Quarterly Models Of Intercity Freight Demand

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INTRODUCTION

Every industry and firm must have a flow of information concerning expected demand for its product or service. The interdependent nature of the transportation industry in general and the rail industry in particular creates a crucial need for accurate forecasts of modal transportation demand. For an industry in which intermodal shipments are increasing as a percentage of total traffic and, therefore, the economic health of one mode is partially dependent upon other modes, both motor carrier and railroad executives are increasingly called upon to evaluate the outlook for the entire industry as opposed to just their particular mode and company. In this type of operating environment, there is no substitute for a national transportation forecasting system which translates movements in the aggregate industry indicators into forecasts for various modes on a commodity basis as well as equipment requirements.

In reviewing the literature on freight demand forecasting, it is apparent that a disproportionate share of effort by economists in this area has been directed toward the identification and measurement of "modal split determinants"; i.e., previous research has been focused almost exclusively on "internal" industry economics. Although there is little doubt that cross price elasticity of demand is of paramount importance in the competitive freight transportation environment, it is likewise important not to lose sight of those forces external to the freight sector which generate the "derived" demand for transportation services.

Another major shortcoming in previous studies is the tendency to analyze annual data since it is generally more readily available. The use of annual data, however, obliterates all the seasonality of freight demand patterns and much of the cyclical aspects as well. Additionally, both transportation firms as well as equipment manufacturers schedule equipment, material purchases and labor availability on a quarterly or monthly basis and, hence, annual forecasts of demand are of little use in the short term planning requirements of most firms.

This paper bridges two gaps relative to the transportation industry's information needs. First, we have focused on the linkages between the aggregate level of economic activity and intercity freight demand and,

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secondly, we have utilized quarterly data to provide a more direct input into the short term decision-making process at the industry and firm level.

THE COMPOSITION OF ECONOMIC ACTIVITY AND TRANSPORTATION DEMAND

Over the post war time period, economic activity as measured by real Gross National Product has advanced 104 percent (see Table 1) from 655 billion in 1955 to $1333 billion in 1977. In the same time interval, industrial production rose 135 percent and total intercity freight ton miles registered a more modest 83 percent gain. Hence, it is clear that there is not a one-to-one correspondence between economic activity and transportation demand. This is due principally to the change in the composition of economic activity over time.[1] An example of this is the rapid growth of the services component of personal consumption outlays—a sector of GNP which generates very little, if any, freight demand. In 1955, the services component of personal consumption accounted for 39.9 percent of total

TABLE 1

The Performance of the Transportation Sector
Relative to Economic Growth
1955-1977

Year	GNP[1]	Real Consumption Expenditures[1] Total	Services	Services As % Total	Industrial[2] Production (1967=100.0)	Intercity Freight Ton Miles (Billions)
1955	654.8	395.5	157.5	39.9	58.4	1,274
1960	736.8	453.0	192.3	42.5	66.1	1,314
1961	755.3	462.2	200.0	43.3	66.6	1,310
1962	799.1	482.9	208.7	43.2	72.1	1,371
1963	830.7	501.4	217.6	43.4	76.6	1,453
1964	874.4	528.7	229.7	43.4	81.7	1,543
1965	925.9	558.1	240.7	43.1	89.8	1,638
1966	981.0	586.1	251.6	42.9	97.7	1,747
1967	1007.7	603.2	264.0	43.8	100.0	1,765
1968	1051.8	633.4	275.0	43.4	106.3	1,838
1969	1078.8	655.4	287.2	43.8	111.2	1,895
1970	1075.3	668.9	297.3	44.4	107.8	1,936
1971	1107.5	691.9	306.3	44.3	109.6	1,954
1972	1171.1	733.0	322.4	44.0	119.7	2,073
1973	1235.0	767.7	336.5	43.8	129.7	2,232
1974	1217.8	760.7	344.3	45.3	129.3	2,212
1975	1202.3	774.6	355.3	45.9	117.8	2,066
1976	1271.0	819.4	373.2	45.5	129.8	2,200
1977	1332.7	857.7	389.5	45.4	137.1	2,331
% Change 1955-77	104	117	147		135	83

[1]Billions of 1972 dollars.
[2]Revised index only available from 1954.

consumption compared to 45.4 percent in 1977. Stated alternatively, the output of "transportable" goods has lagged behind the overall rate of economic growth.

As noted in Table 2, all transport modes have not received proportional shares of the expanding freight market. The lion's share of the expanding "freight pie" accrued to inland water carriers who experienced a 439 percent leap in ton miles followed by motor carriers with a 224 percent gain in freight ton miles. Class 1 and 2 Railroads registered a modest 39 percent increase in industry output in this time interval.

The percentage change in alternative market share measures for the railroad industry and regulated motor carriers is presented in Table 3.

QUARTERLY DEMAND FOR RAIL AND MOTOR CARRIER SERVICES

Quarterly data availability for the rail industry as a whole consists of net revenue ton miles and freight carloadings—both published by Association of American Railroads. However, each individual railroad must submit a *Quarterly Commodity Statistics* (QCS) Report to the Interstate Commerce Commission and, therefore, quarterly tonnage, carloading and revenue

TABLE 2

Intercity Freight Ton Miles By Mode
Selected Years: 1950-1977
(Billions of Ton Miles)

Year	Class 1 and 2 Railroads	Motor Carriers	Great Lakes	Rivers and Canals	Oil Pipeline	Airlines	Total
1950	597	173	112	52	129	0.318	1,063
1955	631	223	119	98	203	0.481	1,274
1960	579	298	99	121	229	0.778	1,314
1965	709	371	110	152	310	1.910	1,638
1966	751	381	116	164	333	2.250	1,747
1967	731	389	107	174	361	2.592	1,765
1968	757	396	112	179	391	2.900	1,838
1969	780	404	115	188	411	3.200	1,895
1970	771	412	114	205	341	3.400	1,936
1971	746	430	105	210	444	3.400	1,954
1972	784	470	109	230	480	3.700	2,073
1973	858	505	126	232	507	3.945	2,232
1974	852	495	107	248	506	3.910	2,212
1975	759	454	99	243	507	3.730	2,066
1976	799	510	106	267	523	3.900	2,209
1977	831	561	95	280	560	4.180	2,331
% Change 1950-77	39.2	224.3	−15.2	438.5	334.1	1215.	154.5

Source:
Transportation Association of America, *Transportation Facts and Trends–1978* (Washington, D.C.)

data can be obtained in five-digit Standard Transportation Commodity Code configuration by aggregating individual firm data to a national total.

For the motor carrier industry, there are three principal data sources for quarterly demand patterns. First, the Commerce Department's Current Industrial Report (M37-L) for truck trailers reports highway truck trailer production—by type of trailer—on a monthly basis. Secondly, the Motor Vehicle Manufacturers Association (MVMA) reports on a monthly basis retail sales—by truck size—by manufacturer. Third, the American Trucking Association (ATA) compiles a monthly index of truck tonnage which measures the volume of general freight transported by Class 1 and 2 Motor Carriers. Since both truck trailers and power units are placed into immediate service, either measure is a good barometer of the demand for motor carrier transportation. The ATA truck tonnage index is deficient in that general freight is a declining proportion of total motor carrier tonnage and, therefore, understates the overall demand for motor carrier services. Hence, the quarterly freight carloadings data for the rail industry are comparable to the retail sales data for heavy duty trucks.

Historical data on freight carloadings and retail sales of heavy duty trucks over the 1960-1977 time period are detailed in Tables 4 and 5. Since

TABLE 3

Summary of Market Share Measures for
Class 1 & 2 Railroads and Regulated
Motor Carriers: 1950-1978

Year	Class 1 & 2 Railroads			Regulated Motor Carriers		
	Tonnage	Ton Miles	Revenue	Tonnage	Ton Miles	Revenue
1950	46.7	56.2	63.4	7.0	16.3	26.9
1955	40.9	49.5	56.0	8.8	17.5	32.5
1960	36.1	44.1	49.0	10.7	21.8	39.1
1965	33.3	43.3	43.8	12.6	21.9	44.5
1966	33.1	43.0	43.1	12.9	21.8	45.9
1967	31.3	41.4	42.7	12.5	22.0	46.4
1968	31.3	41.2	41.4	13.2	21.5	46.7
1969	31.3	40.8	40.1	13.8	21.3	48.1
1970	31.1	39.7	39.8	13.1	21.3	48.9
1971	29.4	38.2	39.9	14.1	22.8	48.9
1972	29.3	37.7	39.3	14.7	22.7	49.3
1973	29.7	38.5	38.7	15.2	22.6	50.0
1974	30.3	38.6	38.0	14.9	22.4	50.9
1975	29.6	36.7	38.8	14.4	22.0	49.1
1976	28.0	36.3	36.1	15.3	23.2	52.1
1977	26.6	36.0	33.9	16.0	24.0	54.5
1978	26.0	35.8	N/A	16.3	24.7	N/A
% Change 1950-78	−44.3	−36.3	−46.5	132.9	51.5	102.6

Source: Transportation Association of America, *Transportation Facts and Trends–1979.*

TABLE 4

Historical Freight Car Loadings (Unadjusted)

Year	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
1960	7,576	8,113	7,590	7,161
1961	6,384	7,209	7,490	7,505
1962	6,902	7,473	7,195	7,151
1963	6,599	7,604	7,319	7,348
1964	6,794	7,518	7,436	7,688
1965	6,862	7,543	7,416	7,425
1966	6,989	7,628	7,522	7,482
1967	6,763	7,239	6,976	7,104
1968	6,651	7,371	7,154	7,075
1969	6,571	7,300	7,114	7,250
1970	6,450	7,173	6,823	6,713
1971	6,445	6,816	6,214	5,788
1972	6,148	6,661	6,568	6,725
1973	6,558	6,980	6,902	6,896
1974	6,596	6,860	6,538	6,187
1975	5,667	5,895	5,735	5,928
1976	5,731	6,094	5,878	5,751
1977	5,610	6,224	5,845	5,616

Source: Association of American Railroads, *Statistics of Railroads of Class 1*—Selected Issues.

TABLE 5

Historical Retail Unit Sales of Heavy Duty Trucks (Unadjusted)

Year	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
1960	8,347	10,259	6,436	5,146
1961	5,789	8,685	6,674	6,207
1962	8,321	12,032	10,605	9,661
1963	11,389	15,002	11,613	12,050
1964	15,255	18,476	13,687	11,882
1965	16,036	18,985	17,058	16,510
1966	21,103	23,282	19,645	19,789
1967	20,018	20,962	15,740	15,559
1968	18,656	22,081	19,181	20,026
1969	24,246	27,654	24,069	23,064
1970	24,020	25,308	20,484	21,260
1971	22,819	26,763	24,285	24,797
1972	28,181	33,199	30,851	34,064
1973	36,935	42,426	36,698	38,512
1974	38,364	42,079	36,953	30,137
1975	24,053	21,284	18,911	18,900
1976	19,508	24,288	27,604	25,886
1977	32,838	39,826	34,080	33,899

Source: Motor Vehicle Manufacturers Association of the U.S., *Total New Truck Retail Sales and Stock*—Selected Issues.

the average capacity of the rail car fleet has increased significantly over the historical time period due to technological improvements, it is necessary to adjust the historical data in Table 4 by the index of capacity in Table 6 to derive a consistent set of demand estimates over time.

There is a strong seasonal pattern—as evidenced by Tables 7 and 8—for both freight carloadings and retail sales of Class 8 heavy duty trucks. Tables 9 and 10 contain the quarterly seasonal adjustment factors for rail carloadings and retail truck sales for selected years.

THE ECONOMY—RAIL AND TRUCK INDUSTRY LINKAGES

To accurately forecast intercity freight demand on a modal basis, it is necessary to know the commodity mix transported by each mode. The historical commodity mix of Class 1 Railroads is outlined in Table 13 with similar data for Class 1 and 2 Motor Carriers presented in Table 14.

The mix of commodities transported on the nation's rail network has remained relatively stable overall, with Chemical Products (STCC 28), Transportation Equipment (STCC 37), and Merchandise Traffic (STCCs 44, 45 and 46) experiencing growth and declines concentrated principally in manufactured goods. As indicated in Table 14, tonnage originated by Class 1 and 2 Motor Carriers has advanced at a rapid pace, with total

TABLE 6

Average Capacity Per Freight Car (Tons)

Year	Tons Per Car	Index (1960 = 1.00)
1960	55.4	1.00
1961	55.7	1.01
1962	56.3	1.02
1963	56.8	1.03
1964	58.2	1.05
1965	59.7	1.08
1966	61.4	1.11
1967	63.4	1.14
1968	64.3	1.16
1969	65.8	1.19
1970	67.1	1.21
1971	68.4	1.23
1972	69.6	1.26
1973	70.5	1.27
1974	71.6	1.29
1975	72.9	1.32
1976	73.8	1.33
1977	75.5	1.36

Source: Statistics of Railroads of Class 1—Selected Issues

TABLE 7

Predictable Seasonality Test
Freight Car Loadings

	Sum of Squares	Degrees of Freedom	Mean Square	F Value
Between Quarters	650.361	3	216.787	93.459*
Residual	157.733	68	2.320	
Total	808.094	71		

*Predictable seasonality present at the 99.99 percent confidence level.

TABLE 8

Predictable Seasonality Test
Retail Sales of Heavy
Duty Trucks

	Sum of Squares	Degrees of Freedom	Mean Square	F Value
Between Quarters	6061.117	3	2020.372	63.485*
Residual	2164.073	68	31.825	
Total	8225.190	71		

*Predictable seasonality present at the 99.99 percent confidence level.

tonnage originated increasing from 365 million tons in 1960 to 705 million in 1977, a 93 percent increase. General Freight and "All Other," which collectively accounted for 59 percent of total tonnage in 1977, increased 35 and 158 percent, respectively, over this historical time period. The most rapidly growing component, although small in absolute tonnage, was Refrigerated Solids (primarily Fresh Fruit and Vegetables) which rocketed upward by 315 percent in this time period. Strong tonnage gains were also registered for Heavy Equipment, Building Materials and Agricultural Commodities (principally Wheat, Corn and Other Grain Products).

ECONOMETRIC MODELS

In building the quarterly econometric models for rail carloadings and heavy duty truck demand, we have linked both rail and truck demand to the major commodity sectors outlined above.

Equation 1 below presents the model of retail sales for Class 8 power units, while Equation 2 highlights the linkages between economic activity and rail transport demand.

Eq. 1: $RTS8_t = -20{,}935.3 + 244.168^* BFI_{t-2} - 1219.9^*PIR_{t-4}$
$(-13.7) \quad (8.7) \quad (-7.9)$
$+3{,}358.38^* \quad Dummy_t + 13{,}697.5^*FRB_t$
$(3.5) \quad (4.1)$
$\bar{R}^2 = .961 \quad D.W. = .78 \quad S.E. = 1800$

t-statistics are in parenthesis
Interval: 1961:1 to 1977:4

Where: RT S8 = Retail Sales of Heavy Duty Trucks, Seasonally Adjusted.
BFI = Business Fixed Investment in Billions of Constant 1972 Dollars, Seasonally Adjusted Annual Rates.
PIR = Prime Interest Rate.
FRB = Weighted Average of Federal Reserve Board Indexes of Production, Seasonally Adjusted.
(.15*FRB20 + .019*FRB21 + .077*FRB22 + .095*FRB23 + .039*FRB25 + .091*FRB26 + .134*FRB27 + .064*FRB30 + .229*FRB36 + .06*FRB38 + .043*FRB39)

Where: FRB20 = Index for Food
FRB21 = Index for Tobacco
FRB22 = Index for Textile Mill Products
FRB23 = Index for Apparel
FRB25 = Index for Furniture and Fixtures
FRB26 = Index for Paper and Paper Products
FRB27 = Index for Printing and Publishing
FRB30 = Index for Rubber and Plastic Products
FRB36 = Index for Electric Machinery
FRB38 = Index for Instruments
FRB39 = Index for Miscellaneous Manufacturers.
Dummy[1] = A Dummy Variable With a Value of Ones in 73:4 to 74:4, Zeros Elsewhere.

Eq. 2: $FCL_t = 10{,}479.3 + 3.049.13^*FRBMI_t - 7{,}075.09^*$
$(13.39) \quad (13.47)$
$GNPK72/GNP72_t + 1{,}325.61^*FRB331/FRB_t +$
$(-11.94) \quad (8.03)$
$15.2153^*FPI_t \quad - 425.26^*DumStrike_t$
$(4.20) \quad (-3.0)$
$\bar{R}^2 = .91 \quad D.W. = 1.22 \quad S.E. = 135.5$

t-statistics are in parenthesis
Interval: 1961:1 to 1977:4

Where: FCL = Freight Carloading—Class 1 Railroads, Adjusted for Capacity and Seasonality.

FRBMI = Federal Reserve Board Index for Mining Products, Seasonally Adjusted.

GNPK72 = Potential GNP in Constant 1972 Dollars, Seasonally Adjusted Annual Rates.

GNP72 = GNP in Constant 1972 Dollars, Seasonally Adjusted Annual Rates.

FRB331 = Federal Reserve Board Index for Steel Products, Seasonally Adjusted.

FRB = Federal Reserve Board Index for Total Industrial Production, Seasonally Adjusted.

FPI = Farm Proprietor's Income with Inventory Valuation Adjustment and Capital Consumption Adjustment, Seasonally Adjusted.

DumStrike = A Dummy Variable with a Value of One in 71:3, Zeros elsewhere. (Rail Strike)

Retail sales of heavy duty power units are linked to industrial production of eleven key economic sectors which capture the basic composition of commodities transported by the nation's motor carriers, business fixed investment, and the prime interest rate. Truck sales are, as one would expect, positively linked to the output of commodities transported by trucks

TABLE 9

Historical Seasonal Adjustment Factors: Freight Car Loadings

Year	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
1960	93.553	103.427	101.902	101.080
1961	93.609	103.470	101.769	101.130
1962	93.670	103.520	101.582	101.132
1963	93.875	103.528	101.342	101.142
1964	94.101	123.547	101.111	101.071
1965	94.398	103.550	100.920	100.988
1966	94.597	103.620	100.813	100.786
1967	94.784	103.787	100.712	100.469
1968	95.001	104.076	100.524	100.090
1969	95.293	104.367	100.290	99.739
1970	95.683	104.476	100.101	99.482
1971	96.111	104.350	100.046	99.299
1972	96.560	104.039	100.036	99.281
1973	96.869	103.698	100.122	99.271
1974	97.061	103.444	100.248	99.221
1975	97.128	103.351	100.390	99.065
1976	97.166	103.411	100.444	98.908
1977	97.190	103.508	100.412	98.841

TABLE 10

Historical Seasonal Adjustment Factors: Retail Sales Of Heavy Duty Trucks

Year	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
1960	96.812	126.795	93.900	82.370
1961	97.172	126.503	93.693	82.551
1962	98.099	125.257	93.590	82.981
1963	99.684	122.996	93.614	83.800
1964	101.286	120.563	93.325	85.125
1965	102.652	118.156	93.085	86.583
1966	103.480	116.097	92.985	88.136
1967	103.703	114.350	93.115	89.799
1968	103.126	113.259	93.270	91.349
1969	102.234	112.479	93.580	92.656
1970	101.345	111.620	94.178	93.809
1971	100.440	110.644	94.962	95.002
1972	99.438	109.548	95.964	96.033
1973	98.488	108.537	96.971	96.748
1974	97.792	107.738	97.769	97.223
1975	97.260	107.270	98.329	97.399
1976	97.007	107.030	98.613	97.451
1977	96.943	106.872	98.757	97.435

TABLE 11

Historical Freight Car Loadings Adjusted For Capacity And Seasonal Variation (Millions of Car Loadings)

Year	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
1961	6888	7037	7434	7495
1962	7515	7363	7225	7212
1963	7240	7565	7439	7483
1964	7581	7624	7722	7987
1965	7851	7867	7936	7940
1966	8201	8172	8282	8240
1967	8134	7951	7897	8060
1968	8121	8216	8256	8199
1969	8205	8324	8442	8649
1970	8156	8308	8249	8163
1971	8248	8036	7640	7168
1972	8022	8070	8274	8528
1973	8606	8554	8747	8807
1974	8795	8563	8395	7993
1975	7790	7528	7506	7802
1976	8027	7818	7729	7583
1977	8139	8135	7836	7546

and business fixed investment, and are negatively influenced by the prime rate.

The dampening effect of the prime rate on retail sales is due to the fact that some 30 percent of industry sales are financed by the manufacturer with the financing charges generally being an "add on" to the prime rate.

The dummy variable in Equation 1 was designed to capture the "prebuy" effect on the part of motor carriers to escape the federally mandated Anti-Lock, Anti-Skid brake system (SS-121) imposed upon truck and trailer manufacturers as of January 1, 1975.[1]

Freight car demand is positively linked to the Federal Reserve Board Index of Industrial Production for Mining—a variable which captures the output of coal, iron ore, nonmetallic minerals as well as components of Chemical Products. In 1978, iron ore, coal and nonmetallic minerals collectively accounted for 45 percent of total tons originated by Class 1 Railroads. Rail transport demand is also influenced by output in the primary metals industries as well as farm proprietor income, an excellent proxy for Farm Products (STCC 01) tonnage. Additionally, there is an important interrelationship between rail freight demand and demand for other modes (particularly truck) which is captured by GNPGAP (the ratio of potential to actual GNP). The greater the gap between potential and actual GNP, all other things being held constant, the lower is rail freight demand. In other words, during periods when actual GNP is far below

TABLE 12

Historical Retail Sales of
Heavy Duty Trucks
Adjusted For
Seasonal Variation

Year	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
1960	8,621	8,091	6,854	6,247
1961	5,957	6,865	7,123	7,518
1962	8,482	9,605	11,331	11,642
1963	11,425	12,197	12,405	14,379
1964	15,061	15,324	14,665	13,958
1965	15,621	16,067	18,325	19,068
1966	20,393	20,053	21,127	22,452
1967	19,303	18,331	16,903	17,326
1968	18,090	19,496	20,565	21,922
1969	23,716	24,585	25,720	24,891
1970	23,701	22,673	21,750	22,663
1971	22,719	24,188	25,573	26,101
1972	28,340	30,305	32,148	35,471
1973	37,501	39,088	37,844	39,806
1974	39,230	39,056	37,796	30,997
1975	24,730	19,841	19,232	19,404
1976	20,109	22,692	27,992	26,563
1977	33,873	37,264	34,508	34,791

TABLE 13

Composition of Class 1 Railroad Tonnage
Originations By Two-Digit STCC Code: 1964-1978
(Millions of Tons)

STCC	1964	1967	1970	1973	1974	1975	1976	1977	1978
01	131.43	123.01	134.18	156.10	142.16	134.38	133.25	121.90	128.66
10	116.23	108.97	126.66	125.08	126.51	106.44	96.75	83.20	112.49
11	357.68	384.38	404.62	376.08	390.87	407.57	397.06	414.90	383.11
14	182.81	170.45	163.35	170.47	171.02	150.59	133.30	139.58	134.73
20	94.98	103.24	110.07	106.01	107.30	100.22	99.35	98.70	95.36
24	85.43	91.91	101.90	108.90	105.32	88.58	99.37	99.26	95.08
26	32.97	37.19	42.50	46.49	48.17	40.60	43.43	44.91	41.42
28	65.86	81.85	91.64	99.69	101.43	91.40	98.76	104.27	106.69
29	30.03	28.00	36.27	52.60	53.02	45.77	44.69	46.12	44.38
32	70.96	77.03	71.09	72.62	67.97	56.82	56.16	59.91	59.94
33	83.18	83.72	82.20	71.43	70.32	51.38	49.48	55.16	60.13
34	9.29	13.32	11.28	10.65	11.28	8.24	5.93	2.89	2.51
37	20.33	23.76	24.17	34.27	29.82	27.31	29.95	33.59	32.23
40	35.25	36.51	39.81	44.66	48.14	38.23	35.09	36.12	37.78
44	4.75	4.82	4.71	4.31	4.00	3.22	3.34	4.29	4.27
45	2.41	3.10	4.29	6.42	6.80	6.10	6.49	8.55	9.01
46	7.28	8.88	10.60	20.00	21.11	17.42	19.26	22.33	24.31
All Other	23.80	27.50	25.60	26.40	25.50	20.70	18.50	19.00	18.07
Total	1354.60	1407.60	1484.90	1532.20	1530.70	1395.00	1370.20	1394.70	1390.17

Source: Interstate Commerce Commission, *Freight Commodity Statistics–Class 1 Railroads*

TABLE 13-A

Standard Transportation
Commodity Code

STCC	DESCRIPTION
01	Farm Products
10	Metallic Ores
11	Coal
14	Non-metallic Minerals; except fuel
20	Food or Kindred Products
24	Lumber or Wood Products
26	Pulp, Paper or Allied Products
28	Chemicals or Allied Products
29	Petroleum or Coal Products
32	Clay, Concrete, Glass or Stone Products
33	Primary Metal Products
34	Fabricated Metal Products
37	Transportation Equipment
40	Waste or Scrap Materials
44	Freight Forward Traffic
45	Shipper Association
46	Miscellaneous Mixed Shipment
Other	Forest Products (STCC 08), Fresh Fish or Other Marine Products (STCC 09), Crude Petroleum & Natural Gas (STCC 13), Ordnance (STCC 19), Tobacco Products (STCC 21), Textile Products (STCC 22), Apparel Products (STCC 23), Furniture or Fixtures (STCC 25), Printed Matter (STCC 27), Rubber or Misc. Plastic Products (STCC 30), Leather Products (STCC 31), Non-electric Machinery (STCC 35), Electric Machinery (STCC 36), Instruments or Photographic Goods (STCC 39), Miscellaneous Freight Shipments (STCC 41), Empty Shipping Containers (STCC 42), Mail & Express Traffic (STCC 43).

potential GNP, the trucking industry (as well as other modes) has excess capacity. The trucker who is an owner-operator is not constrained by regulatory agencies; he reacts quickly during cyclical swings in economic activity and begins to take business away from the rail sector which is devoid of any cyclical pricing strategy. By the same token, motor carriers' marketing and pricing strategies become relatively less important as the economy approaches potential GNP. This phenomenon is clearly demonstrated in regression equations for the truck sector where the ratio of potential to actual GNP has a very significant and positive coefficient.[2] From the standpoint of its competitive position vis-a-vis other traffic modes, therefore, the rail sector clearly benefits from policy actions promoting full employment. It was also recognized by the Task Force on Railroad Productivity that the railroads need an aggressive marketing policy[3]; Equation 2 suggests the need is particularly acute during periods of recession.

FORECASTING PERFORMANCE

To test the forecasting accuracy of each model, both were estimated over

TABLE 14

Class 1 and 2 Motor Carrier Tonnage
Originated By Commodity Category
1960-1977
(Millions of Tons)

	1960	1965	1970	1971	1972	1973	1974	1975	1976	1977
General Freight	163.4	210.1	217.9	221.1	247.2	257.1	234.9	200.1	211.1	220.5
Household Goods	2.3	2.4	6.2	2.9	2.8	2.8	2.9	2.6	2.6	2.9
Heavy Machinery	2.7	4.2	6.0	6.5	7.4	8.5	9.1	7.9	8.8	10.5
Liquid Petroleum	87.7	125.3	156.3	155.3	169.3	195.1	174.9	161.2	160.9	185.4
Refrigerated Liquids	1.2	1.8	1.9	.9	1.0	.9	.6	.6)		
Refrigerated Solids	4.0	6.3	10.0	10.8	12.5	17.7	17.3	10.3)	20.7	21.6
Agricultural Commodities	7.1	7.2	8.6	9.5	11.1	12.8	11.8	11.7	12.6	13.9
Motor Vehicles	14.0	19.4	15.7	22.1	24.3	27.7	22.1	19.9	23.7	26.9
Building Materials	7.4	18.9	24.2	28.3	29.4	26.7	23.3	21.3	29.7	40.0
All Other Commodities	75.2	122.5	142.5	150.2	170.2	199.2	184.7	164.9	171.4	194.2
Total	365.0	518.1	589.3	607.6	675.2	738.5	681.5	608.5	649.4	705.4
				% Distribution						
General Freight	44.8	40.6	37.0	36.4	36.6	34.8	34.5	32.9	32.5	31.3
Household Goods	.6	.5	1.1	.5	.4	.4	.4	.4	.4	.4
Heavy Machinery	.7	.8	1.0	1.1	1.1	1.2	1.3	1.3	1.4	1.5
Liquid Petroleum	24.0	24.2	26.5	25.5	25.0	25.1	25.6	26.5	26.0	26.3
Refrigerated Liquids	.3	.3	.3	.1	.1	.1	.1	.1)		
Refrigerated Solids	1.1	1.2	1.7	1.8	1.9	2.4	2.5	3.0)	3.7	3.0
Agricultural Commodities	1.9	1.4	1.5	1.6	1.6	1.7	1.7	1.9	1.9	2.0
Motor Vehicles	3.8	3.7	2.7	3.6	3.6	3.9	3.2	3.3	3.6	3.8
Building Materials	2.0	3.6	4.1	4.7	4.4	3.6	3.4	3.5	4.6	5.7
All Other Commodities	20.6	23.6	24.2	24.7	25.2	27.0	27.1	27.1	26.4	27.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: American Trucking Association, *Intercity Truck Tonnage Report* (1960-1976) and *Motor Carrier Statistical Report* (1976-1977), Annual Report.

TABLE 15

Model Test Results For
Retail Sales Of
Heavy Duty Trucks
Seasonally Adjusted

Fitted Period		One Quarter Ahead	Two Quarters Ahead
1961:1 to 1977:4			
	Forecast	36,908	39,226
	Actual	39,272	40,041
	Error	(2,364)	(815)
	Percent Error	(6.1)	(2.0)
1961:1 to 1978:1			
	Forecast	37,861	38,209
	Actual	40,041	40,671
	Error	(2,180)	(2,462)
	Percent Error	(5.4)	(6.1)
1961:1 to 1978:2			
	Forecast	38,132	39,292
	Actual	40,671	41,874
	Error	(2,539)	(2,582)
	Percent Error	(6.2)	(6.0)
1961:1 to 1978:3			
	Forecast	40,416	41,035
	Actual	41,874	46,262
	Error	(1,458)	(5,227)
	Percent Error	(3.5)	(11.3)
Total			
	Forecast	153,317	157,762
	Actual	161,858	168,848
	Error	(8,541)	(11,086)
	Percent Error	(5.3)	(6.5)

four successive time frames and used to forecast one and two quarters ahead. Forecasts of the independent variables were obtained from Data Resources, Inc. The values which were used would have been the estimates available at the time the forecast would have been made.

A record of forecasting accuracy is presented in Tables 15 and 16. Forecasting one quarter out, errors without regard to sign ranged from 3.5 percent for heavy duty truck retail sales to 19.4 percent for freight carloadings. Estimating two quarters out, the errors ranged from 2.0 percent for retail sales to 19.0 percent for freight carloadings. A significant portion of the forecasting error for freight carloading in quarters 78:3 and 78:4 resulted from the BRAC rail strike in September. The third quarter experienced depressed freight car movements while the fourth quarter data is biased on the high side due to unusually heavy shipments after the strike was settled.

TABLE 16

Model Test Results For
Freight Car Loadings
Adjusted For Capacity And
Seasonally Adjusted

Fitted Period		One Quarter Ahead	Two Quarters Ahead
1961:1 to 1977:4			
	Forecast	7,222	8,338
	Actual	6,723	7,683
	Error	499	655
	Percent Error	7.4	8.5
1961:1 to 1978:1			
	Forecast	8,120	8,155
	Actual	7,683	7,494
	Error	437	661
	Percent Error	5.7	8.8
1961:1 to 1978:2			
	Forecast	8,264	8,295
	Actual	7,494	10,238
	Error	770	(1,943)
	Percent Error	10.3	(19.0)
1961:1 to 1978:3			
	Forecast	8,248	8,250
	Actual	10,238	7,960
	Error	(1,990)	290
	Percent Error	(19.4)	3.6
Total			
	Forecast	31,854	33,038
	Actual	32,138	33,375
	Error	(284)	(337)
	Percent Error	(0.9)	(1.0)

In the aggregate, the models seem to produce forecasts biased on the low side. Percentage errors for the sum of estimates one and two quarters out for Retail Sales were 5.3 percent and 6.5 percent, respectively, under actual values. Aggregate test results for freight carloadings one and two quarters ahead performed 0.9 percent and 1.0 percent under reported car movements. Judgment, which was not applied to the forecasts in Tables 14 and 15, may improve the forecasting ability of each equation.

CONCLUSION

The models outlined above provide transportation economists with an excellent planning tool for measuring the impact on demand from short-run fluctuations in the economy. A quantitative linkage between variables external to the freight sector enables decision-makers to focus attention on

sectors which generate the "derived" demand for modal services and, hence, provide important information in terms of managerial decisions regarding raw material and labor requirement in a short-term planning time horizon.

FOOTNOTES

[1]For a quantitative analysis of the effect of mandated government safety standards see H. Wade German and Larry C. Peppers, "Anti-Locking Brake Systems: The Impact of Public Safety Standards on the Demand for Truck Trailers," *Proceedings, Transportation Research Forum*—1976, pp. 412-15.

[2]See H. Wade German and Larry C. Peppers "Social Control of Business: Implications for Logistics Planning" Robert G. House and James F. Robeson (ed), *Interfaces: Logistics, Marketing and Production* (Ohio State University—1976)

[3]Task Force on Rail Productivity, *Improving Railroad Productivity* Washington, D.C., (Government Printing Office, 1973), p. 13.