PROCEEDINGS —

Twenty-second Annual Meeting

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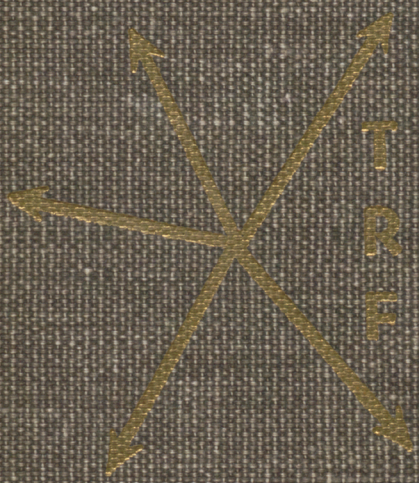

TRANSPORTATION RESEARCH FORUM

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Theme:

"Opportunities and Challenges in the New Environment of Transportation"

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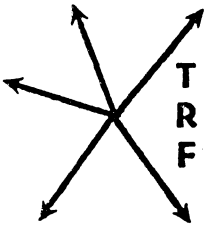

TRANSPORTATION RESEARCH FORUM

Changes in Intercity Truckload Costs & Service 1950 - 1980

*by David S. Paxson**

DRAMATIC CHANGES have occurred over the past 30 years in the scope, size, and operations of the intercity trucking industry. Intercity trucks now carry more than 10 times as much freight (in terms of ton-miles) than did trucks in 1950.[1] The transit times of typical intercity truck movements are now significantly shorter than comparable rail movements, while in 1950 the difference in the transit times of the two modes was smaller. Trucks currently carry a larger percentage of intercity freight: 25 percent of the ton-miles as opposed to 16 percent in 1950.[2] Much of this gain in market share has been at the expense of the rail market share.

The purpose of this paper is to investigate when and why changes in truck costs and service times have occurred. This analysis also attempts to evaluate the specific effect of trucking technological changes, and the building of the Interstate Highway System on truck costs and service. Cost and service changes since 1970 are examined in greater detail so that the data and analysis presented can be used as a basis for making some estimates of future cost and service changes.

The basic findings of this analysis are:

— Truck costs per mile have dropped 21 percent (in constant dollars) since 1950. However, truck costs per mile were lower in 1970 than at present. In 1970, truck costs per mile were 26 percent lower than in 1950. Truck costs per mile were at the lowest in the mid 1970's.

— Truck costs per mile (in constant dollars) have been increasing in the past few years. This has resulted primarily from increases in the costs of diesel fuel and new equipment.

— Average truck transit times have fallen 41 percent since 1950, with most of the decreases occurring by 1970. These decreases have come about due to the building of U.S. Interstate Highway System. The reduction in truck transit time was the major cause of the decreases in truck costs.

These findings have the following implications:

— Since the building of the Interstate System resulted in improvements in truck costs and service, it was unavoidable that the railroads should lose some traffic to intercity truckers. While certainly not the only reason for the loss of rail market share, these truck cost and service improvements have a significant effect.

— Highway improvements are advantageous to the Trucking Industry. If truckers do not cover the highway costs for which they are responsible, inequitable and non-optimal allocations of transportation resources will occur.

— Since most of the Interstate System is now completed, with only marginal future improvements expected, it can be expected that there will be little or no future decreases in truck costs and service resulting from highway improvements.

— Since increasing fuel costs have resulted in rising relative truck costs in recent years, railroads may start to show an improvement in comparative costs with intercity trucking. Such a condition would reverse the trend of the past 30 years.

The analysis to support these conclusions is organized in the following manner. First, the changes in truck cost inputs (specifically equipment, labor, and fuel costs) are examined. Then, an analysis is made of changes in transit times that have resulted from the Interstate System. Finally, the effects of the changing cost inputs and transit times on truck costs are evaluated.[3] The actual cost changes are presented in tabular form at the end of the paper. This analysis uses data collected from trucking companies, truck equipment manufacturers, Government reports, and from a private data base of intercity trucking.[4] Also used are Bureau of Labor Statistics price indices and indices of productivity changes.

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I. CHANGES IN TRUCK COST INPUTS

Equipment Costs

Basic truck equipment costs have decreased over the past 30 years. As shown in Table A, the approximate cost of a heavy duty tractor is now 74 percent (in constant dollars) of the cost of the 1950 models used for standard intercity service.[5] Decreases in constant dollar tractor costs occurred throughout the 1950's and 1960's and continued until 1974. These decreases resulted from the decreasing constant dollar cost per unit of the standard trucks that occurred as truck production reached levels where scale economies were realized.

Changes in safety and environmental requirements resulted in increased tractor production costs in the period 1974-1976. The effect of these new production requirements reversed the trend in tractor prices, with the average retail price of a tractor being 21 percent higher (in constant dollars) in 1976 than in 1974.

Decreased equipment prices during the period 1950-1974 helped contribute to decreases in trucking costs, but this effect was reversed as tractor prices increased after 1974. However, even in 1980, constant dollar prices were significantly lower (36 percent) than in the 1950's.

TABLE A

ESTIMATED RETAIL COST OF A STANDARD HEAVY-DUTY TRUCK TRACTOR BY YEAR

Year	Cost in Actual (Year of Purchase) Dollars	Cost in 1980 Dollars
1950	20,500	66,500
1955	21,000	61,000
1960	21,000	56,500
1965	21,500	57,000
1970	22,000	51,000
1971	22,500	51,000
1972	23,000	50,000
1973	23,500	47,500
1974	25,000	43,000
1975	32,500	48,000
1976	37,000	52,000
1977	37,500	50,500
1978	39,500	50,000
1979	45,000	51,500
1980	49,000	49,000

Note: These figures are based on the approximate average retail prices of GMC and White Freightliner basic model tractors purchased for company use. These prices are in general agreement with the prices paid by several private firms and trucking companies that were surveyed. While the different year trucks are not comparable in terms of horsepower, equipment, and accessories, they are comparable in that they were the basic model for any given year to perform intercity truck service.

Labor Costs

The average income for an intercity truck driver has improved significantly over the past 30 years. Even after adjusting for inflation, a driver now earns almost twice the wage of a 1950 driver (see Table B). These increases occurred between the years 1950 and 1970. Trucking wage rates have been stable (in constant dollars) since 1970.

Even though driver income was increasing from 1950-1970, labor cost per mile to trucking companies was remaining relatively stable. This resulted from the improved highways allowing more miles to be covered per unit of time, thus increasing driver productivity. The net result has been that labor cost per unit of output for trucks has not changed significantly over the past 30 years. Therefore, labor costs have not had an impact on changing truck costs. All increases in income received by intercity drivers were during periods of simultaneously increasing driver productivity.

Fuel Costs

During the 1950's and 1960's, middle distillate fuels were considered a "by product" of gasoline refining, resulting in the price of diesel being substantially lower than the price of gasoline. With the advent of the use of middle distillate fuel by jet planes in the 1960's, and the energy crisis of the 1970's, middle distillates (diesel) were no longer considered "by-products," and are more expensive than in the 1950's.

Presently, the retail price of diesel fuel is 60 percent higher (in constant dollars) than in 1950. However, it should be noted that all of this increase occurred in the 1970's, (see Table C) with prices increasing 32 percent in the past year alone. Diesel prices in 1970 were lower than in 1950. Until the energy crisis of 1974, the cost (in constant dollars) of diesel fuel was relatively stable. It is only since 1974 that fuel costs have

TABLE B

AVERAGE ANNUAL INCOME FOR INTERCITY TRUCK DRIVERS

	Actual $[1]	1980 $	Labor Cost/Mile (1980 $)[2]
1950	4,600	14,300	20¢
1960	7,300	19,600	17¢
1970	11,900	27,600	21¢
1975	16,500	24,000	N/A
1976	17,400	24,200	N/A
1977	18,800	24,700	20¢
1978	20,700	25,300	21¢
1979	23,100	26,900	23¢
1980	25,000	25,000	22¢

1 Source: 1950 Data: Adjustments to U.S. Department of Commerce Data
1960-1978 Data: From Indices from Bureau of Labor Statistics
1978-1980 Data: Adjustments using NMTDB Data.
2 Based on the estimated annual mileage for the specific years.

TABLE C

AVERAGE FUEL COST & EFFICIENCY FOR INTERCITY TRUCKS

Year	Retail Pump Price[1] of Diesel Fuel		Approximate Fuel[2] Efficiency (MPG)	Fuel Cost/ Mile[3] (in 1980 $)
	Actual $	1980 $		
1950	19¢	62¢	3.5	18¢
1955	20¢	58¢	3.5	17¢
1960	22¢	59¢	3.5	17¢
1965	23¢	61¢	4.0	15¢
1970	23¢	53¢	4.0	13¢
1971	25¢	57¢	4.0	14¢
1972	27¢	59¢	4.1	14¢
1973	28¢	57¢	4.1	14¢
1974	43¢	74¢	4.2	18¢
1975	46¢	68¢	4.5	15¢
1976	50¢	71¢	4.7	15¢
1977	53¢	71¢	4.8	15¢
1978	56¢	71¢	4.9	14¢
1979	65¢	74¢	4.9	15¢
1980	98¢	98¢	4.9	20¢

Sources:
1 Survey of truck stops; Union Truck Stops data; American Petroleum Institute.
2 From estimates derived from changes in the engineering efficiency of Cummins tractors, 1977-1980 figures from NMTDB data.
3 This is calculated by dividing the fuel price by the MPG figure.

become an important factor in changing truck costs.

Fuel efficiency has also been increasing since 1950 (see Table C). This has resulted from engineering changes and from new technologies. In the late 1960's, modulated fan drive engines were introduced. The early 1970's saw the introduction of high torque rise engines and radial tires. In the late 1970's, fuel efficiency increased as these and other fuel saving measures were utilized to a greater degree. These changes occurred as the increasing cost of fuel made it economically justifiable to invest in fuel saving technology and operations.

Increases in fuel efficiency somewhat negated the effects of increasing fuel prices. An adjusted fuel cost/mile is presented in Table C. These data show that a significant increase in net fuel cost/mile occurred between 1973 and 1974, and between 1979 and 1980.

In general, fuel costs have tended to raise truck costs. In recent years, fuel cost increases have had the effect of counteracting the cost decreases brought about by decreased tractor costs and decreased transit times. Since fuel costs are now 22 percent of total costs (as opposed to 13 percent in 1970), they will continue to be an important determinant of total truck costs.[6]

II. CHANGES IN TRUCK SERVICE

Changes in Truck Transit Times

The construction of the Interstate Highway System has resulted in decreased average truck transit times. The introduction of limited access highways has allowed higher average speeds and reduced congestion delays.

Most of the construction of the Interstate System, and therefore most of the productivity increases, occurred between 1955 and 1970 (see Table D). By 1970, 70 percent of all planned miles of Interstate Highway were completed. In most areas, the Interstate System was first built in congested areas (where it was most needed) so that the 70 percent that was completed by 1970 accounted for most of the improvements in transit time which would be realized from the system being constructed.

The net effect of the Interstate System on improving transit time is shown in Tables E and F. Table E gives the decrease in transit time for nine sample city pairs movements of approximately 250 miles. Table F gives the same information for city-pair movements of approximately 1000 miles. Tables E and F are both presented to show that transit times were reduced for both short and long haul truck movements.

Tables E and F show the average truck transit time dropped approximately 43 percent between 1950 and 1980. As would be expected, because most of the Interstate was completed by 1970, the major portion of the transit time decreases occurred between 1950 and 1970. Note also that the deviation of truck transit times has decreased since 1950. This results in a greater similarity in transit times for city-pair hauls of a given length of haul. This increased transit time similarity helps trucking companies in operations planning and in guaranteeing service reliability.

TABLE D

MILES OF INTERSTATE HIGHWAY COMPLETED

Year	Miles Completed	Percentage of Total Planned Miles*	Total Percentage of Planned Mileage Completed in Previous 5 Years
1950	None	——	——
1955	1,000	2%	2%
1960	9,000	21%	19%
1965	16,000	38%	17%
1970	29,000	69%	31%
1975	35,000	83%	14%
1980	38,000	90%	7%

*Total planned mileage for the interstate system is 42,000 miles.
Source: U.S. Federal Highway Administration

TABLE E

AVERAGE TRUCK TRANSIT TIME 1950-1980 FOR 250 MILE HAULS (In Hours)

BEA City Pairs (200-300 Miles)	1950	1960	1970	1980	Change % 1950-1980
Pittsburgh-Cincinnati	10.8	8.1	5.8	5.4	—50%
Boston-New York	8.9	5.5	4.5	4.2	—52%
Norfolk-Philadelphia	10.7	8.5	7.0	6.4	—40%
Baltimore-Pittsburgh	9.0	6.6	5.4	5.0	—44%
Louisville-St. Louis	7.2	6.4	5.5	4.4	—39%
Chicago-Toledo	6.8	4.9	4.4	4.1	—39%
Nashville-Memphis	6.3	5.5	4.0	3.8	—40%
Kansas City (MO)-Omaha	5.7	4.8	3.8	3.3	—42%
Birmingham-Memphis	7.4	6.3	5.6	5.3	—28%
Mean	8.0	6.3	5.1	4.6	
Standard Deviation	1.4	0.8	0.7	0.7	
10 Year Change		—21%	—19%	—10%	
30 Year Change				—43%	

Source: Derived from estimates made in Richard J. Olsen and G. W. Westley, "Synthetic Measures of Truck Operating Times between the Metropolitan Centers of BEA Economics Areas: 1950, 1960, and 1970, with Projections for 1980," Oak Ridge National Laboratory, January 1975.

NOTE: These estimates do not account for any decrease in average transit time that may have occurred with the decrease in speed limits in 1973.

The decrease in truck transit times brought about by the building of the Interstate System has been of benefit to the trucking industry in two ways. First, the transit time capability for any specific movement has been improved. For example, a city-pair movement that was a three day trip in 1955 became a 2 day trip in 1970. Decreased transit time is important in that it decreases the non-transport logistical costs (e.g., inventory) incurred by shippers. As total logistics costs for movements by trucks have decreased, the choice of the truck mode for shipment has become more attractive.

Decreases in transit time also improve productivity for truckers. Since a truck can cover more mileage in a unit of time at higher average speeds, decreased transit time will lower the fixed costs per unit of output. As annual mileage increases, fixed costs are spread over more miles, and costs per mile are reduced.

III. CHANGES IN INTERCITY TRUCKING COSTS 1950 TO 1980

Cost Calculations

In order to calculate historical truck costs, the data collected for this report relating to truck costs and truck operating characteristics were used as input values for the AAR Truck Cost Model.[7] All cost data were adjusted to 1980 dollars. The result of the cost calculations are presented in Table G.

The data inputs used to calculate the historical costs shown in Table G were the following: Capital costs were based on the data presented in Table A, labor rates were obtained from Table B, and fuel cost and efficiency figures from Table C. Average speed and annual mileage were calculated from the transit time change data presented in Tables E and F.

The AAR Truck Cost Model output gives the estimated direct operating cost

TABLE F

AVERAGE TRUCK TRANSIT TIME 1950-1980 FOR 1000 MILE HAULS (In Hours)

BEA City Pairs (925-1000 Miles)	1950	1960	1970	1980	Change % 1950-1980
New York-St. Louis	32.2	24.0	19.6	18.1	—44%
Omaha-Salt Lake City	32.8	27.0	20.1	18.8	—43%
Birmingham-New York	32.9	26.5	21.9	19.5	—41%
Boston-Chicago	30.1	20.9	18.3	17.1	—43%
Cleveland-Tulsa	30.1	24.5	19.8	17.6	—42%
Chicago-Dallas	28.9	21.8	18.5	17.0	—41%
New Orleans-Chicago	27.7	22.7	18.5	16.3	—41%
San Antonio-Denver	28.4	23.1	18.7	17.4	—39%
Minneapolis-Dallas	27.8	22.4	18.7	17.0	—39%
Mean	30.1	23.6	19.3	17.6	
Standard Deviation	2.09	2.06	1.16	1.00	
10 Year Change		—22%	—18%	— 9%	
30 Year Change				—42%	

Source: Derived from estimates made in Richard J. Olsen and G. W. Westley, "Synthetic Measures of Truck Operating Times between and Metropolitan Centers of BEA Economics Areas: 1950, 1960, and 1970, with Projections for 1980," Oak Ridge National Laboratory, January 1975.

NOTE: These esimates do not account for any decrease in average transit time that may have occurred with the decrease in speed limits in 1973.

TABLE G

ESTIMATED CHANGES IN INTERCITY TRUCKLOAD COSTS 1950-1980

	A	B	C		D
Year	Average Line-Haul Speed MPH)A	Average Annual Mileage[1] (000 Miles)	Estimated Direct Cost/Truck Mile[2] (1980 $)	Operating Index 1950 = 100	Estimated Average Total Cost/Truck Mile (1980 $)B
1950	35	70	1.01	100	1.42
1960	48	92	.80	79	1.12
1970	59	109	.75	74	1.05
1980	63	115	.80	79	1.12

1 Derived from estimates made in Richard J. Olsen and G. W. Westley, "Synthetic Measures of Truck Operating Times between the Metropolitan Centers of BEA Economics Areas: 1950, 1960, and 1970, with Projections for 1980, "Oak Ridge National Laboratory, January 1975. Note: These estimates do not account for any decrease in average transit time that may have occurred with the decrease in speed limits in 1973.

2 From the data on previous tables and the AAR Truck Cost Model.

per truck mile. The costs as calculated, along with an index of the cost changes, are presented in column C of Table G. Total fully allocated costs per truck mile (column D) were obtained by adding overhead and empty mileage costs to the direct operating costs. For the purpose of this analysis, the overhead costs were assumed to be 20 percent of line-haul costs, and empty mileage was assumed to be 15 percent of total mileage.[8]

Cost Changes

As can be seen from the data in Table G, truck vehicle mile costs are now 70 percent of the costs in 1950. Note that in constant dollars, truck vehicle mile costs were lower in 1970 than at present. Costs were even lower in the early 1970's, and did not start to increase until the later part of the decade. For example, truck costs as calculated from the NMTDB data for the years 1977 to present are shown in Table One.

The causes for the increases in costs in the late 1970's were most likely (1) increased fuel costs, (2) lower annual mileages resulting from decreased speeds and lower demand due to economic recession, and (3) higher equipment prices.

The pattern of changing truck costs per vehicle mile (decreasing until the early 1970's, and increasing since then) is consistent with the basic point of this paper: that the building of the Interstate Highway was of singular importance in the reduction of truck costs. Since most of the system was built by the mid-1970's, costs were no longer decreasing after this time.

The effect of the building of the Interstate System can best be understood by comparing 1980 truck costs with the costs that would be incurred using 1980 truck equipment, labor, and fuel rates on a hypothetical 1950 (pre-Interstate) road network. Using a 1950 road system would result in decreased annual mileage and lower fuel efficiency (due to more driving on congested roads). Standard costs were calculated using the AAR Truck Cost Model, with all inputs except annual mileage and fuel efficiency being similar.[9] The costs were as shown in Table Two.

Using a 1950 highway system would increase present truck costs almost 50 percent.

IV. SUMMARY AND DISCUSSION

Over the period 1950-1980, truck labor costs were basically stable. Even though labor productivity was increasing during the period, the net labor cost to the trucking industry remained steady due to increasing driver income. Equipment and fuel costs for trucking decreased from the 1950's till the mid 1970's, and then increased. These trends can be expected to continue.

The reduction of average truck transit times from 1950 to 1970 reduced truck fixed costs per mile. Since there are no planned improvements to the Interstate Highway System that will significantly further reduce truck transit time, no further truck cost decreases due to such improvement will occur. On the contrary, if average truck speeds are reduced, whether in reaction to enforcement of speed laws or to increased fuel costs, annual mileage will decrease and therefore vehicle mile costs will increase. This would be a continuation of the trend observed occurring since 1977, which is that truck costs are increasing in constant dollar terms.

Also affecting future truck costs will be any truck productivity increases resulting from increased truck size and weight limits. However, the occurrence of limit increases is speculative, and full impact of the new limits if they do occur is unclear. Size and weight limit increases will lower truck costs only for

TABLE ONE

Line-Haul Truck Costs*

Year	Ann. Miles	Cost (Actual ¢)	Cost (1980 ¢)	Index (1950 = 100)
1977	123,000	51¢	66¢	65
1978	120,000	54¢	67¢	66
1979	119,000	65¢	75¢	74
1980	114,000	80¢	80¢	79

*Based on NMTDB data and the AAR Truck Cost Model.

TABLE TWO

	Annual Mileage (000)	Fuel Efficiency (MPG)	Total Cost Per Mile
1980 Costs on **1950** Roads	70,000	3.5	$1.67
1980 Costs on **1980** Roads	115,000	4.9	$1.12

the transportation of those commodities that can utilize the increases.[10] More research needs to be done in this area.

Shorter transit times improve truck competitiveness for intercity freight not only by reducing costs, but by improving the cost-service packages that are offered to the shipper. The gains in service that resulted from highway construction have already been realized, but will continue only as long as the road system is well maintained. However, for the sake of competitive fairness, it is important that the trucks pay their fair share of the costs of maintaining the highway system. As highway maintenance costs increase, truck taxes may be expected to increase.

The overall outlook is that the competitive relationship between the railroads and trucking is changing. The long term trend of erosion of rail market share by trucks has ended. Railroads should be able to at least maintain their competitive position in the coming years, and under certain conditions be able to improve that position. The likelihood of such improvement will be dependent upon:

(1) The implementation and impact of truck size and weight limit increases.
(2) Changes in the cost of energy.
(3) Changes in the service demanded by shippers.

and

(4) Changes in truck tax levels.

While the outlook contains some uncertainties, it is likely that the competitive trend will be much more favorable to rail than it has been over the past thirty years.

FOOTNOTES

1 Transportation Association of America, "Transportation Facts & Trends" 1979.

2 Ibid.

3 For the purposes of this analysis, only vehicle-mile costs, and not ton-mile costs, were compared over time. Longitudinal analysis of truck ton-mile costs can be misleading because they vary widely, depending upon the density of the commodity hauled.

4 Data from the National Motor Transport Data Base (NMTDB) was used extensively in this analysis. For more information about this privately collected field survey of intercity trucking, contact: AAR Truck & Waterway Information Center, 1920 L Street, N.W., Washington, D.C. 20036.

5 All of the historical cost data used in this analysis are converted into 1980 dollars. This was done utilizing the Producer Price Index factors as provided by the U.S. Department of Commerce.

6 See: "The Energy Crisis and Intermodal Competition," presented to the Transportation Research Board, January, 1980; Washington, D.C.; by the author. It is published in TRB Record #758. This publication is also available from the AAR Truck & Waterway Information Center.

7 For more information on this model see: AAR Truck & Waterway Information Center Staff Memo 79-07 "The 1979 AAR Truck Cost Model; A User's Guide" by D. Jansen. This publication is available from the AAR-TWIC office.

8 These are the average values for the company driver operations of an Irregular Route Common Carrier, as shown by the NMTDB data. This analysis assumes that overall empty mileage levels were similar throughout the 1950-1980 period.

9 For an Irregular Route Common Carrier utilizing company drivers and pulling van trailers.

10 Analysis of the NMTDB indicates that 16 percent of all intercity truck movements are at a weight near the limit, and thus would be able to utilize a weight increase.