle utilized by for-hire carriers.[14] They accounted for 91.6% of the for-hire vehicle fleet in 1992, and 93.4% in 1997. Those operated in long-haul service were 54.7% of the total for-hire fleet in 1992, and 60.9% in 1997.[15]

TL carriers dominate long hauls in both capacity and total mileage, when considering only truck tractors. Looking at capacity, TL had 249,100 units in 1992, for an 80.6% share, as compared to LTL's 60,000 trucks, 19.4% (Column 2, Table 5). By 1997 LTL had closed the gap slightly. In that year TL had 333,100 long-haul tractors, for 75.6% of the total, to LTL's 106,000, or 24.4%.[16] Turning to output, in 1992 TL long-haul truck tractors operated 24.2 billion miles, for an 81.2% share, as compared to LTL's 5.6 billion, for only 18.8% (Column 4, Table 5). By 1997 this gap had also narrowed a bit. In that year TL tractors operated 34.3 billion miles, or 76.7% of the total, while LTL units accounted for 10.4 billion miles, and a 23.3% share.[17]

The most interesting change is the intensity of use (mean annual miles per truck). Average annual miles of for-hire truck tractors operated in long-haul service are the highest of any subcategory of vehicles in the data. The

Table 5: Number of Vehicles, Total and Mean Annual Miles by Segment for Long-Haul Operations

	Year	Number of Vehicles	Mean Annual Miles	Total Annual Miles
Truckload	1992	249,100	97,000	24.2 billion
	1997	333,100	103,100	34.3 billion
Less-than-Truckload	1992	60,000	93,800	5.6 billion
	1997	106,000	98,300	10.4 billion

Source: Authors' calculations from 1992 and 1997 TIUS/VIUS Microdata Files, U.S. Department of Commerce, U.S. Census Bureau.

figure is consistently higher for TL than for LTL (Column 3, Table 5). In 1992 the average LTL long-haul truck tractor operated 93,800 miles, while the typical TL unit was 3.4% higher, at 97,000 miles.[18] By 1997 both figures had grown (possibly due in part to changes in speed limits), and the gap had slightly increased. LTL long-haul tractors averaged 98,300 miles per year[19] while the typical TL unit was 4.8% higher, at 103,100.[20] Looking at the upper end of the distribution of these values, the 75th percentile is at 124,700 for TL, and 125,000 for LTL, while the 90th percentile is at 150,000 for TL, and 160,000 for LTL.[21] This implies that there were approximately 83,300 TL for-hire truck tractors that operated more than 124,000 miles in 1997, and that 33,300 of these were used even more intensively, operating 150,000 or more miles. The corresponding figures for LTL are 26,500 tractors that operated 125,000 or more miles, 10,600 of which operated 160,000 or more miles.

Since annual mileage per truck is an indicator of efficiency of use, these figures indicate that for-hire carriers are, as a group, very efficient. However, the typical TL firm operates each long-haul tractor with a single driver, who has the same number of miles as the vehicle, as the truck and driver travel together to the final destination. In contrast, the typical LTL firm operates each long-haul tractor in "relays," so that a different driver operates the truck on each shift, as the truck moves between fixed terminal points.[22] So for TL firms the annual mileage may also be taken, somewhat more directly than in the case of LTL firms, as an indicator of the relevance of fatigue issues to safe operations. These figures indicate that fatigue questions are most salient for tractor-trailers in long-haul TL operations.

CONCLUSION

Though unable to directly examine long-term changes in the LTL and TL segments of for-hire trucking in the VIUS, by combining historical information from the ICC's *Motor Carrier Financial and Operating Statistics Data*, with the recent years of the *Economic Census* and the VIUS, some general trends can be identified. While during regulation many firms provided both TL and LTL service, after deregulation low-cost entrants to the TL market gained market share by successfully competing for much of the truckload service offered by LTL firms, and part of that handled by private carriers and rail. LTL firms specialized more narrowly in LTL freight, and this market is smaller than that for full truckload freight transport, both in terms of the physical truck movements required and the total revenue generated. As a result, TL dominates LTL in the market for general freight, earning 66.9% of general freight revenue in 1997, while operating 73.2% of for-hire vehicles and operating 76.2% of total for-hire miles. TL firms dominate in the long-haul market, with only 12% of the TL fleet involved in local hauls in 1997. Combin-ing this fact with employment data from the *Economic Census* suggests that the TL firms involved in local freight are specializing in this geographic segment, while LTL firms, whether local or long distance, may have been increasing the area served from each local terminal. Both LTL and TL, however, shifted resources to long-haul service in the 1990s.

Finally, TL firms have a higher intensity of vehicle use compared to LTL firms, though LTL firms appear to have slightly reduced the gap in intensity of use in the 1990s. This difference in intensity of use is most striking in long-hauls and becomes largest when considering the sub-group of TL long-haul truck tractors, which averaged 103,100 miles in 1997.[23] Looking at the 75th percentile of the distribution of annual miles in this subgroup we find that there were approximately 83,000 truck tractors in long-haul TL service that operated more than 124,000 miles per year. Combined with operational details of how drivers are utilized in this type of trucking, this suggests that the salience of driver fatigue issues is highest in the long-haul TL segment.

The 2004 revisions to the Federal Hours of Service regulations were predicated on the need to improve safety, especially through a reduction in fatigue-related fatalities. The court decision that, at least temporarily, overturned the new regulations in July, 2004, made it clear that these issues will continue to be relevant. This suggests that the VIUS data will be a valuable source of data to gauge the long-run impact of new regulations on the number of vehicles on the road and to test the impact of these regulations on productivity, as measured by mean annual miles per truck.

Endnotes

1. There is one limitation to the new NAICS categories. Industry analysts normally consider NAICS 4921101, the non-local and non-air part of NAICS sector 492, "couriers and messengers," to be part of the long distance trucking industry, as commonly studied. However, starting in the early 1990's (while still using the prior system of industry classification, the SIC), the Census Bureau changed the category of United Parcel Service, the single largest trucking company in the U.S., from "ground courier" to "air courier." This is despite the fact that a majority of UPS revenue and by far the majority of its employment appears to be in the intercity ground transport of parcel freight. In the 1997 *Economic Census* the size of the category 4921102, Air Courier Services, reveals that UPS is included in this segment, and there is no effective way to analytically undo this change. So we do not include NAICS category 4921101 in Table 1, as it is not comparable to the other categories without UPS, although we discuss the parcel segment in this section.

2. This is an approximate calculation by the authors from the national summary report of the *Commodity Flow Survey* (CFS) for 1997 (U.S. Census Bureau 1998). The CFS does not report shipment counts, but aggregate weights by weight category are reported. A crude estimate can be computed by using the midpoint of each category as the average weight of shipments in that category.

3. The Atlanta consulting firm the Colography Group, using proprietary data from industry participants, provides a smaller estimate: 156 million in 1997 according to (Reed Business Information 1999). However, they do not provide corresponding estimates for parcel or truckload, so it is not clear how their data compares to the CFS-based estimate.

4. See note 1.

5. Specialized freight has always been primarily TL in operational character because the shipment densities are not generally high enough to make LTL service cost-effective. To get the total employment figure of 1.136 million and the total revenue figure of $124.5 billion, subtract the values for NAICS 48421, Used Household and Office Goods Moving, from those for NAICS 484, All Truck Transportation. These figures form the denominators of the percentage calculation in the text; to get the (TL) numerators, further subtract from the denominators the employment and revenue figures for LTL segments, NAICS 484122 and 4841102/4841104.

6. The ICC was "sunsetted" at the end of 1995 with the ICC Termination Act, at which time the data collection program was transferred to BTS. The data was collected by the ICC on its "Form M," which all regulated motor carriers were required to submit annually. Both the ICC and the American Trucking

Association (ATA) separately keypunched parts of the Form M data from the original paper records; the ATA called their version the *Motor Carrier Financial and Operating Statistics*, which is the name the BTS now uses for its successor. The information presented in Figures 1 and 2 was derived from an electronic data file published by the ATA.

7. Figure 1 and Figure 2 are histograms showing the frequency distribution of long haul for-hire carriers of general commodities by the percentage of their total freight revenues generated from less-than-truckload (LTL) shipments. (The balance would have come from truckload shipments.) The figures utilize the subset of for-hire motor carriers known as Instruction 27 firms, which, according to the ICC's definition, were those primarily engaged in the intercity transport of general commodities (ICC 1992). Until 1980 the *Motor Carrier Financial and Operating Statistics* data covered firms with $300,000 or more in annual revenue (for three consecutive years), and firms with $500,000 (with the same qualification) after 1980. There was some loss of compliance with reporting requirements in later years of the data set, but the qualitative results exhibited are quite robust.

8. Another consequence of this transformation of the structure of the industry was that average wages of truck drivers declined sharply, and a large "secondary" segment of the truck driver labor market was established (Belzer 2000, Burks 1999). In contrast, the earnings of trucking executives dropped during the initial transition to deregulation, but then grew with the general trend towards increased compensation to upper management during the 1980s (Burks et al 2004a).

9. See Burks et al. (2004b) for further information about the VIUS and how this sample was obtained. It should be noted that approximately 6% of the total estimated population of for-hire vehicles are lost from the analysis of the contrast between TL and LTL in both 1992 and 1997 because sampled respondents left relevant data items blank.

10. The p-value for the increase in percent of LTL vehicles between 1992 and 1997 is 0.005.

11. The p-value for the increase in LTL share between 1992 and 1997 is < 0.001.

12. The p-value for the increase in LTL long-haul between 1992 and 1997 is < 0.001. The p-value for the increase in TL long-haul share is < 0.001.

13. Since deregulation regional LTL carriers (specialized in high-speed service on short-haul lanes) have grown more robustly than national LTL carriers (with national scope and a focus on longer lanes). This has resulted in two continuing challenges to national carriers: regional firms have grown large enough to link together and provide national service in direct competition with national firms, and the demand growth in high-speed short-haul service has forced national carriers to adjust their networks to provide faster service at shorter distances.

14. The VIUS defines a truck tractor as a powered unit with a fifth wheel on its rear to which a semi-trailer may be attached. The present analysis considers only vehicles with maximum GVW of 26,000 pounds or more, which implies that the truck tractors considered here are those referred to by the industry as Class 7 and Class 8.

15. Percentages calculated from the *Vehicle Inventory and Use Survey*. Table available from the authors upon request.

16. The p-value for the increase in LTL share between 1992 and 1997 is < 0.001.

17. The p-value for the increase in LTL share between 1992 and 1997 is < 0.001.

18. The p-value for this difference in means is 0.005.

19. The difference in means for LTL long-haul truck tractors between 1992 and 1997 has a p-value of 0.005.

20. The difference in means for TL long-haul truck tractor between 1992 and 1997 has a p-value < 0.001. The p-value for the 1997 difference between LTL and TL is 0.001.

21. For example, to find the annual miles at the 75th percentile of the whole distribution of cases, line up all the cases in order of their reported annual miles, from lowest to highest value. Then find the case which has 75% of the total number of cases below it, and 25% above it, and record the annual miles of that case. By construction, 75% of all cases have lower annual miles, and 25% have higher annual miles, than those reported for this particular vehicle.

22. Both types of firms make some use of driver teams, in which a pair of drivers trade off driving and resting in a sleeper berth. Such teams make up a very small proportion of the workforce (on the order of a percent or two), although they are no doubt over-represented at the highest annual mileage levels.

23. All the annual mileage estimates are based on a boundary between long-haul and shorter operations of 200 miles from home base, in order for consistency of historical comparison across all VIUS data years (see Burks et al. 2004b). If the more common long-haul demarcation of 500 miles from home base was used, the distribution of annual miles would be shifted to the right.

References

American Trucking Association. "Motor Carrier Financial and Operating Statistics." Electronic data file. Alexandria, VA, 1992.

Bearth, Daniel P. "Consolidation, Innovative Service and Regional Carriers Reshape Sector." *Transport Topics* 1, (2001): 10-12.

Belzer, Michael H. "Collective Bargaining after Deregulation: Do the Teamsters Still Count?" *Industrial and Labor Relations Review* 48, (1995): 636-55.

Belzer, Michael H. *Sweatshops on Wheels: Winners and Losers in Trucking Deregulation.* Oxford University Press, Inc., New York, New York, 2000.

Burks, Stephen V. "The Origins of Parallel Segmented Labor and Product Markets: A Reciprocity-Based Agency Model with an Application to Motor Freight," Dissertation (PhD). University of Massachusetts, Amherst, 1999.

Burks, Stephen V., Frederick Guy, and Benjamin Maxwell. "Shifting Gears in the Corner Office: Deregulation and the Earnings of Trucking Executives." forthcoming, *Research in Transportation Economics*, 2004, *10*.

Burks, Stephen V., Kristen Monaco and Josephine Myers-Kuykindall. "The Balance Between Private and for-Hire Carriage and Trends in the Use of Large Trucks in the U.S. (1977 to 1997)," this issue, *Journal of the Transportation Research Forum*, 2004.

Campbell, Bernard G. "Deregulation and the Motor Carrier Industry." *Data Resources U.S. Review,* (March 1987):24-29.

Cook, James. "A Leader for Changing Times." *Logistics Management* (2003) (electronic edition, 11/01/03).

Federal Motor Carrier Safety Administration. "49 CFR Parts 385, 390, and 395; Hours of Service of Drivers; Driver Rest and Sleep for Safe Operations; Final Rule," U.S. Department of Transportation (2003) Federal Register 22457-517.

Glaskowski, Nicholas A. *Effects of Deregulation on Motor Carriers*. Eno Transportation Foundation, Westport, Connecticut, 1990.

Gose, Joe. "Red Hot Regionals: Non Union Subsidiaries Mean Big Bucks to Big Trucking Firms." *Kansas City Business Journal* 12, (1993): 1.

Interstate Commerce Commission. "Uniform System of Accounts for Common and Contract Motor Carriers of Property," Uniform Code of Federal Regulations. 49CFR1207 (1992): 248-465.

Logistics Management. "Carriers, Shippers Prepare for Changes in Hours-of-Service Rules," January 1, 2004. Reed Business Information. URL: http://www.manufacturing.net/lm/index.asp.

Malloy, Michael. "Schneider Warns Hours Rule Will Cut Carriers' Productivity." *Transport Topics*, (2003): 2.

Perry, Charles R. *Deregulation and the Decline of the Unionized Trucking Industry*. Philadelphia, Pennsylvania: Industrial Research Unit, The Wharton School, University of Pennsylvania, 1986.

Reed Business Information. "LTL Losing Share to Competitors, Study Says," *Logistics Management Distribution Report*, (1999).

Rose, Nancy. "Labor Rent Sharing and Regulation: Evidence from the Trucking Industry." *Journal of Political Economy* 95, (1987): 1146-78.

Rose, Nancy L. "The Incidence of Regulatory Rents in the Motor Carrier Industry." *Rand Journal of Economics* 16, (1985): 299-318.

Rothenberg, Lawrence S. *Regulation, Organizations, and Politics: Motor Freight Policy at the Interstate Commerce Commission*. University of Michigan Press, Ann Arbor, Michigan, 1994.

Schulz, John. "Changing Lanes," *Traffic World*, (2003): p.21.

Trunick, Perry A. "Stretching the Limits of Regional Trucking." *Transportation and Distribution* 37, (1996): 38-43.

United States Senate. "Federal Restraints on Competition in the Trucking Industry: Antitrust Immunity and Economic Regulation,"Judiciary Committee, U.S. Senate, Washington, DC, 1980, 1-351.

U.S. Census Bureau, *1992 Truck Inventory and Use Survey Microdata File*, CD, U.S. Department of Commerce, Washington, DC, 2001.

U.S. Census Bureau, *1997 Vehicle Inventory and Use Survey Microdata File*, CD-EC97-VIUS, U.S. Department of Commerce, Washington, DC, 2000.

U.S. Census Bureau, *Econ97 Report Series - 1997 Economic Census*, CD, U.S. Department of Commerce, Washington, DC, 2000.

US Census Bureau. "1997 Commodity Flow Survey," US Dept of Commerce, Washington, DC, 1998.

US Court of Appeals. "Public Citizen et al vs. Federal Motor Carriers Safety Administration," Washington DC, 2004, No. 03-1165.

Wlazlowski, Tiffany. "LTL Carrier Profits Increase as Freight Shifts from Truckload." *Transport Topics*, (2004): 1, 33.

Stephen Burks *is assistant professor of economics and management at the University of Minnesota, Morris. He does research on the U.S. trucking industry and in the areas of field experiments and behavioral economics in the workplace. His interest in trucking dates from the era of deregulation when he spent several years working in the industry before becoming an economist.*

Kristen Monaco *is professor of economics at California State University, Long Beach. Her research focuses on the industry structure and labor market outcomes, with a particular focus on the trucking industry.*

Josephine Myers-Kuykindall *was recently named "Scholar of the College" at the University of Minnesota, Morris, where she is completing her bachelor of arts degree in mathematics, statistics, and economics.*