Estimating the Competitive Effects of Larger Trucks on Rail Freight Traffic

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Final Report

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Abstract

This is a study of the potential for larger trucks to divert traffic from the Class I railroads. Increases in truck size/weights can be expected to have a large effect on rail traffic, with diversions of 10-15% of non-intermodal rail traffic possible if weight limits are increased from 80,000 to 90,000 pounds. Diversions of 15-20% would be possible if weight limits were increased to 97,000 pounds. Under the most aggressive scenarios for increasing truck size/weights, the majority of general merchandise traffic would be subject to diversion. While efficient unit trains and multi-car shipments will continue to be the most effective means of transport for bulk commodities, the largest trucks will be able to provide very effective competition against rail moves that involve very circuitous routes or very short trains, even for distances in excess of 200 miles.

The diversion of traffic from rail to truck could potentially add 6-12 million truck trips and 3-5 billion truck-miles to the nation's highways. Although some of the existing truck traffic could be handled in fewer trucks, such benefits would be offset by the added traffic resulting from rail diversions.

The actual diversion would be affected by the strategies adopted by railroads and trucking companies in response to higher size/weight limits. Railroads could compete with the larger trucks by lowering their rates, increasing productivity or improving service. Although these strategies could help the industry retain market share, they would likely result in lower profits for the railroads. Trucking companies could decide to keep some of the benefits in terms of higher profits rather than simply lowering rates, which would tend to reduce the amount of freight diverted. However, inter-city trucking is a very competitive industry and rates tend to drop close to the long-term variable costs of the most efficient carriers.

The study was conducted in coordination with the Association of American Railroads (AAR). The study uses a methodology developed at MIT and applied previously in various studies, including a similar study of the competitive effects of larger trucks on short line railroads. The methodology was applied in two analyses, each of which examines rail mode share for a set of generic origins and destinations under various assumptions concerning trucking capabilities.

Estimating the Competitive Effects of Larger Trucks on Rail Freight Traffic

1. Introduction

This study assesses the competitive impact of increases in truck size/weight limits on the freight traffic that is handled by the Class I railroads. Two of the three major categories of rail freight are considered in some detail: bulk traffic and general merchandise traffic. The third major category of freight is intermodal traffic. TOFC is included as a competitive option for general merchandise traffic, but the study does not address high-volume double-stack domestic freight or the movement of marine containers to and from ports.

The basic conclusions are in line with prior studies: increases in truck size/weight limits could potentially have a very large impact on rail traffic. If motor carriers were allowed to use significantly larger or heavier trucks, most general merchandise traffic currently handled by the railroads would be at risk of diversion. Trucks already enjoy considerable advantages in terms of trip times and reliability, and the use of larger vehicles would allow them to compete more effectively with respect to cost. Heavy trucks would also be able to compete with short- and medium distance rail unit train movements, which could result in the restructuring of distribution systems for grain, coal, ores, and other bulk commodities.

These conclusions are based upon analysis of the competitive balance between rail and truck for sets of hypothetical origin-to-destination (O-D) movements. The O-D movements were structured to represent a typical mix of commodity and customer characteristics. For each O-D movement, the estimated mode share was based upon a comparison of the total logistics costs for using rail, intermodal, and truck transportation. In addition to direct transportation costs, the total logistics costs included inventory costs, loading and unloading costs, and loss & damage. Transportation and logistics costs were estimated using models developed in prior studies. The methodology was developed in studies of rail/truck competition conducted by MIT for the International Railway Congress (Union International de Chemins-de-fer or UIC) (Martland 2001, 2003). The methodology was subsequently enhanced and applied in a study of the competitive effects of increases in truck size/weights on the short line industry (Martland, 2007). That study, which was conducted in cooperation with the American Short Line and Regional Railroad Association (ASLRRA), used cost and capacity characteristics of larger trucks that were provided by Roger Mingo, an expert on trucking industry costs and productivity.

The purpose of the UIC study was to identify the most promising technologies for the international rail industry. To do this, MIT developed and applied a methodology known as "performance-based technology scanning". Basically, this methodology provided a means of comparing various technologies by first estimating their impact on performance and then estimating how improvements in performance would affect market share. In the UIC study, the focus was on technologies that would improve rail market share, whereas in this and in the earlier short line study, the focus is on the effect of changes in technologies – namely increases in truck size/weight limits – that would reduce rail market share.

This paper presents two analyses that address the effects of increases in truck size/weights on the rail market share for traffic handled by the rail industry. The first study concerns the rail market share for the entire range of general merchandise and bulk freight, while the second focuses on the relative costs of moving bulk traffic short distances by rail and by truck.

2. Estimating Modal Shares for General Freight Traffic

This section describes the methodology that was used to estimate the competitive effects of larger trucks on rail traffic. The key steps in the methodology are:

1. Prepare a base case:
    a. Create a set of origin-to-destination (O-D) movements to represent the traffic that is handled or could be handled by a railroad or group of railroads. Since each O-D will represent many actual O-Ds, it is necessary to structure the set of O-Ds to provide a realistic mix of customers (i.e. a realistic mix of commodities, trip distances, and annual use rates).
    b. Identify the cost, capacity, and service characteristics offered by each transportation mode serving each O-D.
    c. Estimate the total logistics costs that would result from using each available mode for each O-D.
    d. Allocate the traffic to each mode based upon a comparison of the total logistics costs. If the costs are equal, all modes share the traffic equally; if one mode dominates, then that mode captures all of the traffic.
    e. Sum over all O-D pairs to get the mode split for the base case.

2. Structure new cases to reflect a different operating environment:
    a. Change performance characteristics for one or more modes.
    b. Change unit costs
    c. Change operating parameters

3. Compare results of the new cases to the base case:
    a. Document changes in market share by mode
    b. Document changes in traffic volumes (tons, ton-miles or shipments by mode)
    c. Document changes in performance (cost, service, capacity)

This methodology relies upon expert judgment in defining the base case and in structuring the new cases. If reasonable estimates of transport costs and service are available, then it is possible to obtain reasonable estimates of total logistics costs for any specified customer. If the characteristics of the generic O-Ds included in the study customers reflect the characteristics of a group of actual rail customers, then the aggregate results provide an indication of the effects of the changes in technology, unit costs, or operations on traffic volumes related to these customers.

This approach cannot provide exact estimates of market changes, since actual conditions will often be more complex than what is covered by this methodology. However, this methodology does include the major factors known to influence mode choice, and it is broad enough to provide insight into the probable effects of new technologies or other changes in the competitive transportation environment. Technological or operating changes that result in significantly higher or lower logistics costs for one mode can be expected to cause significant changes in mode choice; technologies that only enable minor changes in total logistics costs will be unlikely to cause significant changes in mode choice.

The next two sub-sections describe how the model was used in the prior studies conducted for the UIC and for ASLRRA. This background is relevant, because many of the parameters used in the current study were developed as part of the prior studies.

Structure of the UIC Study

The UIC study of the effects of technology on modal competition (Martland, 2001) considered 24 O-D movements that were suitable for movement by rail, intermodal, or truck. The movements were structured as follows:

- Trip distances: 400, 800, and 1200 miles
- Value/pound: $1.00, $0.50, and $0.25
- Annual use rate: 500 to 2000 tons/year

A base case used typical unit costs and operating parameters for each mode. Logistics costs were estimated as a function of commodity characteristics, trip times and reliability, and modal factors related to loading, unloading and loss and damage. Mode share was estimated based upon a comparison of total logistics costs for each mode.[1] If two modes had the same total costs, then the model predicted that they would share equally in the traffic. If one mode had substantially lower costs, then the model predicted that it would capture all of the traffic. The UIC study was aimed at identifying the technologies and operating strategies that would have the greatest potential for improving railroad market share and financial performance. Toward that end, the study considered the effects of various changes in rail performance on market share, including various combinations of the following:

- Larger freight cars
- Double stack intermodal service
- Better service (faster or more reliable)
- Cheaper service

Using the Methodology To Estimate Impact of Larger Trucks on Short Line Rail Traffic

The methodology was adapted to investigate the impacts of changes in truck technology or operations on rail market share. A base case was established based upon the traffic handled by the short line industry. A hypothetical set of 100 O-D movements was created as follows:

- Trip distances: 50, 200, 400, 600, 800, and 1200 miles
- Value/pound:
    - General traffic: $1.00, $0.50, and $0.25 ($2000, $1000, and $500 per ton)
    - Bulk traffic: $0.10, $0.05 and $0.01/pound ($200, $100, and $20 per ton)
- Density: 15 pounds/cu. ft. for high value, 20 pounds/cu. ft. for medium value and 30 pounds/cu. ft. for low value merchandise and all bulk commodities
- Annual use rate:

[1] In technical terminals, a logit model was used to predict mode split based upon a comparison of the total logistics costs of shipping by rail, intermodal or truck. Given the total logistics costs of shipping by rail (LR), intermodal (LI) and truck (LT), the rail share is estimated as $e^{-LR}/(e^{-LR} + e^{-LI} + e^{-LT})$.

- General traffic: 2, 8, and 25 thousand tons/year
- Bulk traffic: 8, 25, 50 and 100 thousand tons/year

These factors were selected so that it would be possible to consider the range of O-D movements that were actually handled by short lines. The number of shipments in each category was selected so that the predicted rail traffic had characteristics of short line traffic in 2007. The percentage of short line shipments by commodity group was based upon a recent study of short line shipments for the period July 2005 to June 2006. During that period, 45% of short line shipments (other than intermodal) were general freight and 55% were bulk.

- The percentage of shipments in each distance and annual use rate category were based upon the results of a study sponsored by the American Short Line and Regional Railroad Association that analyzed trip times and reliability for a representative sample of 39 O-D movements originating or terminating on short lines during a three-month period in the first half of 2006 (Martland and Alpert, 2006).

- Commodity characteristics were based upon the actual traffic handled by short lines in the 12-month period from July 2005 to June 2006 (Martland and Alpert, 2006). The commodities were aggregated into six groups based upon estimated value, as shown in Table 1. The percentages shown are the percentages of traffic for which the waybill included a valid STCC (standard transportation commodity code).

- The tons/car were typical numbers for each category based upon tons and shipments handled by the Class I railroads in 2003 (as reported in "Railroad Facts").

Each of the 100 generic O-D movements was used to represent multiple customers. Weights were assigned to each of the 100 movements so that the predicted rail share of the traffic would approximately match the above distribution of commodities. Each weight was calculated as the product of three factors representing the type of commodity, distance, and the annual use rate plus a fourth factor needed to translate predictions of mode share of O-D movements into predictions of mode share of tonnage (because the predicted mode share for one generic low volume movement will represent many more actual movements than the predicted mode share for one generic high volume movement).

Table 1 Aggregating Short Line Traffic into Six Generic Categories

Commodity Type	Commodities Included	Tons/car	% of short line shipments	Assumed Value/Pound
High value merchandise	Motor vehicles & equipment Food & kindred products Grain mill products	70 (other than motor vehicles)	16%	$1.00
Medium value merchandise	Pulp & paper products Stone, clay & glass Farm products except grain	80	13%	$0.50
Low value merchandise	Metals & products Lumber & wood Primary forest products	80	15%	$0.25
Liquid bulk	Chemicals Petroleum Products	85	12%	$0.10
High value dry bulk	Grain Sand & gravel Waste & scrap Coke	100	26%	$0.05
Low value dry bulk	Coal Ores	110	18%	$0.01

The factors used were as follows:

- Type of commodity:
  - 0.45 for merchandise
  - 0.55 for bulk

- Distance category(% of O-D movements with distance of 50, 200, 400, 600, 800 or 1200 miles)
  - Merchandise (1%, 4%, 25%, 30%, 15%, 25%)
  - Bulk (25%, 25%, 10%, 10%, 25%, 5%)

- Annual Use Rate Category (% of O-D movements with 4, 16, 50, 100, and 200 million pounds per year)
  - Merchandise (30%, 50%, 20%, 0%, 0%)
  - Bulk (3%, 7%, 10%, 30%, 50%)
- Weight for annual use rate (a factor proportional to 1/annual use rate)

The percentages used were round numbers, which was consistent with the generic nature and limited scope of the study. The weights were quite different for merchandise and bulk traffic because a) rail is generally competitive for merchandise traffic only for longer distances and b) annual use rates are much higher for bulk customers.

The base case used the same rail cost and service parameters that were used in the UIC study, except that the cost of fuel was increased from $1.20/gallon to $2.68 per gallon. The other rail costs, which were typical of the period 2000-2002, were assumed to be reasonable for 2007. The rail parameters were the same in all of the scenarios considered in this study. To reflect the post-2002 trends, rail rates were increased by 10% over the rates used in the prior study (i.e. 10% above the long-run average costs used in the model).

The truck parameters used in this study were based in part upon the prior study, in part upon estimates of truck costs in 2007, and in part upon proposed trucking capabilities. Fuel economy, fuel costs, equipment costs, driver costs, maintenance costs, and overhead costs were all updated using estimates provided by Roger Mingo, an expert on truck costs and performance. Truck size and weight limits were also based upon information provided by Roger Mingo. Other operating parameters were left unchanged from the UIC study, including various parameters related to trip times and reliability, loss & damage, and loading/unloading costs. Truck rates were assumed to be equal to the average long-run truck costs used in the model.

<u>Adapting the Methodology to the Class I Railroads</u>

The current study adapted the methodology used in the short line study so as to reflect the traffic mix and operating characteristics of the Class I railroads. The same set of 100 O-Ds was used, but some of the inputs and weighting factors were changed to reflect Class I rather than short line operations. The major changes were as follows:

- Commodity and distance weighting factors were adjusted to the actual Class I traffic mix for 2007, based upon analysis of the waybill sample:
    - Type of commodity:
        - 0.264 for merchandise
        - 0.736 for bulk
    - Distance category(% of O-D movements with distance of 50, 200, 400, 600, 800 or 1200 miles)
        - Merchandise (5.8%, 16.9%, 14.7%, 13.5%, 14.8%, 34.3%)
        - Bulk (15.6%, 15.8%, 11.9%, 9.7%, 15.6%, 31.4%)
- It was assumed that the customers remaining on Class I lines would be better suited to rail transport than those on the short lines, i.e. the Class I customers were assumed to have somewhat more freight and somewhat denser freight and to be located where they could use the heaviest allowable rail cars.
    - The weights used for annual use rates were shifted so as to increase the annual traffic volume from the average customer. The weights for annual use rate show

the percentage of OD movements with 4, 16, 50, 100, and 200 million pounds per year:
    - Merchandise (20%, 50%, 30%, 0%, 0%)
    - Bulk (2%, 5%, 8%, 25%, 60%)

  - The average density of commodities was assumed to be 18 pounds per cubic foot for high value merchandise, 22 for medium, and 26 for low (the average density for bulk traffic was left unchanged at 30 pounds per cubic foot).

  - 286,000 lb. GVW rail cars were allowed for all customers.

- Each O-D in the Class I study represents many more actual movements and a greater variety of movements than each O-D in the short line study. The mode split model was therefore adjusted so as to be less sensitive to minor changes in relative logistics costs.[2]

Tables 2-7 show the characteristics of rail freight traffic in 2007. Table 2 shows the number of cars, tons, ton-miles and revenue by STCC for the Class I railroads. This data was derived by the AAR from the 2007 Waybill Sample. Table 3 uses the data from Table 2 to calculate the average revenue per car, per ton, and per ton-mile as well as the average trip distance (ton-miles per ton, not ton-miles per shipment), cars per waybill, and tons per shipment. Table 4 shows how the commodity data was aggregated into the eight broad categories. Only the first six categories of freight were considered in this study; summary information for these categories is shown in Table 5. Tables 6 and 7 show the percentage distribution of freight by commodity and by distance.

[2] In technical terms, the scale parameter was set at 100 for the class I study rather than 500 as used in the short line study. With a scale parameter of 100, rail will get about a third of the traffic and intermodal about 10% of the traffic in a situation where total logistics cost for rail are about 15% greater than those for using truck and where logistics costs for using intermodal are about 50% greater than for truck. With a scale parameter of 500 for the same situation, rail would only get about 10% of the traffic and the rest would go by truck. Making the mode split less sensitive is necessary because one O-D represents many O-D movements for which distance, circuity, density, annual use rates, and other customer and modal characteristics could each vary by 20-50% or more.

Table 2 Class I Rail Traffic Volume, by Commodity, 2007

STCC	Commodity	Cars	Tons	Revenue	Ton-Miles
ALL	All	32,117,817	2,021,197,827	70,428,728,275	1,878,691,674,148
1	Farm Products	1,605,728	164,248,254	5,093,782,491	178,488,194,554
10	Metallic Ores	744,932	65,195,928	677,578,073	16,803,480,706
11	Coal	7,616,924	860,657,350	13,981,079,860	721,998,335,139
13	Crude Petroleum	9,516	815,880	56,535,956	1,229,095,998
14	Nonmetallic Minerals	1,593,528	159,992,400	1,946,223,075	48,084,648,601
19	Ordnance	2,768	217,308	33,086,132	216,810,656
20	Food Products	1,021,209	91,305,121	4,366,226,469	112,411,143,826
24	Lumber	547,872	47,183,556	2,943,364,288	70,292,945,256
26	Pulp and Paper	584,140	42,207,032	2,954,162,308	50,361,656,081
28	Chemicals	1,760,533	166,297,161	8,966,884,436	179,087,453,441
29	Petroleum and Coal Prod.	681,108	57,059,060	2,398,339,058	50,174,799,524
30	Rubber and Plastic Prod.	2,520	189,240	16,416,560	360,661,992
32	Stone, Clay, Glass	539,743	53,548,536	2,014,154,459	38,123,129,566
33	Primary Metal Products	723,166	63,384,859	2,975,973,368	51,513,272,750
34	Fabricated Metal Products	3,100	220,372	41,983,192	346,327,482
35	Machinery, Non-electrical	14,208	846,972	134,673,066	1,317,726,468
36	Electrical Machinery	25,252	643,528	123,436,392	918,728,618
37	Transportation Equipment	1,567,301	36,658,400	6,068,132,318	48,796,475,550
40	Waste and Scrap	498,932	42,300,904	1,460,345,305	25,600,233,191
41	Misc. Freight	40,568	1,328,306	179,441,458	1,811,594,065
42	Containers Returned Empty	8,420	257,800	16,054,752	564,410,792
48	Hazardous Waste	15,680	1,217,520	99,939,280	1,746,729,972
99	Intermodal	12,510,669	165,422,340	13,880,915,979	278,443,819,920

Source of data: Waybill Sample for 2007

Table 3 Characteristics of Class I Rail Traffic, 2007

Commodity	Revenue per Car	Revenue per Ton	Revenue per TM	Ton-Miles per Ton	Cars per Waybill	Tons per Car
All	$2,193	$34.85	$0.0375	821	48.2	62.9
Farm Products	$3,172	$31.01	$0.0285	1000	106.7	102.3
Metallic Ores	$910	$10.39	$0.0403	240	188.9	87.5
Coal	$1,836	$16.24	$0.0194	774	222.5	113.0
Crude Petroleum	$5,941	$69.29	$0.0460	989	33.7	85.7
Nonmetallic Minerals	$1,221	$12.16	$0.0405	286	105.9	100.4
Ordnance	$11,953	$152.25	$0.1526	986	56.5	78.5
Food Products	$4,276	$47.82	$0.0388	987	36.1	89.4
Lumber	$5,372	$62.38	$0.0419	1167	31.9	86.1
Pulp and Paper	$5,057	$69.99	$0.0587	1012	34.0	72.3
Chemicals	$5,093	$53.92	$0.0501	842	34.3	94.5
Petroleum and Coal Prod.	$3,521	$42.03	$0.0478	735	46.4	83.8
Rubber and Plastic Prod.	$6,515	$86.75	$0.0455	1319	28.0	75.1
Stone, Clay, Glass	$3,732	$37.61	$0.0528	615	39.1	99.2
Primary Metal Products	$4,115	$46.95	$0.0578	736	39.4	87.6
Fabricated Metal Products	$13,543	$190.51	$0.1212	1250	34.1	71.1
Machinery, Non-electrical	$9,479	$159.01	$0.1022	1269	35.5	59.6
Electrical Machinery	$4,888	$191.81	$0.1344	1335	39.0	25.5
Transportation Equipment	$3,872	$165.53	$0.1244	872	27.4	23.4
Waste and Scrap	$2,927	$34.52	$0.0570	536	39.8	84.8
Misc. Freight	$4,423	$135.09	$0.0991	1134	43.8	32.7
Containers Returned Empty	$1,907	$62.28	$0.0284	1381	26.4	30.6
Hazardous Waste	$6,374	$82.08	$0.0572	1300	36.7	77.6
Intermodal	$1,110	$83.91	$0.0499	1459	34.3	13.2

Table 4 Allocating Traffic Defined by STCC to Aggregate Commodity Groups

	Commodity Group	Commodity	Cars	Tons	Tons per Car
1	High Value Merch.	Food and Kindred Products	1,021,209	113,923,481	89.4
1	High Value Merch.	Motor Vehicles and Equipment	1,567,301	55,932,815	23.4
2	Medium Value Merch.	Farm Products, Ex. Grain	150,938	16,774,448	102.3
2	Medium Value Merch.	Pulp, Paper, and Allied Products	584,140	49,779,896	72.3
2	Medium Value Merch.	Stone, Clay and Glass Products	539,743	62,002,356	99.2
3	Low Value Merch.	Lumber and Wood Products	547,872	60,212,340	86.1
3	Low Value Merch.	Metals and Products	723,166	69,945,875	87.6
4	Liquid Bulk	Chemicals	1,760,533	212,816,423	94.5
4	Liquid Bulk	Petroleum Products	170,277	17,068,050	83.8
5	High Value Dry Bulk	Coke	510,831	51,204,151	83.8
5	High Value Dry Bulk	Crushed Stone, Sand and Gravel	1,258,887	132,714,956	100.4
5	High Value Dry Bulk	Grain	1,454,790	161,677,131	102.3
5	High Value Dry Bulk	Waste and Scrap Materials	498,932	47,804,756	84.8
6	Low Value Dry Bulk	Coal	7,616,924	932,698,346	113.0
6	Low Value Dry Bulk	Metallic Ores	744,932	69,938,974	87.5
6	Low Value Dry Bulk	Nonmetallic Minerals	334,641	35,278,659	100.4
7	Intermodal	Intermodal Flat Car	12,510,669	190,878,268	13.2
7	Intermodal	Trailer or Container	8,420	408,840	
8	Other	All Other	113,612	6,679,868	

Table 5 Characteristics of the Six Commodity Groups Representing General Merchandise and Bulk Traffic

Commodity Group	Cars (Millions)	Tons (Millions)	Ton-Miles (Billions)	Revenue ($ Billions)	Revenue per Ton	Tons per Car
High Value Merchandise	2.59	169.9	161.2	$10.4	$81.54	49.4
Medium Value Merchandise	1.27	128.6	105.3	$5.4	$48.99	87.2
Low Value Merch.	1,27	130.2	121.8	$5.9	$53.54	87.0
High Value Bulk	1.93	230.0	191.6	$9.6	$52.98	93.5
Medium Value Bulk	3.72	393.4	262.9	$9.4	$26.12	96.8
Low Value Bulk	8.70	1,038.0	748.9	$15.1	$15.70	110.3
Total	19.49	2,089.8	1,591.7	$55.8	$30.19	94.9

Table 6 Percentage of Traffic in Each Commodity Group (Cars)

Commodity Group	Percentage of Cars
High Value Merchandise	13.3%
Medium Value Merchandise	6.5%
Low Value Merch.	6.5%
High Value Bulk	9.9%
Medium Value Bulk	19.1%
Low Value Dry Bulk	44.6%
Total Merchandise	26.4%
Total Bulk	73.6%
Total	100.0%

Table 7 Total Cars by Mileage Block

	50	200	400	600	800	1200+
Merchandise	5.8%	16.9%	14.7%	13.5%	14.8%	34.3%
Bulk	15.6%	15.8%	11.9%	9.7%	15.6%	31.5%

3. Results of the Class I Study

The mode shares were estimated for a base case in which truck competition was provided by a tractor-trailer combination with an 80,000 pound gross vehicle weight (GVW). For the 100 O-D sample, the predicted mode shares were as shown in Table 8. These mode shares should not be compared to any statistics concerning freight mode share, as the set of O-Ds was structured to represent movements where rail is in fact competitive. No attempt was made to represent the many intercity movements where truck would be expected to dominate. Also, as mentioned above, no attempt was made to consider major double-stack movements to and from ports. Thus, the base case mode share must be viewed as depicting the rail, TOFC/COFC, and truck shares of a subset of the intercity freight market. What is of interest is not this initial mode split, but how the mode split changes as trucking capabilities change.

Table 8 Base Case Mode Split Class I Analysis

(Mode share of ton-miles for 100 hypothetical O-D movements)

Mode	Merchandise	Bulk	Total
Rail	57.8%	100%	79.2%
Intermodal	4.8%	0%	2.4%
Truck	37.4%	0%	18.4%

The predicted distribution of traffic was found to be similar to the actual distribution of traffic in terms of distance and commodity group. Rail clearly has the advantage for the bulk movements, even for the 50- and 200-miles moves. The detailed results indicate that the rail market share increased for lower value and longer distance movements; for example, Table 9 shows market share for hypothetical movements of 16 million pounds/year (8,000 tons/year) for various distances and commodity values. As would be expected, the rail share generally increases with distance, but declines with the value of the commodity.

Table 9 Market Share for General Merchandise Movements
(hypothetical shipments, 8,000 tons/year)

	400 miles	**600 miles**	**800 miles**	**1200 miles**
High Value	33%	38%	36%	52%
Medium Value	48%	57%	55%	79%
Low Value	56%	73%	72%	91%

The next step in the analysis was to investigate the changes in market share for rail (not including intermodal) as a result of changes in truck capabilities. If everything stays the same except truck size/weights, then how much will the rail market share decline? Since the sample of 100 O-D movements is intended to represent all of the general merchandise and bulk traffic handled by the Class I railroads, the percentage decline in the rail market share will in fact represent the expected percentage decline in this rail traffic (even though the percentage changes in the intermodal or truck shares will not represent the percentage changes in intermodal or truck volumes).

Various competitive scenarios were considered for situations involving two basic changes in truck size and weights that are currently being proposed by advocates of higher truck size/weights. Two scenarios included increases in GVW for tractor-trailer combinations with only a single trailer:

- Increases in load limits for existing trucks to 90,000 lb (3-S2 with 90,000 GVW)
- Increases in GVW to 97,000 lb for trucks with an additional axle (3-S3)

Other cases that were examined with the model include various types of longer configurations involving double or triple trailers. Each of these long-combination options would result in even greater diversion than would result from just increasing the GCW, as will be shown in Section 4.

<u>Results for Trucks with GVW Increased to 90,000 or 97,000 Pounds</u>

The results for heavier vehicles are shown first. The results for the base case and the two heavier load limit cases are shown in Table 10. The base case is the same as in Table 9 above. The next column shows the effect of the smaller proposed change, namely allowing existing tractor/trailer combinations to carry additional weight up to a GVW limit of 90,000 lbs. This option increases the maximum payload from 26.6 to 31.6 tons, with the cubic capacity remaining at 3,984 cubic feet. With only a minimal increase in cost, the higher weight limit allows trucks to capture a third of the merchandise traffic. The final column shows results for a truck with an even higher payload of 34.85 tons and 97,000 lb. GVW. As trucks get larger, the rail market share is clearly predicted to decline. The loss of market share is predicted to occur almost entirely within the general merchandise traffic, as bulk traffic moving in unit trains or multi-car shipments almost always remains much cheaper than could be provided even by heavier trucks. However, this analysis assumes very good rail service; as will be shown in the next section, the larger trucks could actually be competitive with many rail services for distances up to 300 miles.

Table 10 Estimated Impact of Larger Trucks on Mode Shares of Ton-Miles (Analysis of 100 hypothetical rail/truck competitive movements)

Market	Mode	Base	90,000 GVW	97,000 GVW
Merchandise	Rail	57.8%	36.5%	28.4%
	Intermodal	4.8%	3.7%	3.3%
	Truck	37.4%	59.8%	68.3%
Bulk	Rail	100%	100%	98.6%
	Intermodal	0%	0%	0%
	Truck	0%	0%	1.4%
Total	Rail	79.2%	68.6%	64.0%
	Intermodal	2.4%	1.8%	1.6%
	Truck	18.4%	29.6%	34.3%
Decline in Rail Traffic	Merchandise		37%	50%
	Total		13%	19%

As noted above, this analysis is keyed to traffic that could be handled by the Class I railroads; no attempt is made to model shipments that currently are handled exclusively by intermodal or truck. The most relevant number is therefore the predicted decline in rail share as larger trucks are allowed. In other words, the rail share in the base case (79.2%) is assumed to represent all of the traffic handled by the line railroads. The percentage decline in this number – which is shown in the last two rows of the table - represents the potential loss of rail if larger trucks were available and the rail industry made no response in terms of service, equipment, or rates. The increase from 80,000 to 90,000 GVW for existing tractor-trailer combinations would potentially reduce Class I merchandise traffic by about 37% and overall traffic by 13%. Allowing 97,000 GVW would potentially reduce the overall Class I traffic by 22%.[3] To the extent that some heavier vehicles are already allowed on highways, these results may somewhat overstate the impact on railroads, because the traffic may already have diverted to the heavier trucks. The impact of heavier trucks will be the greatest in regions where current limits are the lowest.

The results for these two scenarios can be summarized as follows:

- If GVW were increased from 80,000 to 90,000, the potential loss of rail traffic is estimated to be on the order of 10-15% of overall tons or ton-miles; essentially all of the diversions would come from general merchandise freight rather than bulk traffic.
- If GVW were increased to 97,000, then the potential diversion increases to approximately 15-20% of all tons or ton-miles.

In short, increases in truck size and weight limits pose an extremely serious threat to the general merchandise traffic handled by the rail industry. Diversions of freight will be limited by the

[3] The results are very similar to what was reported in the prior short line study. In that study, the increase from 80,000 to 90,000 GVW for existing tractor-trailer combinations was estimated to reduce short line merchandise traffic by about 34% and overall short line traffic by 13%; the increase to 97,000 GVW was estimated to reduce merchandise traffic by 44% and overall short line traffic by 17%.

ability of the trucking industry to handle additional growth. Recent trends with respect to driver shortages, high fuel costs, and highway congestion suggest that it may be difficult for motor carriers to absorb tremendous amounts of additional traffic. On the other hand, other factors suggest that the situation could be even worse than depicted in this section, because heavier trucks may in fact be able to compete with many rail moves of bulk commodities, as discussed later in this report.

Impacts of Diversions on Highway Traffic

If size/weight limits are increased, the number of trucks required to transport a given amount of freight will decrease, which might seem to indicate that fewer trucks would be seen on the highway. However, the diversion of freight from rail to truck will add traffic to the highways, and this traffic will be concentrated near the origins and destinations of the movements that previously were served by rail. The impact of freight diversions is magnified by the fact that three to four trucks would be needed to carry the freight diverted from a single rail car.

The magnitude of the potential impact on highways is indicated by Table 11. In the base case, trucks carried 37.4% of the general merchandise traffic represented by the 100 O-Ds in the sample. This traffic required 14.3 million truck trips and 4.4 billion truck-miles. With larger trucks to transport the same freight, the savings would be considerable: 2.3 million fewer truck trips with 90,000 GVW trucks or 3.4 million fewer truck trips with 97,000 G VW trucks.

On the other hand, because of the diversion from rail, there would be an additional 6.4 million or 11.2 million truck trips respectively if 90,000 or 97,000 GVW limits were allowed. Thus, for the customers and freight traffic represented by the 100 O-Ds in this study, there would be an increase in truck trips and truck miles, not a decrease.

Table 11 Highway Traffic Volumes
(millions of truck trips; billions of truck-miles)

	Base Case	90,000 lb. GVW	97,000 lb. GVW
Truck shipments			
Base case	14.27	14.27	14.27
Reduction related to larger trucks	0	2.59	3.38
Increase related to diversion	0	6.41	11.16
Truck shipments, current case	14.274	18.43	22.06
Net increase for rail competitive truck traffic	0	4.16	7.79
Truck Miles			
Truck miles	8.88	12.50	13.30
Increase in truck-miles over base case	0	3.62	4.42

As this study did not attempt to include O-Ds that would represent all intercity truck trips, it is not possible to conclude anything about the overall effect on highway truck traffic. It is clear, however, that many millions of additional trips and billions of additional truck-miles could result from the diversion from rail. If heavier long-combination vehicles are allowed, then the diversion from rail would be even greater, as shown in Section 4. The impact on bulk traffic would be more severe, and more localized, where new, more productive trucks could compete effectively with small unit trains operating over circuitous routes, as discussed in the Section 5.

4. Longer Combination Vehicles

This section presents the estimated competitive impacts of heavier multi-trailer combinations on rail traffic. The following seven cases were considered:

- Rocky mountain doubles with 129,000 lb GVW
- Turnpike doubles (TPD) with 129,000 lb GVW
- Turnpike doubles with 129,000 lb GVW with relay drivers
- Triple trailers with 110,000 lb GVW
- Triple trailers with 110,000 lb GVW with relay drivers
- Turnpike doubles with 148,000 lb GVW

Some of the key cost and capacity factors related to the different kinds of multi-trailer combinations are shown in Tables 12 and 13.

Table 12 Key Capacity Factors for Long Combination Vehicles

Configuration	Cubic Feet	Load	Gross Vehicle Weight
Base (3S2)	3984	26.60 tons	80,000 lbs.
3S2 – 90,000	3984	31.10 tons	90,000 lbs.
3S3 – 97,000	3984	34.85 tons	97,000 lbs.
RMD	6089	45.70 tons	129,000 lbs.
TPD – 129,000	7216	43.65 tons	129,000 lbs.
TPD – 148,000	7216	53.65 tons	148,000 lbs.
Triple Trailers	6314	34.15 tons	110,000 lbs.

Table 13 Key Cost Factors for Long Combination Vehicles

Configuration	Driver Cost/Mile	Truck Cost/Mile	Fuel Efficiency (Miles/gallon on Highway)
Base (3S2)	$0.41	$0.32	5.801
3S2 – 90,000	$0.41	$0.33	5.801
3S3 – 97,000	$0.41	$0.36	5.691
RMD – 129,000	$0.44	$0.46	5.493
TPD – 129,000	$0.46	$0.44	5.448
TPD – 148,000	$0.46	$0.49	5.448
Triple Trailers	$0.44	$0.40	5.502

Table14 shows the very substantial potential impact of longer combinations on rail traffic. Each of the three 129,000 lb GVW double-bottom cases is predicted to divert more than half of merchandise traffic and about a third of all rail traffic. Triples would not have as great an impact, while the very heavy 148,000 lb TPD case could even divert half of the bulk traffic. A couple of cases are shown assuming that trucks are operated with relay drivers, which means that they provide faster service at a slight increase in cost. The effects of using relay drivers is much less than the effect of shifting from the base case to any of the other cases.

Table 14 Estimated Impact of Doubles and Triples on Mode Shares of Ton-Miles (Analysis of 100 hypothetical rail/truck competitive movements)

Market	Mode	Base	RMD 129,000 GVW	TPD 129,000	TPD 129,000 Relays	TPD 148,000	Triples 110,000	Triples 110,000 Relays
Mode Share								
Merch.	Rail	57.8%	16.4%	20.0%	17.9%	13.1%	38.7%	35.6%
	Intermodal	4.8%	2.5%	2.8%	2.6%	2.2%	3.8%	3.6%
	Truck	37.4%	81.1%	77.2%	79.5%	84.7%	57.4%	60.8%
Bulk	Rail	100%	84.2%	90.2%	89.4%	48.0%	99.7%	99.5%
	Intermodal	0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Truck	0%	15.8%	9.8%	10.6%	52.0%	0.3%	0.5%
Total	Rail	79.2%	50.8%	55.6%	54.1%	30.8%	69.6%	68.0%
	Intermodal	2.4%	1.2%	1.4%	1.3%	1.1%	1.9%	1.8%
	Truck	18.4%	48.0%	43.0%	44.6%	68.1%	28.5%	30.2%
Decline in Rail Traffic								
	Merchandise		72.6%	65.4%	69.0%	77.3%	33.0%	28.4%
	Total		35.9%	29.8%	31.7%	60.1%	12.2%	14.4%

Table 15 Highway Traffic Volumes
(Millions of truck trips; billions of truck-miles)

	Base	**RMD 129,000 GVW**	**TPD 129,000**	**TPD 129,000 Relays**	**TPD 148,000**	**Triples 110,000**	**Triples 110,000 Relays**
Truck shipments							
Total, base case	14.27	14.27	14.27	14.27	14.27	14.27	14.27
Reduction related to larger trucks	0	5.97	5.58	5.58	7.20	3.16	3.16
Increase related to diversion	0	23.34	19.08	20.82	29.03	5.79	7.09
Total, current case	14.274	31.65	27.77	29.52	36.11	16.92	18.21
Net increase for rail competitive truck traffic	0	17.38	13.50	15.25	21.84	2.65	3.94
Truck miles							
Truck miles	8.88	14.42	13.41	13.99	17.72	10.98	11.74
Increase in truck-miles	0	5.54	4.53	5.10	8.84	2.10	2.86

Effects of Changes in Relative Rail and Truck Rates

The results obtained so far indicate that longer multi-trailer combinations could potentially result in millions of additional annual truck shipments and billions of additional annual truck-miles. The actual results would be limited by capacity constraints affecting both highways and the trucking industry and by strategies taken by trucking companies, railroads, and shippers following any change in size/weight limits. In particular, trucking companies might not pass all of the productivity savings on to customers in the form of lower rates, while railroads might respond to the increased competition by lowering rates or seeking further improvements in rail productivity.

Tables 16 and 17 show that such pricing strategies would reduce the extent of diversion from rail. In these tables, relative prices of truck and rail have been changed:

- For motor carriers, the ratio of revenue to variable costs was *increased* by 10% .
- For railroads, the ratio of revenue to variable costs was *reduced* by 10%.

With these adjustments, the diversion from rail to truck is much less. In fact, the change in relative rates would actually divert some traffic to rail in two cases: 90,000 lb GVW singles and 110,000 GVW triples. In both of these cases, railroads would make a slight gain in ton-miles (less than 1.5%) at the expense of nearly a 10% reduction in revenues (and a much greater reduction in contribution to overhead and profit). In the 97,000 GVW case, there would be almost a 5% reduction in rail traffic and a 7% reduction in truck-miles. In the other cases, the double-digit diversions from rail would result in large net increases in truck trips and truck-miles.

Table 16 Estimated Impact of Doubles and Triples on Mode Shares of Ton-Miles: Revenue/Variable Cost Is 10% Higher for Trucks and 10% Lower for Rail
(Analysis of 100 hypothetical rail/truck competitive movements)

Market	Mode	Base	90,000 GVW	97,000 GVW	RMD 129,000 GVW	TPD 129,000	TPD 148,000	Triples 110,000
Merch.	Rail	57.8%	58.2%	50.3%	29.2%	37.0%	21.7%	59.9%
	Intermodal	4.8%	3.8%	3.4%	2.7%	3.0%	2.3%	3.9%
	Truck	37.4%	38.1%	46.2%	68.2%	60.1%	76.0%	36.2%
Bulk	Rail	100%	100.0%	99.9%	96.6%	98.7%	88.4%	100.0%
	Intermodal	0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Truck	0%	0.0%	0.1%	3.4%	%1.3	11.6%	0.0%
Total	Rail	79.2%	79.4%	75.5%	63.3%	68.3%	55.5%	80.2%
	Intermodal	2.4%	1.9%	1.7%	1.3%	1.5%	1.2%	1.9%
	Truck	18.4%	18.8%	22.8%	35.3%	30.3%	43.3%	17.8%
Decline in Rail Traffic	Merchandise		(0.7%)	13.0%	49.5%	36.0%	62.5%	(3.6%)
	Total		(0.3%)	4.7%	20.1%	13.8%	30.0%	(1.2%)

Table 17 Highway Traffic Volumes
(millions of truck trips; billions of truck-miles)

	Base	90,000 GVW	97,000 GVW	RMD 129,000 GVW	TPD 129,000	TPD 148,000	Triples 110,000
Truck shipments							
Base case	14.27	14.27	14.27	14.27	14.27	14.27	14.27
Reduction related to larger trucks	0	2.29	3.38	5.97	5.58	7.20	3.16
Increase related to diversion	0	0.24	2.33	11.23	7.60	17.25	(0.19)
Truck shipments, current case	14.27	12.26	13.23	19.57	16.29	24.33	10.93
Net increase for rail competitive truck traffic	0	(2.01)	(1.04)	5.30	2.02	10.06	(3.34)
Truck miles							
Truck miles	8.88	7.39	8.30	10.15	8.92	10.75	6.32
Increase in truck-miles	0	(1.49)	(0.58)	1.27	0.04	1.87	(2.56)

Effects of Changes in Fuel Prices

Railroads are much more efficient than trucks in terms of ton-miles moved per gallon of diesel fuel. As a result, fuel is a much larger share of truck costs than of rail costs. From 1980 through the beginning of the 21st century, prices of diesel fuel generally declined. In 2002, the rail industry's average cost of diesel fuel was $0.733, more than 10% below the cost of $0.823 per gallon in 1980. Since 2002, however, diesel fuel prices have risen sharply, at times approaching $5/gallon. In this study, diesel fuel was $2.68/gallon to represent average prices in 2007. If fuel prices continue to rise, then larger trucks would become less of a threat to the railroads.

5. Short Haul Bulk Traffic

Short haul bulk traffic is especially susceptible to diversion from rail to large trucks. The earlier short line and UIC studies analyzed the effects of larger size/weight limits on the ability of trucks to compete for bulk freight in situations where railroads may not be able to use modern rail technology effectively. Those studies, which were based upon generic unit train moves, did not distinguish between short line and Class I rail traffic. Since a quarter of Class I rail tonnage and 9% of Class I rail revenues come from freight moving less than 300 miles (Table 18), the threat of losing a substantial portion of short distance freight is as much a concern to the Class Is as it is to the short lines.

Table 18 Total Rail Traffic, by Distance Block
(Distance in miles)

Distance Block	% of Adjusted Cars	% of Adjusted Tons	% of Tonmiles	% of Revenue
< 25 miles	1.8%	2.5%	0.0%	0.5%
25-50	1.5%	2.3%	0.1%	0.5%
50-100	4.2%	6.0%	0.5%	1.4%
100-150	2.8%	4.3%	0.6%	1.3%
150-200	2.4%	3.7%	0.7%	1.6%
200-250	2.5%	3.1%	0.9%	1.7%
250-300	2.7%	3.1%	1.1%	2.1%
300-400	6.1%	6.9%	2.9%	5.6%
400-600	9.7%	10.5%	6.6%	10.4%
600-800	8.9%	9.4%	7.9%	9.9%
800-1200	20.3%	21.1%	25.1%	21.2%
1200+	37.2%	27.2%	53.4%	43.9%
	100.0%	100.0%	100.0%	100.0%
% LT 300	17.9%	24.9%	4.0%	9.0%

Source: Association of American Railroads analysis of waybill data

The analysis presented in previous sections assumed efficient train operations and heavy cars. In actual fact, there are many rail movements where efficient operations are difficult or impossible to achieve. The main factors that would lead to inefficient operations are as follows:

- Greater circuity: the rail route may be much longer than the truck route.
- Older equipment: older rail equipment will have smaller payloads than modern heavy-haul equipment.
- Lower traffic volume: few customers have the volume necessary to support full unit train operations, and it is more difficult to consolidate traffic into longer trains for short-haul movements. It may therefore be necessary to operate shorter trains for short-haul bulk customers.

The UIC study of bulk freight (Martland, 2003) considered 30 O-D movements chosen to represent short- to medium-distance movements of a commodity with a value of $0.10 per pound ($200/ton), e.g. grain. The study focused on shorter lengths of haul because rail easily dominates the longer-haul markets. Prior studies have shown that this type of traffic can be handled by rail, by truck, by water, and by various intermodal combinations, depending upon the costs for using each mode and the structure of the rail network, and the location of waterways (see studies by Baumol; Babcock and Bunch; Casavant, Dooley, and Hays; and Maze, Allen and Smadi).

In the UIC study, the 30 OD moves were structured as follows:

- Ten Distance Categories: 10, 25, 50, 75, 100, 150, 200, 300, 400, and 500 miles

- Three Categories for truck service:
  - Poor - inefficient tractor-trailer combinations
  - Base - efficient tractor-trailer combinations
  - Good - efficient double-bottom service

- Three categories for rail service
  - Poor – cars with 60-ton payloads moving in 20-car unit trains; cycle times 2.6 to 8.7 days (increasing with distance);$400 per shipment (i.e. per car) for loading and unloading
  - Base – cars with 80-ton payloads moving in 50-car unit trains; cycle times of 2 to 5.4 days; $200 per shipment for loading and unloading
  - Good – cars with 100-ton payloads moving in 100-car unit trains; cycle times of 1.65 to 5.1 days; $100 per shipment for loading and unloading

Table 19 shows the parameters used for each level of rail and truck service. The UIC study used truck, rail and logistics costs typical of the 2000-2002 period. The results of that study were presented in a bar chart that showed the cost per ton-mile for each mileage category (Figure 1).

In Figure 1, there are six bars for each distance category. The x-axis shows the direct distance between origin and destination, not including the initial branch line distance or the access to the highway. The y-axis shows the cost per ton-mile. For each distance group, there is a cluster of six bars; the first three bars show the costs for trucks while the last three bars show the costs for rail. For both rail and truck, the bars show costs for the good, base, and poor service. The rail costs decline with distance; truck costs decline so long as the trip can be completed in one day, then rise.

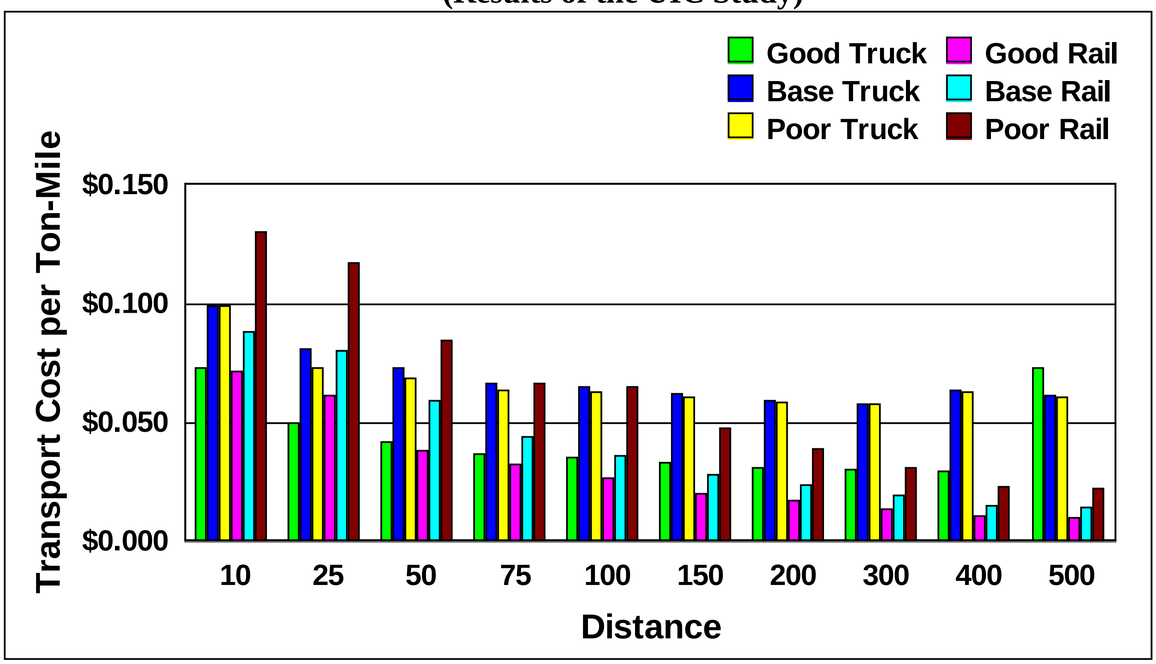
Table 19 Parameters for Different Levels of Rail and Truck Service (parameters used in the UIC study)

Parameter	Poor Rail	Base Rail	Good Rail	Poor Truck	Base Truck	Good Truck
Loading/Unloading $/shipment	$400	$200	$100	$150	$200	$250
Tons/shipment	60	80	100	20	20	40
Access distance	10	5	1	15	10	5
Cars/train	20/80	50	100			
Track cost index	100	80	60			

At the right-hand side of Figure 1, we see the expected result. For a 500-mile haul, even the lowest level of rail service was predicted to be far cheaper than the best truck service. At the extreme left, however, we see something quite different. Here the best truck service is equivalent to or cheaper than the best rail service. In the middle range, the best rail service is the cheapest, but good truck is cheaper than poor rail.

In this example, we see truck costs can drop to about $0.03 per ton-mile (at 2000-2002 cost levels) by using twin trailers (one tractor pulling two trailers), even without increasing the loading per trailer. This is a low enough cost to make trucks a formidable cost competitor over distances of several hundred miles or more.

Figure 1
Comparative Transportation Costs for Various Levels of Truck and Rail Service
(Results of the UIC Study)



If we add in logistics costs, the advantage will shift to the mode with the best loading/unloading capabilities. Loading/unloading costs relate to the customers' facilities and the type of equipment. Where volumes are high and labor is expensive, customers can afford highly efficient conveyor systems; where volumes are low or labor is cheap, customers will favor less capital intensive systems. Inventory costs are not nearly as important for bulk as they are for higher value merchandise movements. Even for the higher-valued bulk commodities, like soybeans, inventory costs will only be a few percent of the transport costs. For lower-valued bulk commodities, like coal, the inventory costs will be negligible. Speed and reliability are therefore important only as they affect equipment utilization and cost, not as a serious factor in either customer costs or mode share.

Updating the Bulk Study

The UIC study was updated for the short line study using the same distance categories, but with truck categories defined to represent the range of size/weight limits currently under consideration:

- Base case: standard tractor-trailer combination with 80,000 lb GVW (gross vehicle weight) (referred to as 3-S2 in studies conducted for CABT by Roger Mingo)
- Larger, single-trailer combination: enhanced tractor-trailer combination with 97,000 lb GVW (3-S3)
- Very heavy, double-bottom combination: turnpike doubles with 148,000 lb GVW (DS9 TPD)

Operating parameters and unit costs for each type of truck were the same as in the analyses described in previous sections. The same three rail scenarios were used in the short line study as in the UIC study already described, the only change being the increase in diesel fuel costs from $1.20 to $2.68 per gallon.

The results are shown in Figure 2. Since this is very similar to Exhibit 3, the conclusions are the same: larger trucks would become a more serious competitive threat for bulk rail freight for distances up to 150 miles or more. The threat is greatest where rail freight service is least efficient, whether because of high circuity, short trains, expensive track structure, or inefficient facilities for loading and unloading.

A second analysis estimated the mode share for trucks if they were competing against the "poor rail" service under conditions that were more favorable to trucks. To reflect the possibility that customers would invest in their facilities in order to capture the benefits of larger trucks, lower loading and unloading costs were used in this study than in the UIC study ($100 rather than $150 to $250 for unloading a single trailer and $150 for unloading two twin-trailers). The distance from the customer to the major highway system was also reduced (which has the effect of increasing the circuity of rail relative to truck). Figure 3 and Table 20 show the results. In Figure 3, the truck options are somewhat less expensive while the three rail scenarios all represent the same "poor" level of service shown in Figure 2. In the base case, rail captured essentially all of the traffic for the three trucking scenarios for distances of 50 miles or longer; truck captured only a small portion of the shortest moves. However, as larger trucks were allowed, the short distance traffic shifted entirely to truck and trucks became competitive even for the 300-mile movements. Unlike the analysis in the previous section, this analysis indicates that larger size/weight limits are likely to be a very serious competitive problem for short- to medium-length bulk movements.

Figure 2 Estimated Costs/ton-mile for Various Bulk Movements

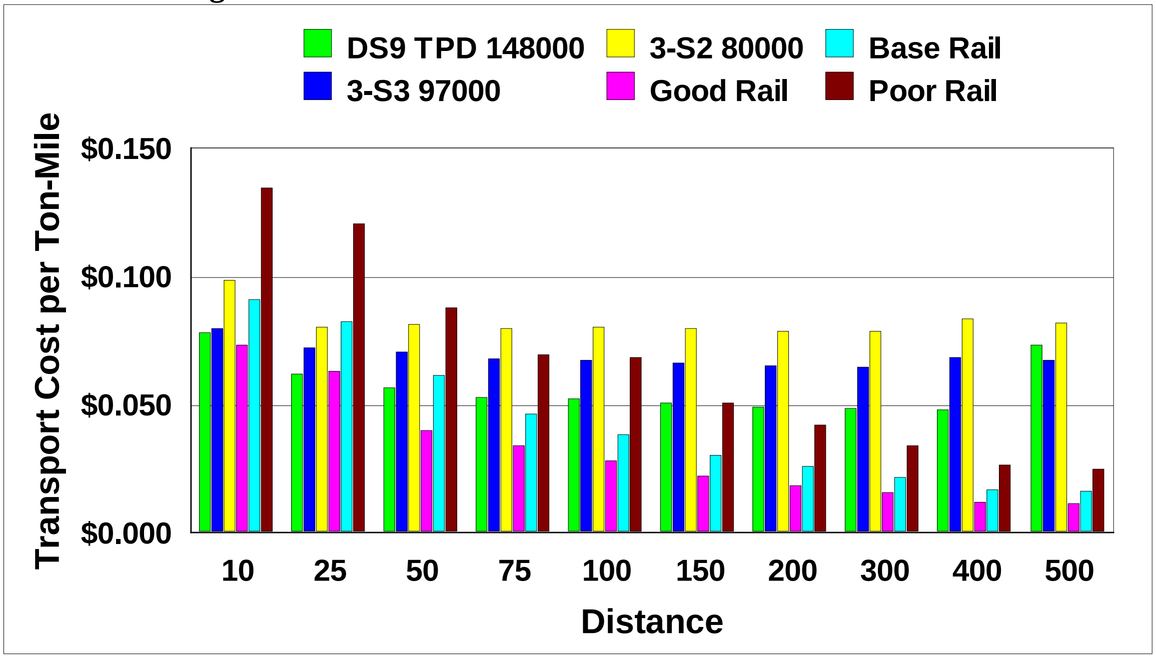


Figure 3 Estimated Costs/ton-mile for Various Bulk Movements (With lower loading/unloading costs for large trucks)

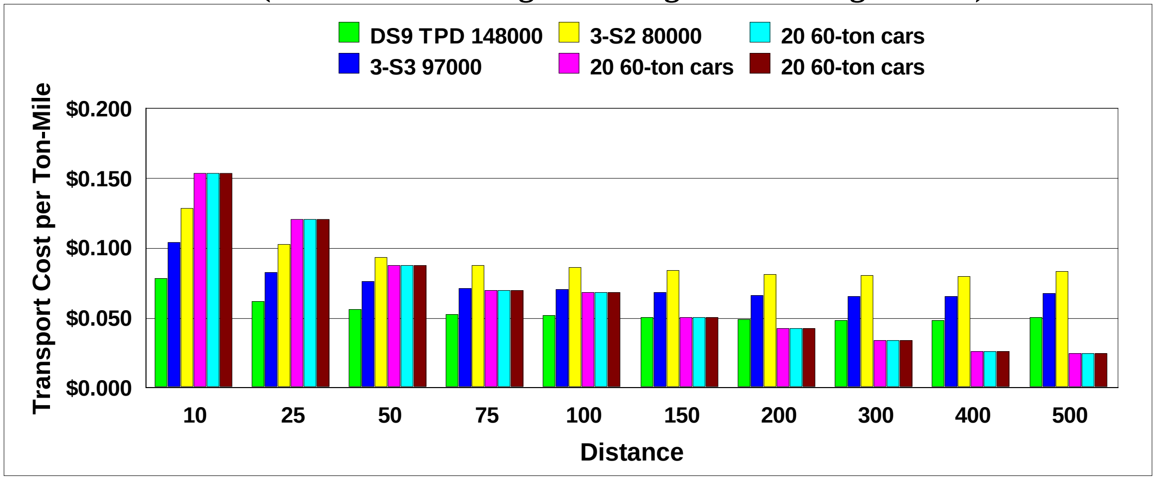


Table 20
Predicted Truck Market Share for Short- and Medium-Length Markets,
(in competition with unit trains of twenty 60-ton rail cars)

Distance	Base Case (80,000 GVW 3-S2)	Heavy Tractor/Trailer (97,000 3-S3)	Turnpike Doubles (148,000 GVW)
10	6%	99%	100%
25	9%	100%	100%
50	1%	98%	100%
75	0	84%	100%
100	0	86%	100%
150	0	3%	100%
200	0	0	100%
300	0	0	63%
400	0	0	0
500	0	0	0

6. Conclusions

Since the results of this study are so similar to the results of the short line study, the same conclusions apply: an increase in truck size/weights would have a potentially very serious impact on rail freight traffic. An increase in gross vehicle weight (GVW) from 80,000 to 90,000 pounds could potentially result in diversion of more than a third of the general merchandise traffic currently carried by the industry. Trucks with GVW of 97,000 would have a much greater impact, as half of the general merchandise traffic could potentially be diverted. The potential diversion could be even greater for the heaviest double- and triple-trailer combinations.

With such large diversions, it is quite possible that the net effect of increasing truck size/weights would be to increase – not decrease – the amount of intercity truck traffic on the nation' highways. The reductions in the number of truck trips required to move existing truck shipments would be offset by the additional truck trips to handle the freight diverted from railroads.

Diversion is not just an issue for general merchandise traffic, where trucks have long been chipping away at rail traffic. Larger vehicles would become very competitive with bulk rail, not just for the shortest hauls, but for hauls of 100-300 miles if rail efficiency is constrained by circuity, rail infrastructure, or customer loading and unloading capabilities. The threat of competition from heavier long-combination vehicles would put pricing pressure on many more bulk movements currently handled by railroads.

There are several other factors to consider regarding the impact of increases in size/weight limits.

- The competitive effects would be less noticeable in regions where railroads are already competing with long-combination vehicles. In such locations, heavy trucks already have been able to divert traffic from rail.
- Diversions could be limited by the capacity of the trucking industry in terms of drivers and vehicles and also by the extent of highway congestion.

- Both the railroads and the trucking companies could adjust their pricing strategies to reflect the change in the competitive environment. Trucking companies could decide to keep some of the benefits in terms of higher profits rather than simply lowering rates, which would tend to reduce the amount of freight diverted. However, inter-city trucking is a very competitive industry and rates tend to drop close to the long-term variable costs of the most efficient carriers.
- Future increases in fuel prices could shift the competitive balance in favor of rail. In this study, the cost of diesel fuel was $2.68, reflecting conditions in 2007; since then, diesel fuel prices have at times approached $5/gallon and most experts anticipate steadily increasing fuel prices over the long-term.

Although railroads would be able to respond to the larger trucks by reducing their rates, improving their service, introducing better equipment, or improving productivity, each of these options would tend to reduce rail profitability. Hence, as in the past, increases in truck size/weights pose a serious threat to the rail industry.

<u>Further Research</u>

This study has used basic concepts of transportation systems analysis to provide an understanding of the likely effects of higher truck size/weight limits on diversion of freight from rail to truck and the resulting impact on truck trips and truck miles. While the results are clear, further study would be useful in addressing the following topics:

- Intermodal traffic: while TOFC and COFC were considered as an option in this study, it did not address international or domestic double stack container traffic.
- Short haul bulk traffic: this study showed that inefficient, short-haul bulk rail traffic is at risk of diversion. How much such traffic exists, and how great is the threat? Has such traffic already diverted to truck in locations where truck size/weight limits are higher?
- Case studies: case studies of particular customers or industries could illuminate the issues. Some freight, e.g. transport of new automobiles, is inadequately covered by the generic methodology used in this study.
- Highway congestion: in general, intercity trucks move on rural interstates where congestion is a limited problem. However, in and around places like Chicago and St. Louis, increases in intercity truck could exacerbate what is already a high level of congestion. The effects of diversion could therefore be related to the locations where the greatest impact on highway congestion would be felt.
- Rural roads: bulk traffic tends to originate where natural resources are found (e.g. coal, sand & gravel, or ores) or in other rural locations where roads may be inadequate for heavy trucks (e.g. grain and other agricultural products). To what extent would diversion of bulk traffic to truck lead to dramatic increases in heavy truck movements on rural roads and small towns?

Acknowledgement

This study was undertaken following a discussion with the AAR concerning the potential for trucks with higher size/weight limits to divert traffic from the Class I railroads. The

methodology used in this study was previously developed by the author in peer-reviewed research concerning the effects of technological and institutional changes on rail/truck competition. The study was funded by the Coalition Against Bigger Trucks (CABT), but the author bears sole responsibility for the methodology, the results, and the conclusions of the study.

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Appendix
Additional Information Related to the Study

Characteristics of Heavy Trucks

For the purposes of this study, the key characteristics of larger, longer trucks are the maximum load in terms of tons or cubic capacity and fuel consumption. The key cost factors are the driver cost, fuel costs, and truck ownership cost. Table A1 shows the values that were used in this study.

Table A1 Characteristics of Heavy Trucks

	Base	90,000 GVW	97,000 GVW	RMD 129,000 GVW	TPD 129,000	TPD 148,000	Triples 110,000
Truck Size/Weight							
Maximum Load (tons)	26.6	31.6	34.85	45.7	43.65	53.65	34.15
Maximum load (cubic feet)	3984	3984	3984	6089	7216	7216	63.14
Truck Operating Factors							
Miles per gallon, highway	5.80	5.80	5.69	5.43	5.45	5.45	5.50
Miles per gallon, local roads	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Truck Cost Factors							
Driver cost/mile	$0.41	$0.41	$0.41	$0.44	$0.46	$0.46	$0.49
Fuel cost/gallon	$2.68	$2.68	$2.68	$2.68	$2.68	$2.68	$2.68
Truck ownership cost/day	$55.89	$55.89	$57.86	$66.08	$69.70	$69.70	$66.08

Source: data prepared for CABT by trucking industry expert Roger Mingo

Customer Characteristics

Customers were represented by 100 generic O-D pairs that were characterized in terms of four key variables: O-D distance, annual use rate, commodity density, and type of commodity. Table A2 shows how 100 O-Ds were created to represent a broad range of customers and commodities. There were six categories for distance and five categories for annual use rate, which are shown as the headings for the columns and the rows in the table. There were six categories of commodities: high, medium and low value merchandise and high, medium and low value bulk (as described in Section 2 of the report). The letters in each cell indicate the O-Ds that were included in the sample. For example, the entry in the cell in the upper left of the table is "M: H,M,L", indicating there were three merchandise O-Ds (one with high, one with medium, and one with low value commodities), each of which had an annual use rate of 2,000 tons and a distance of 50 miles. If O-Ds had been developed for each commodity type, each distance category, and each annual use rate category, there would have been six entries in each cell and a total of 180 O-Ds (6 commodities x 6 distance categories x 5 use rate categories). The actual number of O-Ds was lower because there were no merchandise moves with very high annual use rates, no bulk moves with very low annual use rates, and other unlikely moves (e.g., short distance high value merchandise) were not considered.

Table A2 Characteristics of the 100 Generic O-D Pairs Used in the Study

		O-D Distance (Miles)					
Annual	**Total**	**50**	**200**	**400**	**600**	**800**	**1200**

Use Rate	**O-Ds**						
2,000 tons	18	M: H,M,L	M: H,M,L	M: H,M,L	M: H,M,L	M: H,M,L	M: H,M,L
8,000 tons	31	B: H,M,L	M: L B: H,M,L	M: H,M,L B: H,M,L	M: H,M,L B: H,M,L	M: H,M,L B: H,M,L	M: H,M,L B: H,M,L
25,000 tons	31	B: H,M,L	M: L B: H,M,L	M: H,M,L B: H,M,L	M: H,M,L B: H,M,L	M: H,M,L B: H,M,L	M: H,M,L B: H,M,L
50,000 tons	10	B: H,M,L	B: H,M,L	B: L	B: L	B: L	B: L
100,000 tons	10	B: H,M,L	B: H,M,L	B: L	B: L	B: L	B: L
Total O-Ds	100	15	17	17	17	17	17