Appendix H

Three Modal-Diversion Models

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This appendix contains brief descriptions of two computer models that are designed to estimate modal diversion between rail and truck using disaggregate data on individual shipments and a third model designed to estimate diversion using more aggregate data.

■ H.1 The Intermodal Competition Model

The most commonly used tool for estimating rail/truck modal diversion from disaggregate data is the AAR's proprietary Intermodal Competition Model (ICM)[1]. This model is designed to analyze a sample of actual rail movements, taken from the ICC Carload Waybill Sample,[2] and, for these movements, to estimate which will be diverted to truck, which will be retained as a result of competitive railroad rate reductions, and which will be unaffected by the reductions in truck transport costs. The most recent version of this model also is capable of analyzing the effects of increased truck costs on railroad rates charged on existing truck-competitive rail movements and on diversion from truck to rail (using a sample of truck movements from the North American Trucking Survey[3]).

The proprietary nature of the ICM makes a careful evaluation of the accuracy of its estimates difficult. We have reviewed output produced by the previous version of the model and concluded that the cross-elasticities of rail demand relative to changes in truck costs that are implicit in these results appear to be reasonable.[4] However, the comparison of cross-elasticities produced by the ICM to those produced by a CN/CP analysis

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

[2] The ICC Carload Waybill Sample consists of a systematic sample of waybills for railroad shipments terminating on Class I railroads in the United States.

[3] The North American Trucking Survey is a survey of truck drivers conducted during 1993 and 1994 at 46 truck stops by Arthur D. Little, Inc., under contract to the Association of American Railroads.

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

discussed in Appendix G suggests that the ICM may tend to overestimate diversion moderately. For this reason, caution should be applied when using results produced by the model.

An important concern about the use of the ICM relates to the truck cost analysis performed by the model. This analysis presumes that the utilization rates of larger and heavier vehicles generally would be the same as current utilization of 48-foot semis; i.e., that all loads carried would be loads for which the vehicles are designed and that there would be no increase in empty mileage and no decrease in annual mileage. These assumptions about utilization are optimistic, especially with respect to non-door-to-door configurations such as twin 48s. The ICM's estimates of cost savings resulting from the use of larger and heavier trucks are overstated, and, accordingly, modal-diversion estimates derived using these cost estimates are too high. This problem is not insurmountable. The model has been run in the past using exogenously specified estimates of the effects of regulatory changes on truck transport costs;[5] and adjustments also can be made to ICM results (with some loss of accuracy) to compensate for any known tendency of the model to over or underestimate diversion.

Several other factors have affected ICM results that have been produced in the past, although some of these may have been corrected in the latest version of the model. These factors are listed below, along with estimates of the effect of these factors on the model's estimates of overall diversion to twin 48s.[6]

- Fuel taxes were assumed to be zero on all truck movements originating in Canada, increasing overall diversion by an estimated 8.0 percent in the twin-48 analysis and to an unknown extent in other model runs.

- The costs of reconfiguring twin 48s and the costs of access hauls to the twin-48 network were not adequately reflected for short hauls (particularly those under 800 miles) while they were overestimated for long hauls (particularly those over 1,800 miles), increasing overall diversion by about 23 percent.

- Because the ICC waybill sample does not identify the true origin and true destination of intermodal movements (but only the rail origin and rail destination), the ICM underestimates the cost of intermodal

[5] *Ibid.;* and Sydec, Inc., Jack Faucett Associates, and Transportation Consulting Group, Inc., *Truck Size and Weight and User Fee Policy Analysis Study, Part One: Productivity Effects of Policy Options,* Final Report, prepared for the Federal Highway Administration, Washington, D.C., March 1991.

[6] Sydec, Inc., Transmode Consultants, Inc., and Jack Faucett Associates, *Analysis of Longer Combination Vehicles,* Final Report, prepared for the Federal Highway Administration, Washington, D.C., November 1993, pp. V-4 and V-5.

movements and significantly underestimates diversion of these movements. Overall diversion was estimated to be reduced by 3 percent, but the magnitude of this underestimate can be expected to grow as intermodal traffic grows.

- The use of waybill data for a recent historic year tends to understate the portion of rail traffic that is intermodal or will be in the future. Since intermodal traffic is the traffic most readily divertible to twin 48s, this understatement tends to reduce overall diversion to twin 48s.
- The ICM estimates of other logistics costs (OLCs) (which have been printed in the past but are no longer printed) do not appear to represent realistic relationships between OLCs for rail movements and OLCs for truck movements. (However, the model appears to have been calibrated to compensate for this effect.)

It should be emphasized that some of these problems may have been corrected in the latest version of this model.

Finally, no review has been conducted of the construction of the North American Trucking Survey (NATS) or of the way the ICM uses this data to represent the universe of rail-competitive truck shipments. However, the National Motor Truck Data Base (the predecessor to the NATS) had an inherent, but easily correctable, bias toward overrepresenting long-haul movements.[7] If the ICM is used with NATS for estimating diversion from truck to rail resulting from policy changes that increase truck costs or reduce rail costs, a failure to adjust for this bias will result in significantly overrepresenting long-haul truck movements, which are relatively divertible, and so in overestimating diversion from truck to rail.

H.2 The T-R/R-T Diversion Model

The Truck-Rail, Rail-Truck (T-R/R-T) Diversion Model is a new model currently being developed by Transmode Consultants under contract to the Federal Railroad Administration (FRA). A preliminary description of this model is contained in a Draft Users Manual[8] released in December 1994. The actual model and a somewhat revised Users Manual are scheduled for release in the next few months.

The T-R/R-T Model is based on much of the same research as the ICM. It distinguishes four types of truck transport (truckload (TL), less than

[7] *Ibid.*, p. C-7.

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

truckload (LTL), longer-combination vehicle (LCV), and private); three types of intermodal transport (trailer-on-flatcar, doublestack, and RoadRailer); and conventional rail carload transport.

The T-R/R-T Model represents nearly all movements as originating and terminating at county seats. The actual origins and destinations of shipments currently being made by truck or conventional rail are contained in the data sources used, but those of intermodal shipments are not. The model creates assumed origins and destinations for these shipments from their intermodal origins and destinations, County Business Pattern data, and a gravity model.

The T-R/R-T Model estimates origin/destination (O/D) distances for conventional truck movements as great-circle miles (GCMs) between county seats, adjusted for circuity. For LCV movements, the model estimates mileages of LCV operation from a node-link representation of an LCV network and from mileages of access hauls using GCMs between origins and destinations and nearby LCV network nodes (assumed to represent staging areas). The model currently assumes that LCVs can operate on all ramps connecting LCV network links.

For shipments that currently are not handled by conventional rail, railroad O/D distances are estimated by applying a rail/truck circuity factor to GCMs. It is not clear what assumptions are made about the availability of rail service at the origin and destination. The use of a rail/truck circuity factor results in consistent estimates of rail and truck O/D distances (both of which apparently are underestimated as a result of omitting any adjustment for truck/GCM circuity).

For shipments that are currently handled by conventional rail, railroad O/D distances are set to actual distances obtained from the railroad waybill. The use of actual distances for rail and GCMs with no circuity factor for truck results in overestimating the difference in length of haul between the two modes and biases the analysis toward rail-to-truck diversion.

All intermodal shipments are assumed to be made through one of 32 major intermodal rail terminals at each end of their rail haul. Rail distances between each pair of these terminals are maintained in a matrix used by the model and are actual rail distances between terminals. The use of a restricted set of intermodal terminals most likely results in overestimating highway access miles to intermodal terminals for some shipments.

A major advantage of the T-R/R-T Model relative to the ICM is that the T-R/R-T Model is nonproprietary. The "User Manual"[9] provides a better

[9] *Ibid.*

description of the model and its construction than available documentation for the ICM. However, no definitions or derivations for the many parameters incorporated in the model are provided (though some of the parameter values can be inferred from three pages of output reproduced in an appendix); and the "User Manual" provides no information about how to modify any of these parameters.

A second advantage of the T-R/R-T Model is its ability to create initial origins and final destinations for current intermodal movements. This capability enables the model to develop much better estimates of the potential for diverting current intermodal movements to alternate modes than the ICM was able to do the last time we were exposed to its use for this purpose (as discussed in the preceding subsection).

Despite these advantages, several concerns exist about the current version of the T-R/R-T Model as a result of a brief review of the draft model description and of the three pages of output produced in an appendix for a single shipment (of a weight-limited sodium compound).

The most significant concerns relate to the analysis of LCVs. Data contained in the appendix indicates that transit times for LCVs are assumed to be one-third shorter than those of for-hire TL transport, and that reliability is assumed to be 20 percent better. Although not discussed anywhere in the User Manual, the shorter transit times reflect an assumption that around-the-clock relay operation would be used for LCVs but not for conventional trucks. However, the cost structures used for LCVs and for conventional trucks apparently do not reflect any cost difference between relay operation and the single-driver operation assumed for conventional trucks. (If the costs actually are similar, conventional TL operators would choose to provide the better service attainable with relay operation.)

The transit time assumption for LCVs apparently also ignores the delays that can be expected at staging areas in order to match pairs of trailers moving in the same general direction. Also, because of the need for such delays (without which the economies of LCV operation are unattainable), it seems that, for most shippers, transit-time reliability of LCVs would be *poorer* than that of conventional truckload service (though some shippers might be willing to pay a premium to guarantee expedited handling of their trailers).

Other concerns include:

- The procedures used for estimating length of haul for shipments currently handled by rail (discussed above) apparently overstate somewhat the lower circuity of truck, thus biasing the analysis somewhat toward diversion to truck.

- A load ratio (loaded miles per total mile) of 1.0 is assumed for all modes except rail (for which it is 0.6) and private truck (for which it is

0.5). An overall load ratio of 1.0 is unattainable for any mode. (There might be some analytic justification for treating loaded backhauls as if they had load ratios of 1.0, or even higher; but the movement in question – from Barstow, California to Swansea, Illinois – is unlikely to represent a backhaul.)

- The assumptions used for LCV access costs (roughly half to two-thirds of those for intermodal access costs) may be somewhat optimistic.
- Rail costs appear to be modeled as being directly proportional to distance, with no additional costs for pickup and delivery.
- A negative charge for pickup and delivery appears to be incorporated into the rate structure of truckload carriers (actually, a $162 charge per shipment for pickup and a $332 credit for delivery).
- The costs for LCVs appear either to exclude or to underrepresent the cost of reconfiguring LCVs en route and the inefficiency resulting from an inability to pair all trailers operating on the LCV network. Also, the apparent assumption that efficient interconnections will exist between all intersecting LCV roads without any added circuity will result in underestimating the lengths of LCV hauls.

It is likely that some of these concerns will be addressed prior to public release of the model. However, addressing other concerns will require a larger effort than the one that is currently underway. Accordingly, we do not believe that the version of the model to be released this summer will be appropriate for analyzing modal diversion.

■ H.3 The 1,000-Mile Strategic Choice Model

The 1,000-Mile Strategic Choice (TMSC) Model currently is being used by Mercer Management Consulting (MMC) to perform truck/rail modal diversion analyses as a part of a study being conducted for the Southern California Association of Governments (SCAG). The model is proprietary and very little information is currently available. However, because of its current use in an important public-policy study, it warrants some brief discussion based on the limited published description that is available.[10]

Unlike the models described in the two preceding sections, the TMSC Model apparently does not contain a representation of either the rail or

[10] Mercer Management Consulting, *Interregional Goods Movement Study*, Task 2C Report: Evaluation of Key Methodologies, prepared for the Southern California Association of Governments, Los Angeles, April 1995.

highway systems. Instead, the model focuses its analysis on the effect on modal choice of changes in four modal characteristics. The modal characteristics considered are: transport costs, transit time, service reliability, and accuracy of freight bills. The modes analyzed are truck, rail intermodal, and rail carload. The effects of any policy change on any of the modal characteristics apparently must be specified exogenously.

The model's estimates of the diversion effects of changes in modal characteristics are derived from 117 responses to a survey of major shippers conducted in 1991 by Temple, Barker, and Sloane (MMC's predecessor). Most or all respondents appear to be manufacturers, and the relevant survey questions all focused entirely on shipments moving about 1,000 miles (hence, the name of the model).

The information collected in the survey appears to be too narrow and focused to be used as the basis for estimating overall modal diversion. In particular, it is not clear what assumptions the model makes about shipments of natural resources or about hauls that fall outside of the 800 to 1,200-mile range.