Appendix G

Rail/Truck Modal Diversion

Appendix G. Rail/Truck Modal Diversion

Modal choice generally is determined by perceived total logistics costs (TLC) for using the various modes or modal combinations that are practical for a given set of shipments. TLC consists of actual transport costs (or carrier charges) incurred by the shipper plus a variety of other logistics costs (including inventory costs, stock-out costs, etc.) incurred by the shipper or receiver. Any increase in TLC for use of a particular mode can result in diverting some traffic from that mode to competing modes, and any decrease in TLC can result in diverting some traffic from competing modes to the mode in question.

Potential modal diversion can be estimated using either disaggregate data for a sample of potentially affected movements or more aggregate data in which the total volume of such movements has been summarized by one or more key variables, such as by commodity. The diversion estimates can be derived from estimates of before and after TLC, from absolute or percentage change in TLC, or, for situations in which other logistics costs are essentially unaffected, from changes in transport costs (or carrier charges) incurred by the shipper.

Computer models that have been developed for performing disaggregate analyses of rail/truck diversion include: the proprietary Intermodal Competition Model (ICM) developed by the Association of American Railroads (AAR);[1] and the recently developed Truck-Rail, Rail-Truck (T-R/R-T) Diversion Model developed by Transmode Consultants under contract to the Federal Railroad Administration.[2] Brief reviews of both models are presented in Appendix H. Although concerns about both models exist, the ICM has been used to estimate modal diversion in several public and proprietary studies. The T-R/R-T Model, on the other hand, is essentially untested and, in its current form, apparently contains a significant number of questionable parameter values that are likely to affect its results.

The first two sections of this appendix presents some sources of aggregate data that can be used for performing modal diversion analyses when acceptable diversion models are not available. The data is presented as

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[1] Scott M. Dennis, *The Intermodal Competition Model,* Association of American Railroads, Washington, D.C., September 1988.

[2] Transmode Consultants, Inc., *Truck-Rail, Rail-Truck Diversion Model,* User Manual, Draft, Washington, D.C., December 1994.

elasticities of modal demand (in tons or ton-miles) relative to changes in rail rates or truck costs. Truck costs are used (instead of rates) because they are more easily estimated (see Appendix F) and because the highly competitive nature of the trucking industry causes trucking companies to pass both upward and downward cost changes through to shippers in a reasonably direct manner..

The concluding section of this appendix contains a more technical discussion of the development of elasticities.

■ G.1 The Effects of Changes in Truck Costs

Cross Elasticities from the ICM

One source of aggregate data consists of a set of cross elasticities developed, by commodity group, by Jones, Nix and Schwier,[3] using results obtained from the ICM. These cross elasticities are presented in Exhibit G.1. Each cross elasticity represents the percentage change in rail ton-miles that would result from a one percent change in truck costs. For example, a one percent decrease in truck costs would result in diverting to truck 2.0 to 2.2 percent of the ton-miles of food products currently carried by rail.

Exhibit G.1 shows high elasticities (generally above 2.0) for most categories of finished or highly processed goods and much lower elasticities (below 1.0) for all categories of bulk materials and for automobiles. Since rail traffic now consists disproportionately of the latter categories of commodities, the overall effect of changes in transport costs would be somewhat less than a glance at Exhibit G.1 might suggest.

It is reasonable to presume that the cross elasticities shown in Exhibit G.1 represent the effects of a reasonably uniform change in truck costs;[4] and they also can be used to analyze the effects of a reasonably uniform change in rail rates (by estimating the equivalent change in truck costs that would have the same effect on the difference in costs for using the two modes). However, somewhat different effects may be expected if a change in costs is not uniform (e.g., it affects long-haul traffic differently than short-haul traffic or tank trucks differently than vans).

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[3] J. Jones, F. Nix, and C. Schwier, *The Impact of Changes in Road User Charges on Canadian Railways*, prepared for Transport Canada by the Canadian Institute of Guided Ground Transport, Kingston, Ontario, September 1990, Table 4.2.

[4] The actual assumptions used in the ICM analysis are not stated in the report and are no longer readily available (Joseph Jones, Boon, Jones and Associates, personal communication, November 1994).

Exhibit G.1 Implicit Cross Elasticities by Commodity Group Derived from ICM Results

Commodity	Rail Ton-Mile Cross Elasticities
Bulk Farm Products	0.02 - 0.03
Finished Farm Products	3.5 - 3.7
Bulk Food Products	0.62 - 0.83
Finished Food Products	2.0 - 2.2
Lumber and Wood	0.57 - 0.73
Furniture	4.0 - 4.7
Pulp and Paper	0.71 - 0.93
Bulk Chemicals	0.49 - 0.67
Finished Chemicals	3.2 - 3.5
Primary Metals	1.2 - 1.5
Fabricated Metals	5.2 - 7.3
Machinery	3.7 - 4.8
Electrical Machinery	4.1 - 4.8
Motor Vehicles	0.21 - 0.28
Motor Vehicle Parts	1.1 - 1.4
Waste and Scrap	0.17 - 0.22
Bulk All Else	0.14 - 0.19
Finished All Else	3.9 - 4.5

Source: J. Jones, F. Nix and C. Schwier, *The Impact of Changes in Road User Charges on Canadian Railways*, prepared for Transport Canada by the Canadian Institute of Guided Ground Transport, Kingston, Ontario, September 1990, Table 4.2

Exhibit G.2 Implicit Overall Cross Elasticities from the ICM

	Cross Elasticities	
	Rail Ton-Miles	Rail Revenue
1. Uniform Change in Truck Costs[1]	0.52	0.81
2. Canadian Tax Policy[2]	1.00	–
Size and Weight Analyses		
3. Bridge Formula B[3]	0.99	1.43
4. Twin 33s[3]	1.50	2.30
Twin 48s[4]		
5. Low Usage	2.09	2.43
6. High Usage	2.30	2.91

Elasticities derived from:

[1] Scott M. Dennis, *The Intermodal Competition Model,* Association of American Railroads, September 1988, pp. 7-9.

[2] J. Jones, F. Nix and C. Schwier, *The Impact of Changes in Road User Charges on Canadian Railways,* prepared for Transport Canada by the Canadian Institute of Guided Ground Transport, Kingston, Ontario, September 1990, p. 27.

[3] Jack Faucett Associates, *Modal Diversion Effects of Changes in Truck Size and Weight Limits,* Working Paper prepared for the Federal Highway Administration, July 1990, Exhibit 5.

[4] Sydec, Inc., Transmode Consultants, Inc., and Jack Faucett Associates, *Analysis of Longer Combination Vehicles,* Final Report, prepared for the U.S. Department of Transportation, November 1993, Exhibits IV-4 and IV-11.

An alternative to the use of elasticities by individual commodity group is the use of overall elasticities. Exhibit G.2 presents six sets of overall cross elasticities developed from published results using ICM data. For each source, the elasticities show the effects of a one percent change in truck costs on rail ton-miles and, for all but one of the sources, on rail revenue. The estimated effects on rail revenue include revenue lost both as a result of losing traffic and as a result of rate reductions adopted in order to avoid additional traffic losses.

Exhibit G.2 indicates that the effects on rail revenue are always somewhat greater than the effects on rail ton-miles. This is the case for two reasons: the most readily diverted traffic (as indicated in Exhibit G.1) tends to be more highly rated (cost more per ton-mile) than average; and some rail revenue is lost on traffic that is retained by rail as a result of rate reductions.

The first set of elasticities shown in Exhibit G.2 were developed by Scott Dennis, of the AAR,[5] by using the ICM to analyze the effects of a uniform ten percent reduction in costs for all rail-competitive trucks.

The "Canadian Tax Policy" elasticity was developed from results published by Jones, Nix, and Schwier. In this analysis, the Exhibit G.1 elasticities were used to estimate the effects of potential changes in Canadian truck-tax policy that would decrease overall truck costs by four percent or increase them by 9 or 17 percent. The Exhibit G.1 elasticities were applied, by commodity group, to traffic and revenue data for the Canadian National (CN) and Canadian Pacific (CP) railways. The elasticity shown in Exhibit G.2 was derived by dividing the resulting estimate of the percentage increase in rail ton-miles for the first policy alternative by the assumed four percent decrease in truck costs. Some internal inconsistencies in the Jones, Nix, and Schwier results[6] leave us with somewhat less confidence in this elasticity than in the preceding set of elasticities.

The final four sets of cross elasticities were developed from the results of three ICM analyses of potential changes in U.S. truck size and weight regulations.[7,8] All four sets of cross elasticities relate the percentage

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[5] Scott M. Dennis, *op.cit.*, pp. 7-9.

[6] Jones, Nix, and Schwier data actually can be used to derive both a rail ton-mile elasticity (1.00, as shown in Exhibit G.2) and a rail revenue elasticity (0.95). For reasons discussed above, these elasticities are inconsistent with each other. Accordingly, to avoid misleading the casual reader, the second elasticity has been omitted from Exhibit G.2.

[7] Jack Faucett Associates, *Modal Diversion Effects of Changes in Truck Size and Weight Limits*, Working Paper, prepared for the Federal Highway Administration, July 1990, Exhibit 5.

[8] Sydec, Inc., Transmode Consultants, Inc., and Jack Faucett Associates, *Analysis of Longer Combination Vehicles*, Final Report, prepared for the U.S. Department of Transportation, November 1993, Exhibits IV-4 and IV-II.

change in rail ton-miles and rail revenue to the *average* percentage change in costs for all shipments carried by combination trucks.

The principal distinction between the four sets of size-and-weight analyses are the assumptions relating to truck lengths. The first analysis (labeled "Bridge Formula B") would allow some increase in truck weights but would have very little effect on lengths; the second analysis would also allow the use of twin 33-foot trailer combinations on a relatively extensive set of major roads; and the last two would also allow the use of twin 48-foot trailer combinations on the Interstate System and on some additional roads. The last two analyses differ in their estimates of the amount of traffic that can be carried efficiently on twin 48s. These two sets of diversion estimates also were adjusted downward by Sydec to minimize the effects of some limitations in the ICM's ability to represent the network on which twin 48s would be allowed to operate.[9]

The Exhibit G.2 cross elasticities show substantial variation between the results obtained from different analyses. The first two analyses assume a uniform change in costs for all use of combination trucks, while the last four assume the changes in truck costs are relatively concentrated on longer haul truck movements that tend to be more competitive with the rail industry. For example, in the "Bridge Formula B" case, the average cost savings for all combination trucks was estimated to be about one percent, but the savings for shipments that actually benefited from the higher limits was estimated to average 3.6 percent and to be as high as 14 percent for some movements. The concentration of the cost savings on relatively competitive operations results in greater diversion than would be produced by a more uniform distribution of the cost savings.

The above discussion leads us to conclude that uniform changes in the cost of operating combination trucks are likely to produce cross elasticities of about 0.5 for rail ton-miles and 0.8 for rail revenue, and that changes that are more focused on rail-competitive segments of the truck industry are likely to produce cross elasticities that are two to three times as large.

Cross Elasticities from the CN and CP

Another source of cross elasticities is a set of modal diversion estimates developed by the CN and CP railroads as part of a 1987 study sponsored by the Roads and Transportation Association of Canada.[10] In that study, the two railroads provided estimated ranges for the expected effects of

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[9] *Ibid.*, pp. V-4 - V-5. Also discussed briefly in Section H.1 of this report.

[10] N.A. Irwin and R.A. Barton, *Economics of Truck Sizes and Weights in Canada*, Final Report, Council on Highway and Transportation Research and Development and the Roads and Transportation Association of Canada, Ottawa, July 1987.

three possible changes in truck size and weight limits on their traffic volume and revenue. Using estimates of the average reduction in truck costs for the three scenarios (which ranged from 8 to 14 percent), Jones, Nix, and Schwier[11] derived the implicit cross elasticities shown in Exhibit G.3.

The CP diversion estimates tended to produce slightly larger cross elasticities than the CN estimates. More significantly, both sets of cross elasticities are appreciably smaller than those produced by the ICM for the effects of changes in truck size and weight limits. At least part of the reason for the lower cross elasticities is that the Canadian railroads have relatively large volumes of long-haul movements of low-value natural resources – commodities that, as indicated in Exhibit G.1, have relatively low cross elasticities and are relatively resistant to diversion to truck. Other possible contributors to the difference in cross elasticities could include tendencies for the CN and CP analysts to have underestimated diversion or for the ICM to have overestimated it.

Conclusions

On the basis of the above discussion, we conclude that, for *uniform* changes in truck costs, it is appropriate to assume cross elasticities of about 0.5 for rail ton-miles and 0.8 for rail revenue.

Separate cross elasticities were not obtained for rail tons. However, most rail traffic diverted to truck is likely to be intermodal traffic, frequently moving long distances, or single carload traffic, most typically being shipped more moderate distances. (Most short distance single carload shipments have already been diverted to truck while the longest haul movements are more insulated from truck competition than more moderate-haul movements.) Therefore, the length of haul of newly diverted rail traffic is likely to be slightly higher than average, and the cross elasticity of rail tons is likely to be slightly smaller than that of rail ton-miles. Hence , it would appear appropriate to assume that for a *uniform* change in truck costs, the cross elasticity of rail tons is likely to be about 0.4.

For changes in truck costs that are concentrated on the more rail-competitive truck operations, when expressed relative to the *average* change in costs for combination trucks, the cross elasticities are higher. In the case of the truck size and weight studies reviewed, the cross elasticities ranged from 1.0 to 2.3 for rail ton-miles and from 1.4 to 2.9 for rail revenue. Accordingly, for nonuniform changes in the cost of operating combination trucks, some judgment is necessary to determine the extent to which the changes are focused on rail-competitive truck operations, and

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[11] Jones, Nix, and Schwier, *op.cit.*, Table 4.3.

Exhibit G.3 Implicit Cross Elasticities from CN and CP Analyses

	Cross Elasticities	
	Rail Ton-Miles	**Rail Revenue**
Canadian National	0.39 - 0.51	0.54 - 0.71
Canadian Pacific	0.35 - 0.59	0.59 - 0.92

Source: J. Jones, F. Nix, and C. Schwier, *The Impact of Changes in Road User Charges on Canadian Railways*, prepared for Transport Canada by the Canadian Institute of Guided Ground Transport, Kingston, Ontario, September 1990, Table 4.3.

so the extent to which the cross elasticities suggested in the preceding paragraph should be modified.

Since rail routes usually are more circuitous than truck routes, the change in truck ton-miles generally will be smaller than the change in rail ton-miles. Estimates of the change in truck ton-miles can be obtained by multiplying the rail estimate by -0.85.[12]

■ G.2 The Effects of Changes in Rail Rates and Rail Costs

Information about the modal-diversion effects of changes in rail rates and costs is less readily available than the information presented above about the effects of changes in truck costs.

Much traffic currently carried by rail is fairly well insulated from intermodal competition, though the portion of rail traffic that is not well insulated is somewhat larger than the corresponding portion of traffic in combination trucks (which includes substantial amounts of local and short-distance movements). Railroads usually have a substantial advantage in efficiency for transporting multi-carload shipments, and such shipments constitute about 62 percent of rail tonnage.[13] Because rail traffic is somewhat less well insulated from intermodal competition than truck traffic, *uniform* percentage changes in rail rates are likely to result in diverting somewhat more traffic between modes than would the same uniform percentage change in truck costs and rates.

In the preceding section it was suggested that a uniform one percent change in truck costs would result in diversion amounting to about 0.5 percent of rail ton-miles and 0.4 percent of rail tons. The above discussion implies that a uniform one percent change in rail rates might result in diversion amounting to about 0.75 percent of rail ton-miles and 0.6 percent of rail tons; i.e., that the *own elasticities* of rail ton-miles and rail tons to changes in rail rates are about -0.75 and -0.6 respectively. (These elasticities are negative since an increase in rail rates will result in a *decrease* in rail traffic.)

The elasticities suggested in the preceding paragraph are appropriate when changes in rail costs and rates are reasonably uniform across all

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[12] The results of two ICM analyses indicate that, on average, rail routings are 16 to 18 percent more circuitous than truck routings. (Jack Faucett Associates, *Modal Diversion Effects of Changes in Truck Size and Weight Limits,* Working Paper, prepared for the Federal Highway Administration, July 1990, Exhibit 4.)

[13] Derived from 1992 waybill data from Bureau of Transportation Statistics, *Rail Waybill Data: 1988-1992,* CD-ROM, Washington, D.C. 1994.

categories of traffic. Changes in rail costs that apply primarily to truck-competitive traffic (most of which provides relatively low operating margins) are likely to produce rate changes that are concentrated on this traffic. As in the case of changes in truck costs, rate changes that are concentrated on modally competitive traffic are likely to produce substantially higher elasticities than uniform changes in rates, with the highest elasticities (perhaps in the two to four range) likely for doublestack and trailer-on-flatcar traffic.

As suggested in the preceding section, changes in truck ton-miles can be derived by multiplying estimated changes in rail ton-miles by -0.85.

■ G.3 Freight Demand Elasticity Studies: Technical Considerations

Three different methods are commonly used in the transportation literature for computing elasticities:[14]

- A *point elasticity* is calculated by expressing the quantity demanded as a function of price and then calculating

$$e_p = \frac{dQ}{dP}\frac{P}{Q}$$

If the functional relationship between quantity and price is not available, then it is generally not possible to calculate a point elasticity.

- An *arc elasticity* is calculated from information on price and quantity before and after a price change

$$e_a = \frac{\log Q_2 - \log Q_1}{\log P_2 - \log P_1}$$

This measure most nearly approximates a point elasticity.

- A *shrinkage factor* also is calculated from information on price and quantity before and after a price change

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[14] Barton-Aschman Associates Inc. and R.H. Pratt, *Traveler Response to Transportation System Changes,* prepared for the U.S. Department of Transportation, Federal Highway Administration; July 1981.

$$e_s = \frac{(Q_2 - Q_1)/Q_1}{(P_2 - P_1)/P_1}$$

The problem with calculating elasticities as shrinkage factors is that if the price is reduced by a given amount and then increased by the same amount, the shrinkage factor does not predict that demand will return to its original level. For small changes in price, however, the shrinkage factor will not differ significantly from the arc elasticity.

Elasticities can be short-run or long-run in nature, depending on the time period over which changes in demand are observed. Differences between short-run and long-run elasticities can be substantial. For example, the short-run price elasticity for gasoline is about -0.20, while the long run elasticity is close to -1.00. This is because in the short-term, the only way to reduce gasoline consumption is to reduce vehicle miles of travel, while in the long term, more fuel-efficient vehicles can be used.

The focus of this section is on using price elasticities of demand to measure the responsiveness of demand to a change in price. Analyst employ elasticities to evaluate how proposed policies will impact freight demand. Ordinary price elasticities of freight demand include the scale or output effect associated with a change in price--i.e., they assume a carrier might adjust output levels as part of an overall response to changes in prices. In contrast, conditional or compensated elasticities measure the substitution effects of a price change and hold output constant. In their study of freight demand elasticity models, Oum, et. al., found that many of the existing empirical models do not treat output as an endogenous variable and, as a result, may report biased elasticities.[15]

Since compensated elasticities are the only elasticity measures available, they are used by policy analysts in assessing impacts of proposed policies. Fortunately, in most applied planning situations, the analyst is most critically interested in the modal substitution issues – i.e., an estimate of how much traffic will be shifted from one mode to another as a result of a given price change in one of the modes. The compensated elasticity models provide estimates of the specific measures of interest to the analysts.

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[15] Tae Hoon Oum, W.G. Waters II, and Jong-Say Yong, "Concepts of Price Elasticities of Transport Demand and Recent Empirical Estimates," *Journal of Transport Economics and Policy*, May 1992, p. 142.

There have been two major approaches in collecting the data needed for developing estimates of freight demand elasticities. One involves the collection of aggregate data to develop elasticity estimates. Specifically, these studies rely on data collected in the aggregate for a particular geographic corridor (state-to-state freight shipments, for example) on average freight rates, shipment volumes, shipment times, and delivery reliability by mode. Depending upon the particular analytic model used to develop elasticity measures, the dependent variable will vary to some degree. If a logit model is used to develop elasticity measures from the aggregate data, the dependent variable is a ratio of the modal volumes. If the translog model is used, the dependent variable is average freight rate on the geographic corridor for all modes. Oum analyzed a variety of functional forms for developing elasticities from aggregate data and concluded that the translog model performed the best in all aspects.[16] When the policy analyst is focusing on total traffic volumes and modal shifts occurring as a result of the implementation of a particular policy, then elasticities from aggregate models seem most appropriate.

The second class of models requires researchers to collect data from a representative sample of individual shipments. For each shipment, information is collected on freight rates for the mode used as well as alternatives. Data are also accumulated on time and variability of the shipment by the mode used and the alternative. In most instances, some form of logit or probit model is employed to develop freight demand elasticities from the disaggregate data.[17] The disaggregate models have intuitively appealing features. For example, the decision to shift traffic from one mode to another as a result of shifts in price is, in essence, an individual, disaggregate decision. It is more logical to use disaggregated data from individual shippers to develop elasticity measures designed to capture such individual decisions. Winston concludes: "(disaggregate models) offer a much richer econometric specification than any of the previous freight demand models. In addition, disaggregate models yield more precise estimates of market elasticities than the aggregate or inventory models. Finally, and perhaps most important, the disaggregate models are grounded in a behavioral theory of the actual decision-maker's behavior thereby adding considerable substance to any policy implications."[18]

However, despite these advantages, the development of a disaggregated data base is problematic. For one, it is time consuming and expensive to develop. Second, many of the data items required are not easy to obtain

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[16] Tae Hoon Oum, "Alternative Demand Models and Their Elasticity Estimates," *Journal of Transport Economics and Policy*, May 1989, p. 185.

[17] Clifford Winston, "A Disaggregate Model of the Demand for Intercity Freight Transportation," *Econometrica*, Vol. 49, No. 4 (July 1981), p. 981.

[18] Clifford Winston, "A Disaggregate Model of the Demand for Intercity Freight Transportation," *Econometrica*, Vol. 49, No. 4 (July 1981), p. 998.

because of the confidentiality of private information.[19] Third, there is always the issue of whether the selected sample is representative of all major groups in the universe as well as the issue of expanding the sample results to the universe. If there are any biases in sampled shippers, these biases will be reflected in the developed elasticity measures. Use of the disaggregate data require the analyst to spend a great deal of time developing a systematic approach for its expandibility to the population.

The issue here, however, is not so much on whether the disaggregate or aggregate approach is the most time and cost efficient, rather the issue here is to find a set of elasticities that can be employed when an analyst wishes to estimate the demand impact of modal cost/price increases resulting from the initiation of a new policy. As Oum has argued, the disaggregate and aggregate approaches should be viewed as complementary, not competing.[20]

The analyst must be aware of the limitations in the entire set of freight demand elasticities that have been developed in the literature. This section discusses some of these limitations.

For one, the most careful and thorough freight demand elasticities developed to date do not reflect all the changes that have occurred in the freight transport sector since deregulation. There were a flurry of very impressive freight demand elasticity studies conducted in the mid to late 1970s. However, there has been a dearth of such studies in the deregulated environment.

The absence of such investigations reflects a number of factors. Deregulation has shifted the focus in rate-making from the collective group to the individual carrier and shipper. More and more rates are being negotiated between carriers and shippers and kept out of the public domain. For example, more and more of the records from the Railroad Waybill Data do not include rate information because the rates are negotiated between the parties and filed as "contract rates." There is no question that the transport sector has changed dramatically since passage of the Motor Carrier Act of 1980 and the Staggers Rail Act of 1980. As a consequence, reference to elasticities based on pre-1980 data must be subjected to careful scrutiny.

There are, for example, solid data supporting the growth of intermodal transportation in the new deregulated environment. Railroads have

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[19] Both Oum in "Alternative Demand Models and Their Elasticity Estimates," and Winston in "A Disaggregate Model of the Demand for Intercity Freight Transportation" discuss the advantages and disadvantages of the disaggregate models.

[20] Tae Oum, "Alternative Demand Models and Their Elasticity Estimates," *op. cit.*, p. 164.

experienced unprecedented growth in intermodal traffic throughout the 1980s and into the 1990s. All indications point toward higher and higher levels of intermodal movements on this nation's railroads. Certainly, the development of the intermodal option is now much more prominent in the marketplace than it was prior to deregulation. Demand elasticities not reflecting these changes must be carefully interpreted.

As noted above, there are limitations inherent in both the aggregate and disaggregate approach to the development of demand elasticities. The aggregate studies suffer from their inability to model the actual modal decision process. All individual decisions are lumped together and the unit of analysis becomes modal market shares or freight rates on particular corridors. The disaggregate studies are based on a limited set of individual decisions which may be taken out of context from a shipper's overall modal assessment process. Thus, shippers might make modal decisions based on their entire set of shipment needs over a particular time period – quarter, half-year, or year. It may not be very effective to base demand elasticities on an individual shipment from a particular shipper rather than from that shipper's entire set of shipments.

Despite these very significant limitations, the policy analyst still must address the issue of how to estimate freight demand impacts associated with the implementation of a policy with a quantifiable impact on modal costs. The next section will present freight demand elasticity estimates that represent the best available estimates. There will be strong caution that these estimates have some very significant limitations. Nevertheless, the policy analyst may need to evaluate them as the best available evidence, albeit evidence that must be carefully screened, evaluated, and subjected to sensitivity analysis based on additional available evidence.