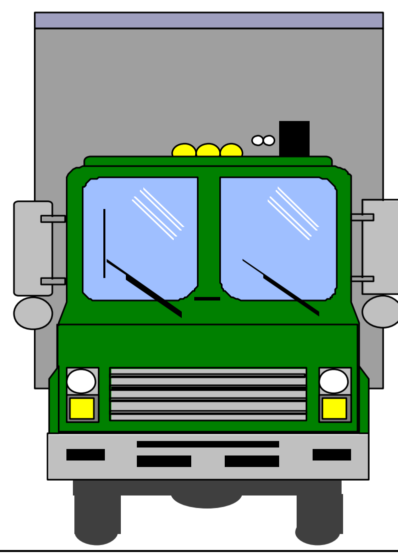
CHAPTER IV

Freight Distribution



Introduction

This chapter presents a discussion of the methodology used to evaluate changes in shipper decisions when faced with a change in trucking costs. Of particular interest to this study is the shift of freight from one truck configuration to another, and from one gross vehicle weight (GVW) group to another. Also of concern is the shift in freight between rail and truck.

This information, expressed in truck vehicle-miles-of-travel (VMT) and rail car miles, is important in estimating not only shipper cost savings, but also impacts on pavements, safety, energy consumption, air quality, and noise levels.

Analytical Approach

Figure IV-1 provides an overview of the analytical approach used to estimate the truck VMT and rail car mile impacts of changes in Federal truck size and weight (TS&W) limits. The general structure of the analytical approach is depicted on the left-hand side of Figure IV-1.

The analytical approach incorporates the most appropriate and current data and state-of-the-art modeling techniques. Data are analyzed via modeling techniques with explicit user-controlled assumptions. The next section discusses the data, the model, and assumptions used to generate each scenario's VMT and rail car miles.

Rail and Truck Base Case Traffic

As indicated in Chapter III, the analysis year for this study is 2000 and the base year is 1994. The base year provides the link between the Department of Transportation's (DOT's) *1997 Federal Highway Cost Allocation (HCA) Study* and this *1999 Comprehensive TS&W (CTS&W) Study*. The *HCA Study* provides 1994 and Year 2000 VMT for the study vehicles, disaggregated by weight group (presented in 5,000-pound increments), highway functional class, and State. The base year data for the rail car mile traffic comes from the Surface Transportation Board's (STB's) 1994 Waybill Sample (see Figure IV-2).

The Year 2000 truck VMT and rail car miles were projected by applying estimated growth rates to the 1994 base year data. Annual truck VMT growth is projected at 2.6 percent, consistent with the *HCA Study*. Growth estimates for rail shipment car miles were developed by DRI/McGraw Hill ("International and Domestic Freight Trends," May 1996).

DRI/McGraw Hill estimates that absent any changes to the Nation's TS&W limits, rail carload car miles will increase 2.2 percent annually, and rail intermodal car miles will increase 5.5 percent annually.

The truck and rail freight diversion analysis may be divided into three groups: (1) truck-to-truck, (2) rail-to-truck, and (3) truck-to-rail. The following two sections focus on truck-to-truck and rail-to-truck diversion. Current analytical and data constraints preclude the estimation of truck-to-rail diversion. Although a decrease in TS&W limits may cause some truck traffic to divert to rail, this diversion is likely to be relatively minor.

Figure IV-1. Analysis of Scenario Vehicle Miles of Travel and Car Miles

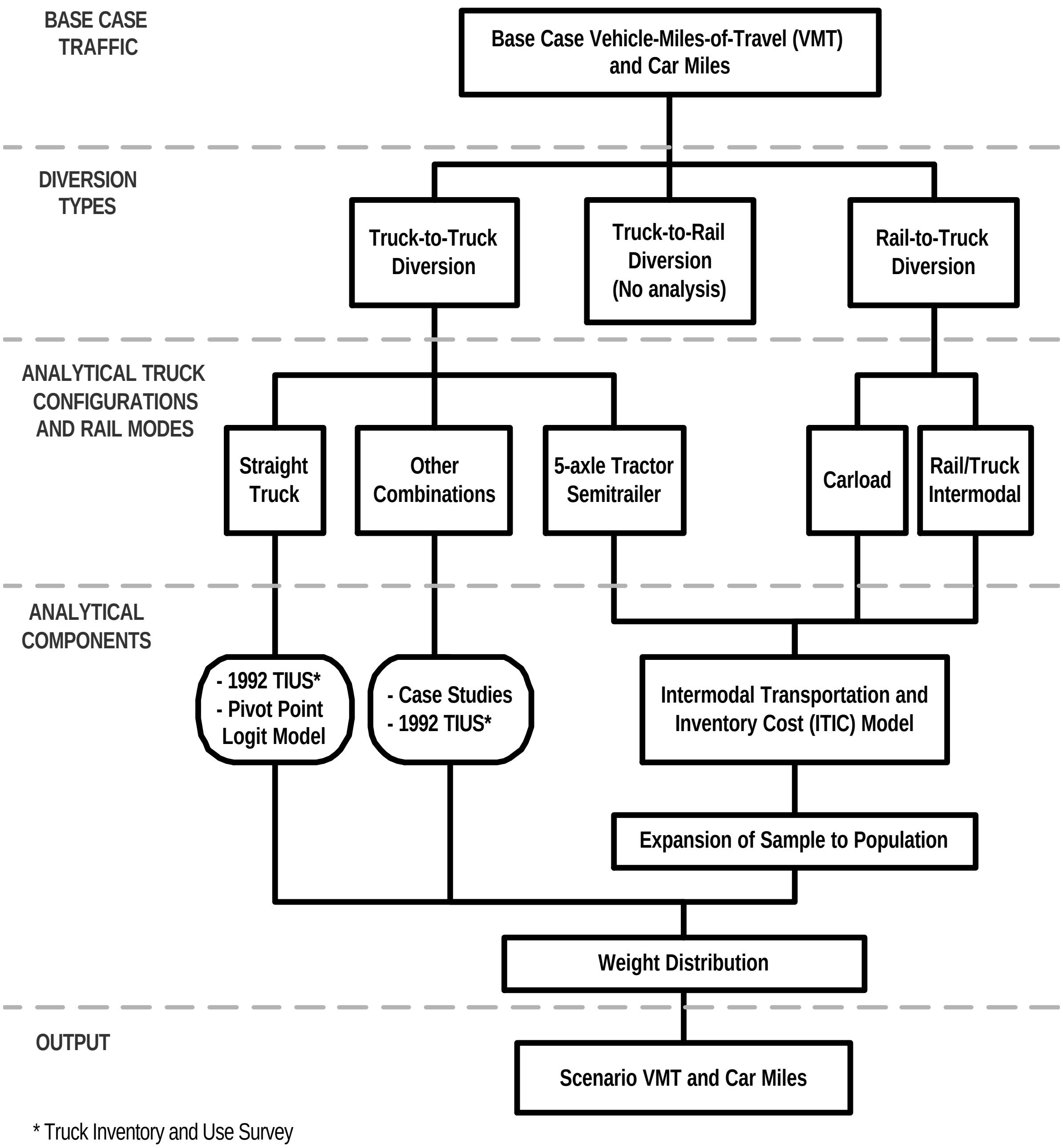


Figure IV-2. The Surface Transportation Board's Waybill Sample

The Waybill is the railroad's bill of lading and contains a great deal of detailed information. The sample includes 2.5 percent of all railroads' Waybill records. The Surface Transportation Board's complete Waybill database contains 192 data items for each record. The data items used in this study include:

- location codes for the origin and destination of each shipment,
- commodity shipped,
- rail equipment used,
- shipment weight,
- shipment revenue,
- originating, terminating and intermediate railroads, and
- junction points between railroads.

Diversion

Truck-to-Truck Diversion

Diversion of freight from one truck configuration to another accounts for a substantial share of the total change in truck VMT associated with TS&W policy options. The analysis of truck-to-truck diversion is divided into single-unit trucks (SUTs), five-axle tractor semitrailers and other combination trucks. These subdivisions are based on the availability of data.

Single-unit and other combination truck analyses rely on aggregate weight distribution and operational characteristics data. Analysis of the five-axle tractor semitrailer utilizes a shipment-by-shipment data set which includes weight distributions and operational characteristics.

<u>Single Unit Trucks</u>

Three- and four-axle SUTs tend to operate at, near or above the current Federal weight limits. These trucks generally transport freight in short-haul operations of 200 miles or less. Often SUTs are designed to perform a specific task. Common examples of SUTs are dump trucks, garbage haulers, and transit mixers.

The diversion analysis for SUTs depends on weight distributions from the *HCA Study* and relative changes in payload ton-mile costs for the impacted traffic. The analysis is discussed further in the Analytical Models Section.

<u>Five-Axle Tractor Semitrailer</u>

The five-axle tractor semitrailer is the most common combination vehicle, comprising the largest and fastest growing segment of combination trucks. These vehicles account for 78 percent of the combination truck fleet and are growing at a rate of 3.8 percent per year. As outlined in Figure IV-3, the five-axle tractor semitrailer encompasses a large variety of operations and body types.

Figure IV-3. Five-Axle Tractor Semitrailers

Five-axle tractor semitrailers encompass many different body types. Forty-four percent of five-axle tractor semitrailers are vans, 22 percent are platforms, 10 percent are dump bodies, 7 percent are tank trucks and 17 percent are other body types. Thirty-eight percent of the five-axle tractor semitrailers operate short-haul, under 200 miles. An example of this type of truck is a platform or low-boy trailer used to deliver building supplies. These operations tend to be affected by increases in truck weight more than truck size, since they handle high density (heavier weight) materials. Sixty-two percent of the five-axle tractor semitrailers operate long-haul, over 200 miles. An example of this type of truck is a van trailer used to deliver merchandise from a manufacturer to a retailer's warehouse. These operations tend to be impacted by increases in truck size more than truck weight, as packaged finished goods are low density (lighter weight).

Freight diversion to or away from the five-axle tractor semitrailer accounts for the largest changes in VMT for each scenario. Figure IV-4 highlights the types of truck configurations into which freight from a five-axle tractor semitrailer could shift in the model simulation process. This analysis was performed using the Intermodal Transportation and Inventory Cost (ITIC) model which is described in detail later in this chapter.

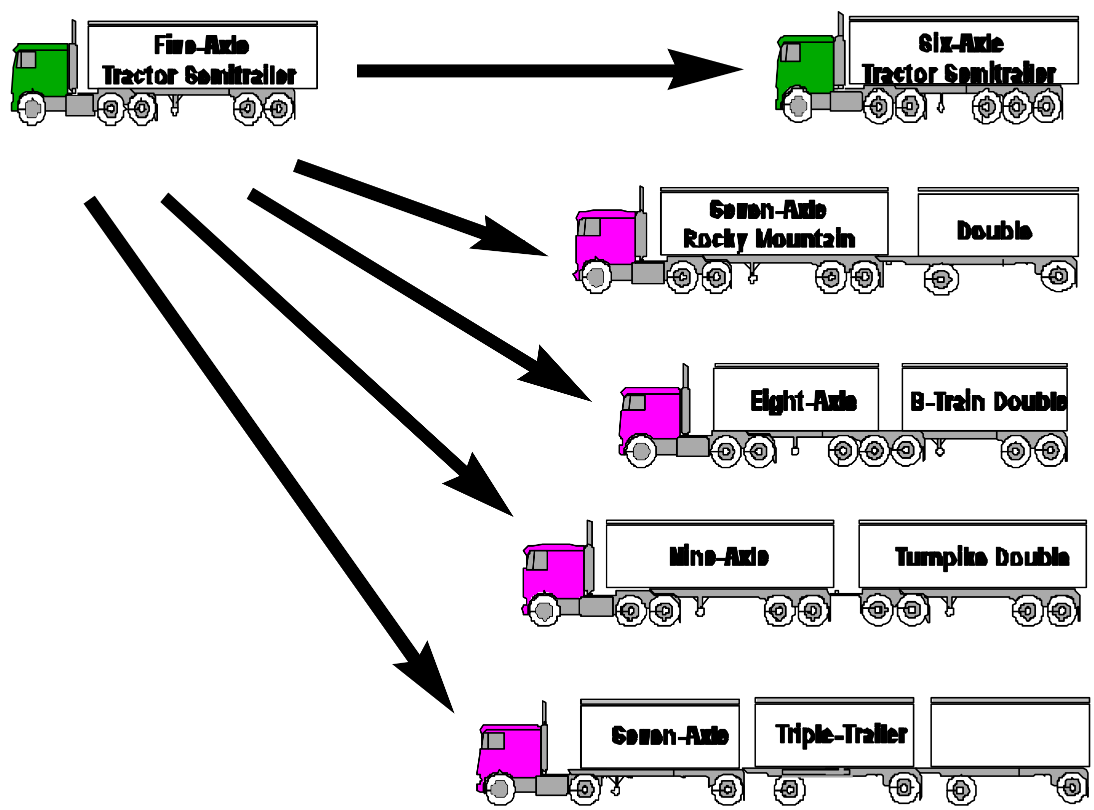
Other Combinations

In the case of other combination trucks, the ITIC Model cannot be used because a shipment-by-shipment data sample is not available. Instead, diversion associated with these vehicles is estimated using operating weight distributions from the *HCA Study* and the 1992 Truck Inventory and Use Survey (TIUS). Diversion of freight to and from the following vehicle types is estimated:

- Five-axle double-trailer combinations;
- Six-axle double-trailer combinations;
- Six-axle tractor semitrailer combinations;
- Seven-axle Rocky Mountain Double (RMD) trailer combinations;
- Eight-axle double-trailer combinations;
- Nine-axle Turnpike Double (TPD) trailer combinations; and
- Seven-axle triple-trailer combinations.

These vehicles vary widely in their use. For example, the five- and six-axle double-trailer combinations are principally used by less-than-truckload (LTL) carriers. LTL carriers combine shipments from several sources to create full truckload (TL) shipments. These packages generally are

Figure IV-4. Five-Axle Tractor Semitrailer Diversion Options



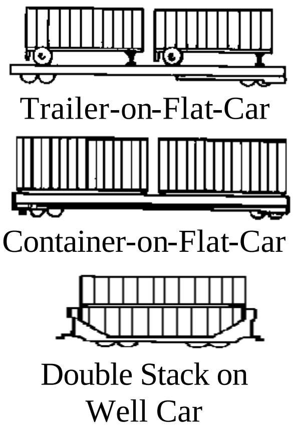
light and fill the truck's cubic capacity before approaching its weight limit. Such operations would benefit from an increase in vehicle size, not weight. Often, the opposite is true for seven-axle RMDs hauling raw materials under special State permits in some Western States. These trucks operate at grandfathered State weight limits which exceed the Federal limit of 80,000 pounds and would likely be used more widely if Federal weight limits were increased.

Rail-to-Truck Diversion

Given an increase in TS&W limits some rail traffic would divert to the newly allowed truck configurations. The diversion analysis focuses on truck-competitive rail shipments, for example, paper products that currently travel on both rail and truck. In rail-truck competitive markets, the increase in TS&W limits would reduce truck transportation costs, causing some shippers to reevaluate their choice of mode.

However, a large portion of rail shipments are not truck competitive and are unlikely to shift to truck, regardless

Figure IV-5. Rail Intermodal Equipment



*Drawings not to scale.

of changes in TS&W limits. Two-thirds of rail shipments are bulk commodities moving in large quantities. For example, coal is often moved as a single shipment of over 40 rail cars.

Rail shipments are classified as either rail intermodal or rail carload. The distinction between the two is made because of operational differences which are discussed in the following sections.

Rail Intermodal

Rail intermodal freight is transported in containers or trailers. Each container or trailer is placed on a rail flat car or well car. Figure IV-5 shows three common rail intermodal types: (1) trailers loaded on a flat car; (2) containers loaded on a flat car; and (3) containers loaded in a double stack configuration on a well car. Rail inter-modal traffic is referred to as trailer-on-flat-car/container-on-flat-car (TOFC/COFC).

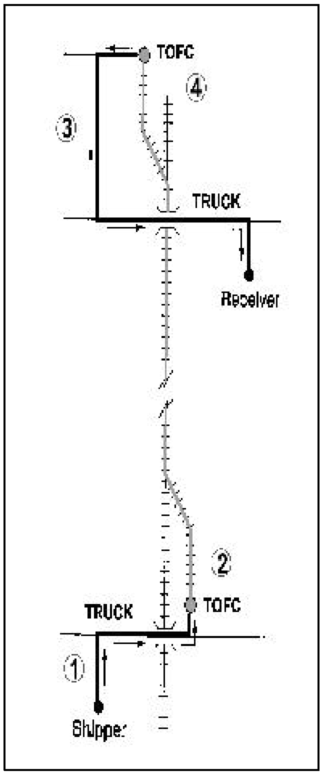
Intermodal shippers include: (1) large transoceanic carriers who move hundreds of containers with each voyage; (2) for-hire trucking companies who move conventional truck trailers on rail; (3) LTL carriers; and (4) intermodal marketing companies who consolidate small numbers of usually domestic containers and trailers from many small shippers.

Rail intermodal carriers serve the same markets as truck carriers, often competing for the same freight. Figure IV-6 shows an example of TOFC service. First, a TOFC shipment leaves the shipper via truck and travels over-the-road to the railroad. Second, the railroad lifts the trailer onto a rail car. Third, the trailer travels, by rail, to the rail intermodal facility closest to its final destination. Fourth, the railroad lifts the trailer off the rail flat car where a truck tractor attaches to the trailer and delivers the shipment, over-the-road, to the receiver. If the price of using trucks became less expensive relative to rail intermodal, then the trailer might complete the move over-the-road without using the railroad.

Rail Carload

The 1994 Waybill Sample indicates that rail carload traffic accounts for 86 percent of all tons hauled by the railroads; the remaining 14 percent being TOFC/COFC. Rail carload traffic operations include over ten different equipment types. Examples include: (1) box cars, generally used for dry and packaged goods; (2) hoppers, usually used for bulk raw materials and grain; and (3) tanks, usually used for liquid chemical and petroleum products. Figure IV-6 provides illustrations of each of these equipment types. Among the carload body types, the box car competes the closest with truck.

Figure IV-6. Trailer-on-Flatcar/Container-on-Flatcar Operations



Analytical Models

The previous section provided an overview of the types of traffic that could be impacted by a change in TS&W limits. This section provides the estimation techniques used to determine truck VMT and rail car miles given a change in TS&W policy.

For purposes of analysis, truck traffic is divided into short-haul and long-haul. This section begins with a discussion of the short-haul truck analysis. The short-haul analysis uses a model which predicts the distribution of payload ton-miles for the affected configurations and weight groups given changes in relative operating costs.

The long-haul truck VMT and rail car mile analysis use the ITIC Model, which will be discussed in more detail following the short-haul truck model presentation. The final section discusses the estimation of the post-diversion weight distribution for the affected truck configurations.

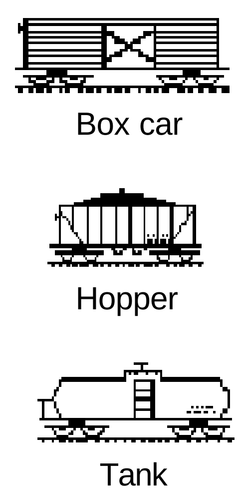
Short-haul Truck Analysis

The short-haul truck analysis focuses on the heavily loaded SUTs and those combination trucks which operate under 200 miles, on a typical haul.

The first step in the SUT analysis is to identify the relevant configurations which are affected by the Federal weight limits. For example, in the North American Trade Scenarios, which assume an increased tridem-axle weight limit, the four-axle SUTs would attract freight from the three-axle SUTs.

Next, the analysis determines the proportion of three- and four-axle SUT VMT which would be impacted by the scenario. A review of the weight distributions from the *HCA Study* shows those three- and four-axle SUTs with operations at or above the Federal weight limits. This is assumed to be the VMT where trucks operate at 85 percent to 110 percent of the Federal maximum GVW. The likelihood of this traffic diverting depends on the relative change in operating costs between the current configuration and the four-axle SUT with a higher GVW.

Figure IV-7. Rail Carload Equipment



*Drawings not to scale.

Short-haul combination trucks are assumed to have diversion which mirrors the diversion of the long-haul combination trucks.

Long-haul Truck and Rail Analysis

The long-haul truck and rail analysis utilizes a unified approach in estimating diversion. The analysis accounts for both the change in transportation cost (as was done for the short-haul analysis) and the impact on inventory costs. For freight traveling over 200 miles, it is important to include the changes in inventory costs which could offset potential savings (or costs) of diverting to a different mode or configuration.

Model Decision Making Process

The long-haul diversion decision is captured in the ITIC Model. The framework of the ITIC Model is shown in Figure IV-8. The ITIC Model is used to evaluate truck-to-truck, rail carload-to-truck and rail intermodal-to-truck diversion. The model comprises two modules, one for transportation costs and one for inventory costs. The inventory cost module is the same for both rail and truck observations. However, the transportation cost module is different for truck and rail because the two modes are represented by different data sets. Figure IV-9 describes factors affecting truck and rail mode choice decisions.

The model determines whether a shipment will divert by estimating the total logistics cost (transportation cost plus inventory cost) to move the shipment by the various modes and truck configurations. If the total cost is lower for a proposed truck configuration, the shipment will divert. The inventory and transportation cost estimation procedures are detailed in the following sections.

<u>Inventory Cost</u>

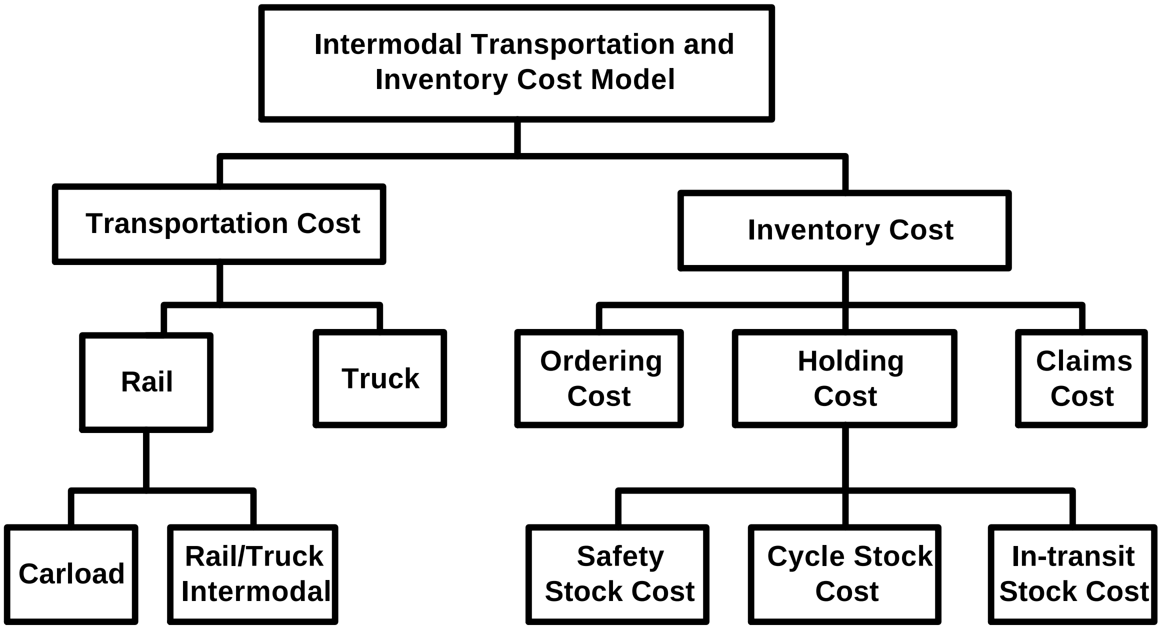
"Inventory cost" is the cost of maintaining stock for either a manufacturing process or to meet customer demands. Inventory costs are calculated in the same manner for both truck and rail moves. Three broad components comprise inventory cost: holding cost, claims cost, and order cost.

Inventory holding cost, which is synonymous with the cost of warehousing inventory, includes the costs associated with safety, cycle, and in-transit stock. Safety stock protects shippers against potential shipping delays. Safety stock requirements are determined by the lead time for each shipment (the sum of the shipment transit time and wait time) and the shipper's estimate of relative modal reliability.

The second element of inventory holding cost is the cycle stock cost, or the average stock on-hand between shipments. The final element is the in-transit stock cost, which is the cost of capital dedicated to purchase the goods.

The second inventory cost component is the claims cost. This is the annual cost of insurance for loss and damage. It includes a penalty for the opportunity cost of funds tied-up during settlement. The final component of the inventory cost is the shipment order cost. This is the cost of

Figure IV-8. Intermodal Transportation and Inventory Cost Model



administering the paperwork and placing an order.

Transportation Cost

"Transportation cost" refers to the cost to the shipper of moving goods from origin to destination. The transportation cost is calculated differently for truck and rail shipments. For truck shipments, it is calculated by multiplying the cost-per-mile by the shipment distance.

For rail shipments, the transportation cost for carload and intermodal shipments varies slightly with intermodal shipments having an additional truck or drayage cost. The transportation cost for rail carload shipments is reported as "revenue" in the Waybill Sample. However, the ITIC Model assumes that if necessary, to avoid losing a shipment, railroads may reduce their rates down to their variable costs. This means the railroads are willing to forgo any contribution to their capital infrastructure and profit to retain a shipment before allowing that shipment to divert to truck. Issues arising from this discounting assumption are discussed in Chapter XI.

Intermodal shipments have an additional truck cost component for each rail move. The railroad cost reflects the cost to haul the shipment over the railroad, while the truck cost is the charge for moving the shipment from the shipper to the railroad and from the

Figure IV-9. Truck and Rail Mode Choice

Shippers choosing between truck and rail often consider a trade-off between price and service. In terms of price-per-ton-mile, rail service is almost always less expensive than truck service. In terms of service quality, truck service offers door-to-door delivery and typically faster deliveries. The price versus convenience trade-off is close in those markets where there is significant competition between rail and truck. In these “rail-truck competitive markets” shippers routinely make choices between truck and rail service.

The most competitive rail-truck service is intermodal. Intermodal service uses equipment that makes part of the journey by highway in trailers or containers, so anything that goes in a truck trailer or container could move intermodally. An equivalent statement can be made for box cars, but box cars are less used for general merchandise shipments. Paper, auto parts, and lumber account for the preponderance of box car traffic.

Other rail traffic is either low-value goods where shippers are more concerned about the price of shipping than the convenience of door-to-door service, or goods of such a nature that rail has a formidable cost advantage over highway movement. Coal, grain, and most chemicals fall into this latter category. Shippers of these commodities use trucks only for comparatively short distances or when rail service is temporarily unavailable, and even then only for short moves.

railroad to its final destination. The railroad cost component is calculated in the same manner as the transportation cost for rail carload and the truck cost component is calculated in the same manner as the transportation cost for trucks.

Limitations

In the interest of simplicity, the ITIC Model applies an “all-or-nothing” rule to determine if a shipment will divert. In other words, if the cost of transporting a given freight shipment from the Waybill Sample is one cent cheaper on an alternative truck configuration or mode, the shipment is predicted to divert. By extension, all similar shipments that the sample shipment represents would also be assumed to divert. This approach is likely to overstate the potential for diversion. If the difference in costs between truck configurations or modes is slight, it is unlikely that the full amount of that type of freight shipped in a year, would automatically divert.

The model only generally captures the service considerations that are a part of each shipper’s decision making process. Service considerations, such as spoilage, are not available in a form suitable for the ITIC Model.

In addition, the commodity descriptions in the data sets

Figure IV-10. Intermodal Transportation and Inventory Cost Model Development

Development of the Intermodal Transportation and Inventory Cost (ITIC) Model involved several stages of sensitivity testing and expert reviews. An expert group was established to evaluate, in detail, the diversion approach and results. This group, comprised of experts in truck and rail operations, inventory and diversion modeling, reviewed both interim and final products.

The group examined the model structure, underlying theory and the reasonableness of the analytical output. The product of this review process was a detailed understanding of the determinants that influence mode selection in the ITIC Model.

In addition, the review process highlighted limitations of the model and areas requiring further development.

may be too generic to determine the service level to be assigned. For example, if a shipment consisted of "food and kindred products," it is impossible to tell whether this is fresh or canned peaches. Therefore, in the case of fresh peaches, the model would assume incorrectly that the shipment is not perishable. Perishable goods would have short delivery deadlines, which could decrease the diversion of a shipment from a semi-trailer to a long double-trailer combination (RMD or TPD) or a triple-trailer combination. This is because more time would be required for a shipper to coordinate the movement of trailers with different service requirements.

The analysis year of the study is 2000. The potential diversion of traffic between truck classes and between truck and rail is estimated assuming that shippers and carriers could immediately change their operations to take advantage of differences in relative transportation costs among modes. In practice it would take many years for all carriers to adapt their fleets to take best advantage of revised TS&W limits. Likewise, it is assumed that the highway infrastructure needed to accommodate truck configurations that may operate under revised TS&W regulations is immediately available. Again, in practice, it would take many years before all bridge and geometric design improvements were made. Thus the study assumes that conditions approaching a long-run equilibrium are achieved instantly. Similar assumptions have been made in previous TS&W studies by the Department and others.

Input Data

Truck

This section discusses the truck data set required for the ITIC Model. Because a single data set which captures all the relevant variables is not available, different sources are used to capture over-the-road shipments, transportation cost, line-haul miles, repositioning miles and commodity attributes. The sample of over-the-road shipments is based on the 1993-1994 Association of

American Railroads' North American Transportation Survey (NATS). The survey collected 24,639 responses. Because each respondent was asked about their current and previous shipment, the sample contained data on 49,278 shipments. For this analysis, short-haul shipments of less than 200 miles were deleted leaving a data set of 47,135 shipments. Also excluded were shipments by autorack trucks, since the study's scenarios do not specifically analyze those vehicles.

Figure IV-11. Diversion of Freight Transported in Short Double-Trailer Combinations

Because a sample of shipments by five- and six-axle double-trailer combinations does not exist, the diversion analysis relied upon the 1992 Truck Inventory and Use Survey, as well as industry observation. The survey shows that 70 percent of the short double-trailer combinations are used in less-than-truckload (LTL) operations. The diversion analysis assumes that to increase the efficiency of the fleet, current LTL double-trailer operations would divert to triple-trailer operations. An additional assumption is made that the other 30 percent of short double-trailer combinations have operations similar to LTL carriers and would also experience cost savings from adding an additional trailer.

The NATS data provide shipment information for origin and destination pairs, truck body type and commodity hauled. For modeling purposes, it is assumed that there are two body types, van and tank, although body type is more detailed in the survey.

The NATS data do not include truck configuration information, such as the number of axles, trailers or trailer length. The data do not distinguish between a five-axle tractor semitrailer, a short double, or an LCV. According to the 1992 TIUS report, 80 percent of all trucks operating over 200 miles are five-axle tractor semitrailers. Therefore, it is assumed that all the shipments represented in NATS are traveling in five-axle tractor semitrailers. This assumption does not affect the overall distribution of VMT among vehicle classes because base case traffic by configurations other than the five-axle tractor semitrailer is analyzed separately.

There were three adjustments to the NATS data. The data were adjusted for trip length to avoid the bias associated with sampling mostly long trips in the survey. The second adjustment was for partial loads. The NATS did not include a question on whether the trailer was fully loaded. Responses to previous roadside surveys were used to estimate partial loads. The final adjustment was to expand the sample of truck moves to the total truck VMT. The diversion results were expanded to the *HCA Study* total VMT by configuration, State and highway functional class.

Four variables were added to the shipment records in the NATS data set:
(1) transportation cost;
(2) line-haul miles;
(3) repositioning miles; and
(4) commodity information.
The truck transportation cost-per-mile is based on a

Figure IV-12. ITIC Model Calibration

A Base Case Scenario, which assumes current Federal truck size and weight (TS&W) rules, was analyzed using the Intermodal Transportation and Inventory Cost (ITIC) Model. The results were evaluated to see how accurately the model determined the truck configuration and mode choice of shipments under current Federal TS&W limits. Since shipper decision making results are known for the Base Case Scenario, this provides a good test case by which to verify the model results.

The carload and truck input data sets were separately analyzed with the ITIC Model. In the base case, if the model selected a mode different from the mode reported in the data set, the shipment was called a "misassigned" record. For example, if a carload rail observation "diverted" to a five-axle tractor semitrailer then that record was said to have "misassigned" since the model did not predict that rail carload was the preferred mode.

In the truck analysis, the misassigned records were less than one percent of the input records. This means that in virtually all cases, the ITIC Model correctly predicted the truck configuration consistent with the input data set.

In the rail carload analysis, 6,563 records were misassigned in the base case; that is the model incorrectly predicted that the shipment would travel by truck. This was equal to 2.53 percent of the carload shipment records in the sample set. This level of error is good for a complex model such as ITIC.

Most, 56 percent, of the misassigned carload records involved transportation equipment. In fact, almost one-half of the total transportation equipment records in the carload sample were misassigned. Apparently, the model does not capture, or is not sufficiently sensitive to, all of the relevant mode choice considerations characterizing the transportation equipment market. The next most common misassigned commodity was pulp and paper, accounting for 12 percent of the misassigned records.

The misassigned records could result from model error or the absence of a critical variable. However, it is also possible that these misassigned shipments are very truck/rail competitive; and therefore highly susceptible to diverting. Deleting the records may result in underestimating diversion. The same conclusion holds if the shipments represent shipper error, i.e., if the shipper lacked complete information about all the relevant costs, and elected to ship by rail even though trucks would have been more advantageous.

In this analysis the misassigned records have been removed from the vehicle-miles-of-travel estimates. This could potentially lead to an understatement of rail diversion.

report by Jack Faucett Associates (August, 1991), "The Effect of Size and Weight Limits on Truck Costs." The report summarizes cost-per-mile information by body type, truck configuration and payload. The modeling approach assumes motor carrier rates may be closely approximated by a per-mile rate.

Line-haul and repositioning miles are also added to the NATS shipment data. The line-haul miles were computed for each truck configuration using the networks presented in Chapter II and the origin and destination cities included in NATS. An estimate of repositioning miles was added to the line-haul distance to reflect the distance a truck would likely travel before obtaining a return shipment.

The final additional data variables provide commodity attribute information on price-per-pound, annual use rate, and shipping density for a commodity. Estimates of the commodity price-per-pound were obtained from the Bureau of Census' 1993 Commodity Flow Survey (CFS) Report.

Rail

The primary source of railroad data is the STB's 1994 Waybill Sample. Records for the following were excluded:
(1) shipments under 200 miles, since short rail moves are not competitive with truck; (2) coal shipments traveling more than 500 miles, since this heavy bulk freight is not directly competitive with trucks;
(3) autorack shipments, since autoracks are not explicitly analyzed in the illustrative scenarios; and
(4) movements of locomotive and empty rail equipment.

The ITIC Model uses the following Waybill Sample variables: origin and destination pairs, commodity shipped, annual tons shipped, number of railroads, equipment type, sample-to-population expansion factors and the variable cost for the rail shipments.

Of the variables just described, the most important for estimating freight diversion is the railroad's variable cost. It is more important than rail revenue since the ITIC Model assumes that each shipment by rail can be discounted down to the railroad's variable cost before the freight would divert to truck. However, rail revenue is important to the rail viability analysis in Chapter XI, "Rail Impacts."

The variable cost for rail shipments is estimated by the STB via an accounting procedure that uses railroad-by-railroad data to compute variable cost for sixteen equipment types.

An expert review of the Waybill and the ITIC Model's analysis of the Waybill records revealed that the variable cost field could not be used in the ITIC Model for intermodal shipments.

The variable cost for intermodal shipments was estimated using an accounting procedure similar to the STB's method. The costs were expanded from an estimation of selected intermodal city pairs which represented a cross-section of annual tons-per-year and mileage groups. The costing method was adjusted for train length, rail yard dwell time, and number of containers or trailers-per-rail car, among other factors specific to each city pair.

Four variables were added

to the Waybill records: (1) commodity information; (2) truck repositioning miles; (3) truck line-haul; and (4) pick-up and delivery cost for intermodal shipments. The commodity attribute information is price-per-pound and shipping density for each commodity. Estimates of the commodity price-per-pound were obtained from the Bureau of Census' 1993 CFS Report.

For each rail shipment, the distance to move the shipment by the various truck configurations was added to the rail database. This provided a means of comparing the rail line-haul distances with the truck line-haul distances. The truck line-haul miles were computed in the same manner described under the truck data section.

The pick-up and delivery cost for intermodal shipments is the cost of getting the container or trailer to and from the railroad network. The distance that the intermodal shipment travels by truck was estimated using the population density for each Business Economic Area as designated by the Census Bureau.

Weight Distribution

The final step in producing each scenario's VMT estimate is to determine the operating weight distribution (by percent of VMT) for each configuration. The operating weight distribution is derived using the scenario payload-ton-miles and the 1994 weight distribution from the *HCA Study*. For example, the solid line in Figure IV-12 shows the 1994 weight distribution for four-axle SUTs. The horizontal axis shows the 5,000-pound weight groups and the vertical axis shows the percent of four-axle SUT VMT in each weight group. Notice that the distribution is bimodal with one peak at the empty or tare weight and one at the average loaded weight. The dashed line in the exhibit shows the new weight distribution for the Uniformity Scenario. It is assumed to follow a distribution similar to the base 1994 distribution.

Figure IV-13. Weight Distribution Example - Base Case and Uniformity Scenario for Four-Axle Single Unit Truck

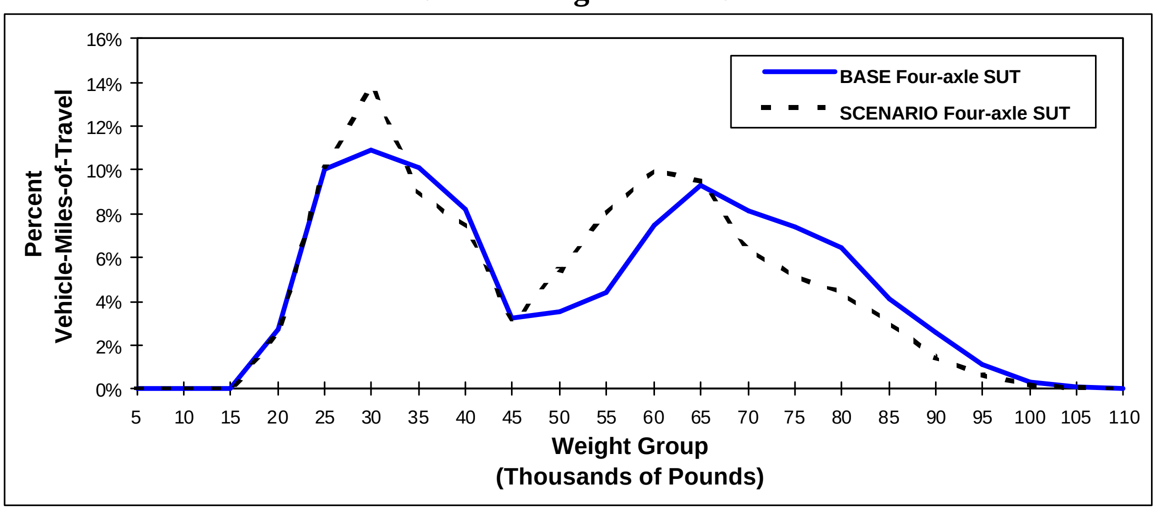


Figure IV-14. Use of the Intermodal Transportation and Inventory Cost Model in Analyzing the Uniformity Scenario

Although the Intermodal Transportation and Inventory Cost Model is used to analyze truck-to-truck and rail-to-truck diversion for the majority of the scenarios, it is not used to analyze the Uniformity Scenario. This scenario requires a level of precision beyond the current truck data set.

The Uniformity Scenario requires evaluation of State grandfathered limits. The input data is not broad enough to capture trucks traveling on roads coming under State grandfather exemptions.

There are two steps in determining the new weight distributions. First, the average loaded weight peak is adjusted for the new payload-ton-miles. Second, the empty weight peak is adjusted by the ratio of empty-to-loaded miles:
(1) for short-haul (less than 200 miles), the ratio is one empty mile for every loaded mile; or (2) for long-haul, the repositioning miles from the ITIC Model are used to estimate the ratio of empty-to-loaded miles.

Assessment of Scenario Impacts

Uniformity Scenario

The Uniformity Scenario tests the impact of eliminating State grandfather authority and establishing current Federal TS&W limits on the National Network (NN) for Large Trucks. It would result in decreased weight limits in States that have grandfathered axle or gross vehicle weights that currently exceed Federal limits, or higher weights on non-Interstate portions of the NN that currently have lower limits than Federal limits.

For this scenario, the primary analytical input to estimate truck-to-truck diversion was the *HCA Study's* distribution of VMT by State, functional class, and 5,000 pound weight group. The analysis indicates that the weight distribution shifts toward the higher functional class highways in States where grandfather rights exist. Figure IV-15 outlines how freight currently traveling in trucks with grandfather exemptions would likely respond to the elimination of these exemptions.

Potential diversion from truck-to-rail was not addressed in this scenario. As previously discussed, the capability to estimate railroad rates for a given truck move does not currently exist.

Figure IV-16 shows the impact of the Uniformity Scenario on SUTs, truck-trailer, and tractor semitrailer combinations. Figure IV-17 shows the impact on multi-trailer combination trucks.

Figure IV-18 shows the VMT impact for the total heavy commercial truck fleet for the Year 2000. As the charts indicate, the configurations most significantly affected are those with six or more axles. These are the configurations that State grandfather rights allow to operate above the 80,000-pound Federal limit.

The six-axle tractor semitrailer is projected to experience a 42 percent decrease in VMT from 6,059 million miles to 3,519 million miles. VMT for the seven-axle tractor semitrailer would decrease 74 percent from 546 million miles to 141 million miles. These operations divert to the five-axle tractor semitrailer.

Double-trailer combinations with seven or more axles also experience significant freight diversion. The analysis indicates that the seven-axle double-trailer combination would decrease 54 percent, from 632 million miles to 290 million miles. The VMT associated with the eight- and nine-axle double-trailer combinations would decrease 74 percent from 759 million miles to 198 million miles. The analysis indicates that freight from these operations would divert to five-axle tractor semitrailer combinations.

Figure IV-15. Uniformity Scenario - Likely Truck Configuration Impacts

Original Truck Configuration		Likely Reaction to the Scenario
Three-axle single unit	ö	Less payload in a three-axle single unit
Four-axle single unit	ö	Less payload in a four-axle single unit
Five-axle tractor semitrailer	ö	Less payload in a five-axle tractor semitrailer
Six-axle tractor semitrailer	ö	Change to a five-axle tractor semitrailer
Six-axle double-trailer combination	ö	Change to a five-axle tractor semitrailer
Seven-axle double-trailer combination	ö	Change to a five-axle tractor semitrailer
Eight-axle (or more) double-trailer combination	ö	Change to a five-axle tractor semitrailer
Triple-trailer combination	ö	Change to a five-axle tractor semitrailer
Five-axle truck-trailer	ö	Less payload in a five-axle truck-trailer
Six-axle truck-trailer	ö	Less payload in a six-axle truck-trailer
Five-axle double-trailer combination	ö	Less payload in a five-axle double-trailer combination

Figure IV-16. Impacts of Uniformity Scenario on VMT by Single Unit Trucks, Truck-Trailers, and Tractor-Semitrailers

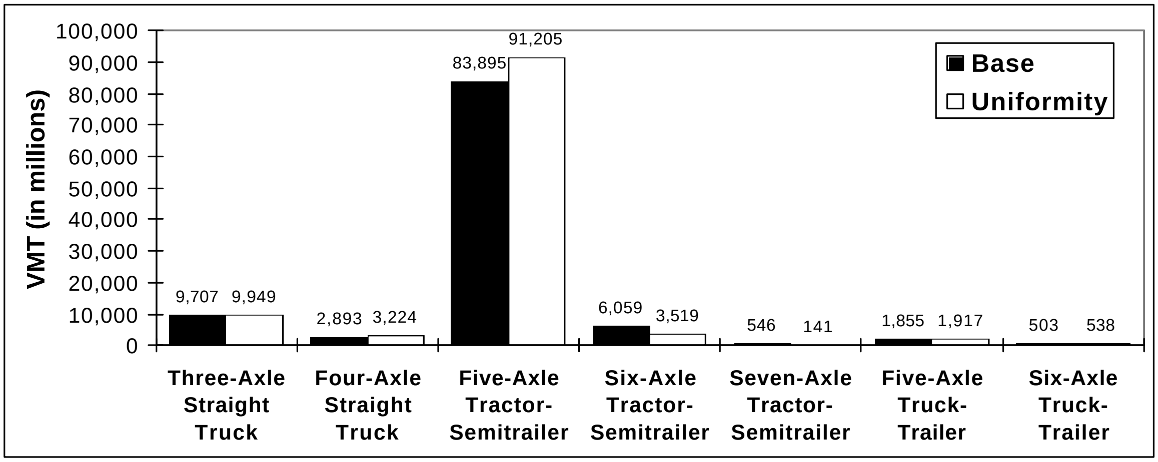
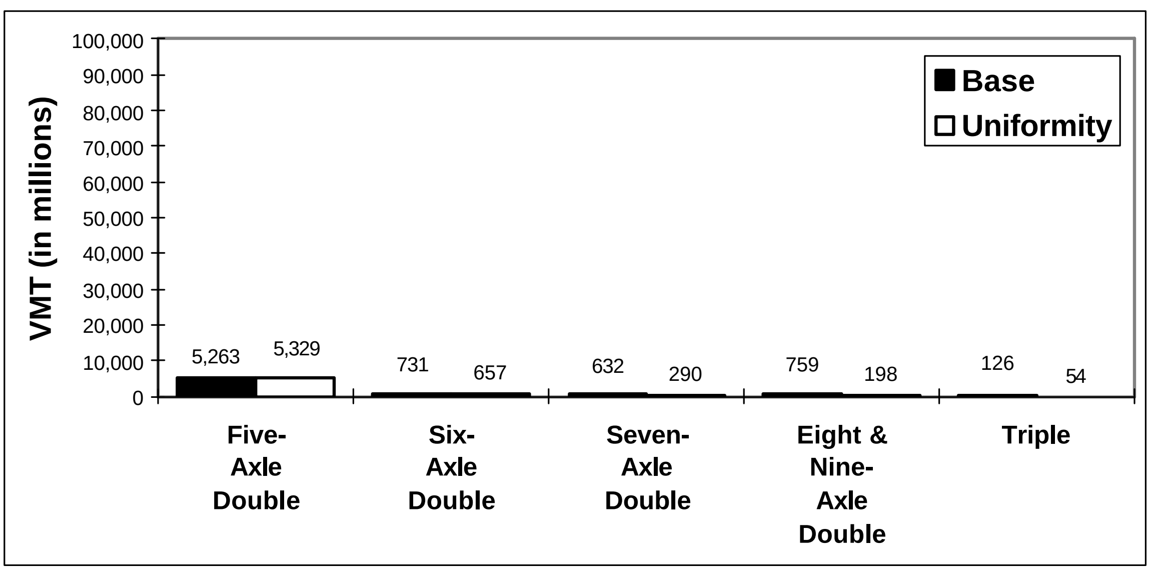


Figure IV-17. Impacts of Uniformity Scenario on Multitrailer Combination VMT



North American Trade Scenarios

There are two North American Trade Scenarios: the first tests a 44,000-pound tridem axle and the second tests a 51,000-pound tridem axle. These axle weights are tested on two common vehicles -- the four-axle SUT and the six-axle tractor semitrailer -- and one vehicle that is not widely used in the U.S.-- a twin 33-foot eight-axle double-trailer combination.

44,000-pound Tridem Axle

This scenario specifies the maximum legal GVWs for the four-axle SUT at 64,000 pounds, the six-axle tractor semitrailer at 90,000 pounds and a twin 33-foot eight-axle double-trailer combination at 124,000 pounds.

Figure IV-19 outlines assumptions regarding how freight currently traveling in the affected configurations would respond to the new tridem axle weight limit.

Figures IV-20 and IV-21 summarize the analysis results. Total heavy commercial truck VMT for the Year 2000 decreases by 11 percent. The three-axle SUT VMT is reduced by 12 percent, from 9,707 million miles to 8,529 million miles. VMT for the four-axle SUT increases 24 percent, from 2,893 million miles to 3,595 million miles. The five-axle tractor semitrailer VMT is reduced by 73 percent, decreasing from 83,895 million miles to 22,274 million miles. This represents the freight traveling near or above the 80,000-pound Federal weight limit or filling a 53-foot trailer. That freight diverts to: (1) the six-axle tractor semitrailer which experiences a 3 percent increase in VMT, from 6,049 million miles to 6,209 million miles; or (2) the eight-axle double-trailer combination whose VMT increases from 683 million miles to 49,003 million miles.

Figure IV-18. Total VMT, Base Case Vs. Uniformity Scenario

Scenario	Vehicle-Miles-of-Travel (in millions)
Base Case	128,288
Uniformity Scenario	132,351
Percent Change	3.2%

Truck-to-Truck Diversion

All truck freight traveling near or above the Federal TS&W limits is impacted by this scenario. Weigh-out commodities such as frozen foods, logs, pulp, paper, building materials, chemicals, fuels, and raw materials divert to the higher payload tridem axle configurations, and cube-out commodities such as processed food, farm produce, textiles, furniture and manufactured goods divert to the higher cube twin 33-foot eight-axle double-trailer combination. The diversion caused by cube-out freight moving to the highest cube truck is larger than the diversion

Figure IV-19. Likely Truck Configuration Impacts for North American Trade Scenario

Original Truck Configuration		Likely Reaction to the Scenario
Three-axle single unit	ö	Change to a four-axle single unit
Four-axle single unit	ö	More payload in a four-axle single unit
Five-axle tractor semitrailer	ö ö	Change to a six-axle tractor semitrailer Change to a eight-axle double-trailer combination
Six-axle tractor semitrailer	ö	More payload in a six-axle tractor semitrailer
Eight-axle (or more) double-trailer combination	ö	More payload in a eight-axle double-trailer combination

Figure IV-20. Impact of North American Trade Scenario (44,000 lb. Tridem Axle) on VMT By Different Vehicles

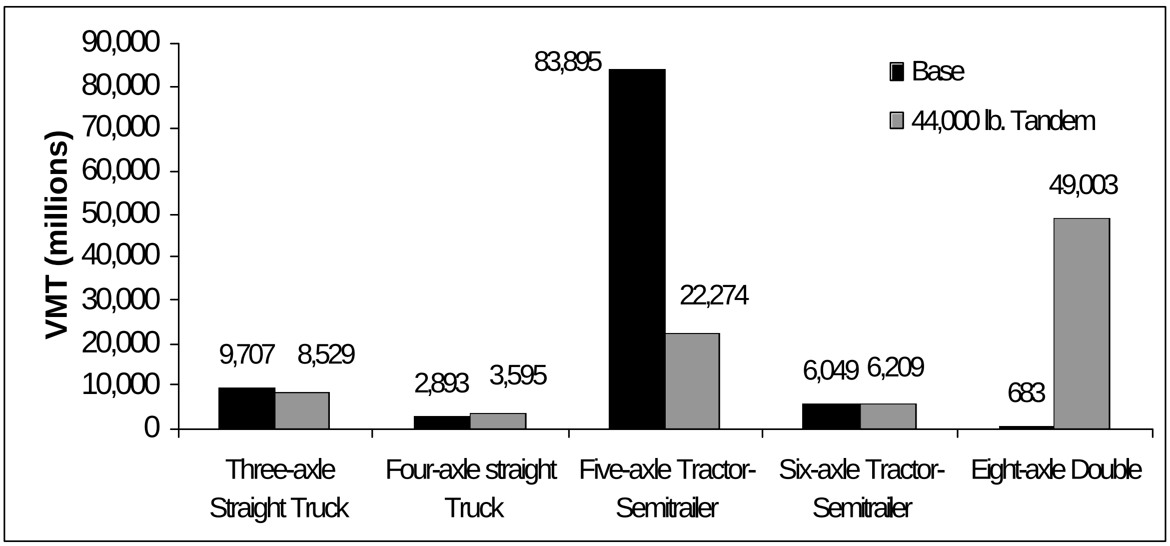


Figure IV-21. Impact of North American Trade Scenario (44,000 pound Tridem Axle) on Total Heavy-Truck VMT

Scenario	Vehicle-Miles-of-Travel (in millions)
Base Case	128,288
44,000-Pound Tridem Axle Scenario	114,671
Percent Change	-10.6%

caused by the weigh-out freight because most long-haul truck shipments cube-out before they weigh-out.

Rail Carload-to-Truck Diversion

Freight accounting for 5 percent of the current rail carload car miles is estimated to divert to trucks. The shipments that would benefit from the heavier payload truck configurations are short moves such as pulp, paper and allied products, food and kindred products, lumber and wood products, primary metal industry products, waste and scrap.

Rail Intermodal-to-Truck Diversion

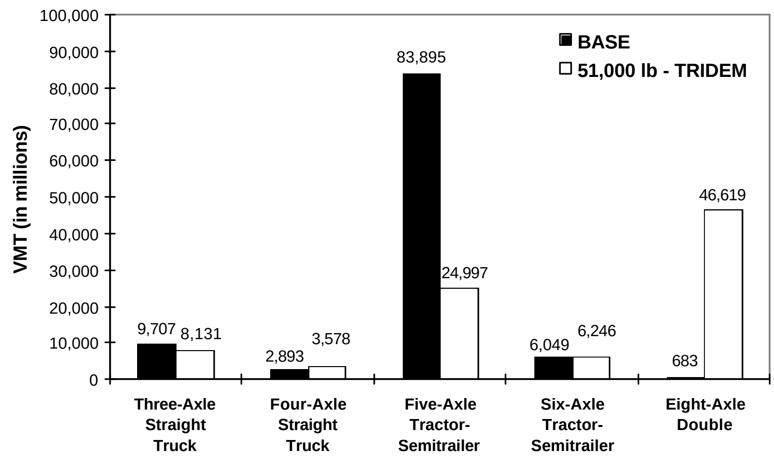
Freight accounting for 2 percent of current rail intermodal car miles is estimated to divert to truck. The amount of diversion is low because this scenario also allows heavier payloads for intermodal trailer- or container-on-rail. The TOFC/COFC container can be heavier because when unloaded and shipped by highway it may move on a six-axle tractor-semitrailer weighing 90,000 pounds.

Two types of intermodal traffic were tested for potential diversion to trucks. The first were containers that were 33 feet or less and weighed between 20,650 pounds and 42,650 pounds. These shipments were tested for diversion to the 124,000-pound eight-axle double-trailer combination. The length was limited because the eight-axle double-trailer combination comprises twin 33-foot trailers (for further explanation see Figure IV-24). The weight was limited because two containers weighing 20,650 pounds each could have traveled on a five-axle double-trailer combination under the current weight limit, if that had been the most economical alternative. Two containers weighing more than 42,650 pounds each would be too heavy for the eight-axle double-trailer combination under this scenario.

Shipments weighing more than 45,000 pounds were tested for potential diversion to the 90,000-pound six-axle tractor semitrailer. The weight was limited because a shipment less than 45,000 pounds could have traveled in a five- or six-axle tractor semitrailer with a GVW of 80,000 pounds.

Even with restrictions on the type of shipment analyzed, the model may

Figure IV-22. Impacts of North American Trade Scenario (51,000 pound Tridem Axle) On VMT by Different Vehicles



over estimate diversion of containers. Many of these containers are moved in bulk by large shipping companies. The added cost of tracking individual containers moving on trucks would outweigh any small savings. The Waybill data set does not specify these grouped container moves.

51,000-pound Tridem Axle

This scenario specifies the maximum legal GVWs for the four-axle SUT at 71,000 pounds, the six-axle tractor semitrailer at 97,000 pounds and a twin 33-foot eight-axle double-trailer combination at 131,000 pounds.

The same types of shifts among truck configurations shown in Figure IV-19 for the 44,000-pound tridem axle scenario would also apply to the 51,000 pound scenario.

Figures IV-22 and IV-23 summarize the analysis results. Total heavy commercial truck VMT for the Year 2000 is estimated to decrease 11 percent. These results are similar to the results for the 44,000-Pound Tridem Axle Scenario because most of the diverting freight is cubing-out and shifting to the twin 33-foot eight-axle double-trailer combination.

Three-axle SUT VMT is reduced by 16 percent, from 9,707 million miles to 8,131 million miles. Four-axle SUT VMT increases by 24 percent, from 2,893 million miles to 3,578 million miles. The five-axle tractor semitrailer

Figure IV-23. VMT for Base Case and North American Trade Scenario (51,000 pound Tridem Axle)

Scenario	Vehicle-Miles-of-Travel (in millions)
Base Case	128,288
51,000-Pound Tridem Axle Scenario	114,632
Percent Change	-10.6%

Figure IV-24. Rail Intermodal Input Data

It is assumed that the current intermodal trailer or container sizes would not change with changes in truck size and weight limits. For example, under the North American Trade Scenarios which analyze heavier twin 33-foot eight-axle double-trailer combinations, rail intermodal shippers would not change container sizes. This means that only 8 percent of the rail intermodal [trailer-on-flat-car/container-on-flat-car (TOFC/COFC)] shipments were analyzed for potential diversion to the eight-axle double-trailer combination. However, the remaining 92 percent were analyzed for potential diversion to the six-axle tractor semitrailer.

The first obstacle in testing alternative sizes of intermodal trailers or containers was determining the impacts on all the participants in the intermodal transportation stream. Container ships and rail flat car and well car loadings would need to change to accommodate new 33-foot containers. This would have implications for pricing and ultimately the choice of container size.

The second consideration limiting the ability to analyze container or trailer size changes is the lack of TOFC/COFC commodity data. The Waybill records do not contain specific commodity information; typically they indicate "freight all kinds" or "TOFC shipment." The Intermodal Transportation and Inventory Cost Model requires the commodity's weight per-cubic-foot to determine the loading in an alternative trailer.

In the absence of TOFC/COFC density data, an assumption was made that all shipments are constrained by cubic capacity. The shipment weight on each Waybill record shows the majority of the TOFC/COFC shipments do not weigh-out. That is, the payload plus the tare weight of the tractor or tractor plus trailer is less than the current Federal limit of 80,000 pounds. Given the assumption that TOFC/COFC shipments cube-out, the shipper would want to use the highest cube container or trailer possible. This *a priori* makes the 40- and 45-foot containers or trailers more economical than 33-foot containers or trailers.

VMT declines by 70 percent, decreasing from 83,895 million miles to 24,997 million miles. The diverted freight was traveling near or above the 80,000-pound Federal weight limit or cubically filling a 53-foot trailer. That freight shifts to either: (1) the six-axle tractor semitrailer which has a 3 percent increase in VMT, from 6,049 million miles to 6,246 million miles; or (2) the eight-axle double-trailer combination which realizes a 6,726 percent increase in VMT from 683 million miles to 46,619 million miles.

Truck-to-Truck Diversion

The configurations and commodities impacted are the same as in the 44,000-Pound Tridem-Axle Scenario. The additional weight for the tridem axle in this scenario has a minor impact on the weight distribution since most truck freight cubes-out before it weighs-out.

Rail Carload-to-Truck Diversion

Freight accounting for 7 percent of the current rail carload car miles diverts to trucks. The shipments which would benefit from the truck configuration changes are shorter moves of such commodities as pulp, paper and allied products, food and kindred products, lumber and wood products, primary metal industry products, and waste and scrap.

Rail Intermodal-to-Truck Diversion

Under this scenario, freight accounting for 3 percent of current rail intermodal car miles diverts to truck. The amount of diversion is limited because this scenario also allows a heavier intermodal trailer or container.

Two types of intermodal traffic were tested for potential diversion to truck. The first were containers that were 33 feet or less and weighed between 20,650 pounds and 46,150 pounds. These shipments were tested for diversion to the eight-axle double-trailer combination at 131,000 pounds. The length was limited because the eight-axle double-trailer combination is comprised of twin 33-foot trailers (for further explanation see Figure IV-24). The weight was limited because two containers weighing 20,650 pounds each could have traveled on a five-axle double-trailer combination under the current weight limit, if that had been the most economic alternative. Two containers weighing more than 46,150 pounds each would be too heavy for the eight-axle double-trailer combination under this scenario. The second type of shipment examined included those weighing more than 45,000 pounds. This traffic was tested for potential diversion to the six-axle tractor semitrailer at 97,000 pounds. The weight was limited because shipments less than 45,000 pounds could have traveled in a five- or six-axle tractor semitrailer at 80,000 pounds.

Even with the restrictions on the type of shipment analyzed, the model may overestimate diversion of containers. Many of these containers move in bulk by large shipping companies. The added cost of tracking individual containers moving on trucks would outweigh any small savings. The Waybill data set does not specify these grouped container moves.

Longer Combination Vehicles Nationwide Scenario

This scenario has a large impact on truck travel because the proposed configurations are both larger and heavier than trucks in common use today. Also, interconnected, nationwide road networks are assumed to be available for the scenario vehicles.

Of all the LCVs, the one of most interest is the nine-axle TPD at 148,000 pounds. This is the longest and heaviest configuration tested in the scenario. A large amount of freight shifts to TPDs from existing trucks, rail carload and rail intermodal. Figure IV-25 outlines assumptions regarding how freight currently traveling in the affected configurations would respond to the new LCVs.

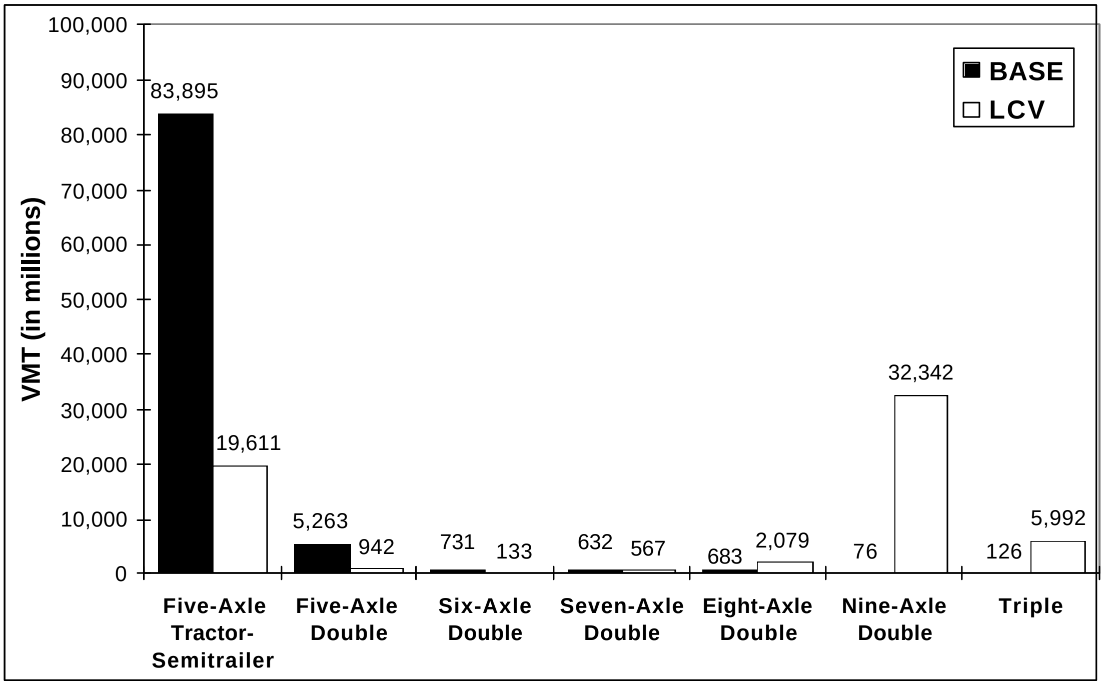
Figures IV-26 and IV-27 summarize the analysis results. Total heavy commercial truck VMT for the Year 2000 is estimated to decrease 23 percent under the scenario assumptions. This large change in VMT is caused by the diversion of freight from the five-axle tractor semitrailer to the nine-axle TPD. The initial five-axle tractor semitrailer VMT decreases 77 percent from 83,895 million miles in the base case to 19,611 million miles after the scenario has taken effect. At the same time the nine-axle TPD VMT increases from 76 million miles to 32,342 million miles. This growth in nine-axle TPD VMT includes the diversion from rail carload and intermodal to truck.

The other major shift in this scenario is from five- and six- axle double-trailer combinations to triple-trailer combinations. The VMT for five- and six-axle double-trailer combinations declines

Figure IV-25. Likely Truck Configuration Impacts of the LCV Nationwide Scenario

Original Truck Configuration		Likely Reaction to the Scenario
Five-axle tractor semitrailer	ö	Change to a seven-axle Rocky Mountain Double (RMD)
	ö	Change to a eight-axle double-trailer combination
	ö	Change to a nine-axle Turnpike Double (TPD)
	ö	Change to a triple-trailer combination
Five-axle double-trailer combination	ö	Change to a triple-trailer combination
Six-axle double-trailer combination	ö	Change to a triple-trailer combination
Seven-axle double-trailer combination	ö	More payload in a seven-axle RMD
Eight-axle double-trailer combination	ö	More payload in an eight-axle double-trailer combination
Nine-axle TPD	ö	More payload in a nine-axle TPD
Triple-trailer combination	ö	More payload in a triple-trailer combination

Figure IV-26. Impacts of LCV Nationwide Scenario on VMT by Different Vehicles



82 percent while the VMT for triple-trailer combinations increases 4,655 percent from 126 million miles to 5,992 million miles.

The following sections discuss the impact of truck-to-truck, rail carload-to-truck and rail intermodal-to-truck modal choices.

Truck-to-truck Diversion

<u>Five-Axle Tractor Semitrailer</u>

As noted in the scenario description the long doubles are restricted to operating on a limited network and must be assembled and disassembled at staging areas for travel to origins and destinations. The model assigns costs for staging area operations and costs for the drayage in single-trailer combinations for travel to origins and destinations. Nevertheless,

Figure IV-27. Total VMT for Base Case and LCV Nationwide Scenario

Scenario	Vehicle-Miles-of-Travel (in millions)
Base Case	128,288
LCVs Nationwide Scenario	98,562
Percent Change	-23.2%

a significant share of freight currently using a five-axle tractor semitrailer is predicted to divert to the nine-axle TPD under assumptions in the scenario. Introducing the nine-axle TPD is equivalent to reducing by half the number of tractors and drivers needed to pull the same number of 53-foot trailers. This translates into an almost two-for-one savings over the transportation cost of a five-axle tractor semitrailer.

The analysis results show that virtually all freight currently using fully loaded five-axle tractor semitrailers would shift to the nine-axle TPD. Partial loads act as a constraint on diversion. It is assumed that 15 percent of the current five-axle tractor semitrailers are partially loaded and would not divert to the nine-axle TPD. As indicated earlier, the 15 percent is based on a trend analysis from previous truck surveys.

If the allowable weights for the TPD were lower or the network upon which they can operate were less extensive, a smaller share of shipments from five-axle tractor-semitrailers could be expected to divert to the TPD. Also, additional research is required to assess whether the logistics costs assumed in the model for using TPDs reflect all shipper and carrier considerations.

Five-Axle and Six-Axle Double-Trailer Combinations

These trucks are used primarily for moving LTL shipments. LTL shipments are consolidated from small shipments and usually have multiple origins and destinations. The LTL carriers use a hub-and-spoke system and short 28-foot doubles to combine shipments for the long-haul portion of the trip and then use the single 28-foot van or a specialized two-axle van for delivery.

These carriers would shift their long-haul traffic to triple-trailer combinations, in place of current double-trailer combinations. The analysis assumes that all but 15 percent of the VMT for five- and six-axle double-trailer combinations would shift to triple-trailer combinations. The remaining 15 percent is assumed to be partial loads which would still travel as double-trailer and not triple-trailer combinations. As for the TPDs, if the assumed gross vehicle weights were lower or the network/access provisions less liberal, less diversion to triples would be expected.

Seven-Axle Rocky Mountain Double

The results of the analysis indicate that little freight would divert from the five-axle tractor semitrailer to the seven-axle RMD. Most freight diverts to the nine-axle TPD which can hold both more volume and weight. The analysis assumes that there is a shift to heavier payloads among the current fleet of seven-axle RMDs.

Rail Carload-to-Truck Diversion

Freight accounting for 9 percent of rail carload car miles is estimated to divert to trucks, based on the scenario assumptions. The shipments which divert to the heavy payload truck configurations are shorter moves of such commodities as pulp, paper and allied products, food and kindred products, lumber and wood products, primary metal industry products, waste and scrap. Even though the analysis of this scenario indicates significant increases for truck weights, there is still limited diversion of carload traffic to trucks.

Figure IV-28. Operating Restrictions

This study did not assume operating restrictions beyond a restricted roadway network for Longer Combination Vehicles (LCVs). This analytical assumption does not necessarily match what would occur given implementation of the scenario because some operating restrictions would certainly apply to the operation of LCVs. For example, metropolitan areas might restrict their hours of operation to avoid conflicts with rush hour traffic. This study does not estimate the costs for monitoring compliance with the restricted roadway or the costs of any additional operating restrictions.

Rail Intermodal-to-Truck Diversion

Freight accounting for 31 percent of current rail intermodal car miles is estimated to divert to truck under the LCVs Nationwide Scenario. Only long-haul traffic over high density corridors would continue to operate on rail. For example, high volume lanes such as Los Angeles to Chicago would continue to operate but lower volume lanes such as Atlanta to New York would not operate. This is because the railroad's variable cost-per-trailer or container is much lower on the high volume lanes.

The analysis of freight diversion from rail intermodal to truck was accomplished in two steps. The first group of intermodal traffic tested for diversion included containers of 33 feet or less. Similar to the North American Trade Scenarios, these were tested for potential diversion to the eight-axle double-trailer combination assuming no change in the freight loaded into a container or trailer. The current payload must be more than that which would currently fit on a five-axle double-trailer combination, two 20,650-pound containers, but less than two containers each at 42,650 pounds which is more than the hypothesized eight-axle double-trailer combination could carry.

All the remaining rail intermodal Waybill observations were tested for diversion to the nine-axle TPD. Much of the current rail intermodal cost advantage vanished when compared to the TPD. As was the case when comparing the TPD to the five-axle tractor semitrailer, the two-to-one transportation cost advantage of hauling two trailers with one tractor causes significant freight diversion.

H.R. 551 Scenario

This scenario tests the impact of limiting any further increases in the number of trailers over 53

Figure IV-29. Impact of Long-Doubles Network and Access Provisions

One of the reasons freight diverts to the nine-axle turnpike double from the five-axle tractor semitrailer is the extensive roadway network for longer double-trailer Longer Combination Vehicles (LCVs, "long doubles"). The long doubles network is 42,500 miles. Although, this is only one quarter of the National Network for Large Trucks, the long doubles network includes freeways in every State. The result is a road network that connects to each major city with limited connections to urban centers. Therefore, long doubles travel about the same number of miles as would a standard five-axle tractor semitrailer to carry a given shipment.

The other factor contributing to the popularity of the nine-axle turnpike double is the liberal access assumed to and from the 42,500-mile network. Previous studies have forced long doubles to use as few as 50 staging areas nationwide for assembling and breaking-down the combination. This study assumes that staging areas would be provided every 15.6 miles on rural freeways and about every 50 miles on non-freeway rural highways. Trucks with trip origins or destinations in an urban area would use urban fringe staging areas. These rules imply 2,455 rural and 830 urban fringe staging areas. This assumption substantially increases the roadway geometry cost, (see Chapter 7), but decreases miles traveled for long doubles and the miles to and from the network.

The staging area costs are included in Chapter 7, "Roadway Geometry." They are not included in the truck operating costs used by the Intermodal Transportation and Inventory Cost Model because it is unclear what services would be offered and whether the staging areas would be managed by the government or by private industry. The diversion analysis assumes all of the network interchange facilities are in place by the study analysis year (2000). These improvements, of course, could not happen immediately so the diversion estimates must be considered to be long-term changes, assuming that all infrastructure improvements are made and the network, staging area, and access provisions are as liberal as assumed in this scenario.

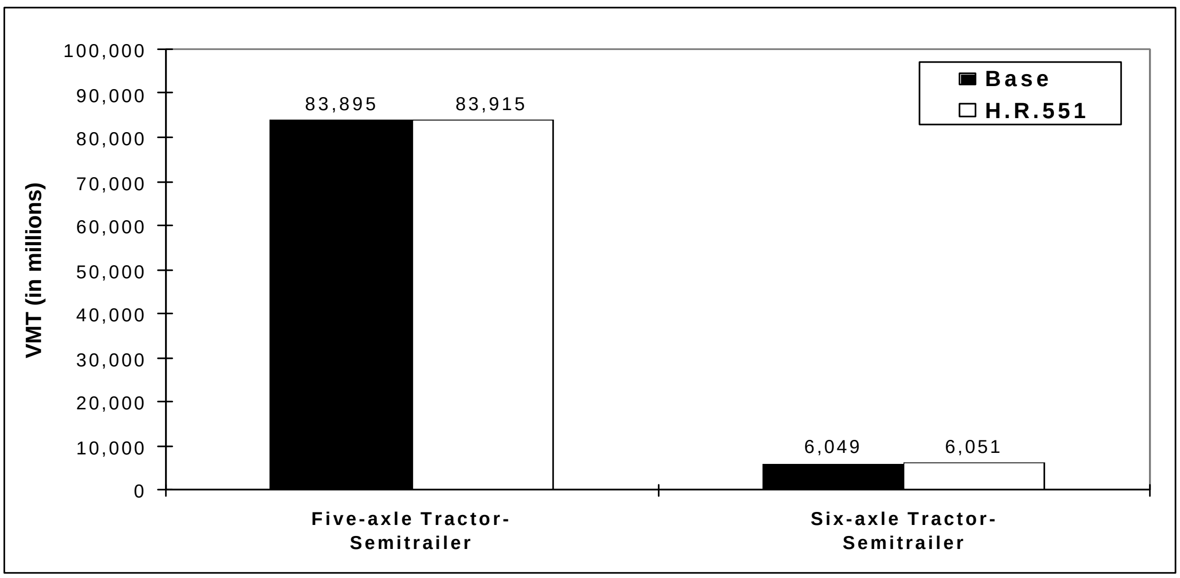
feet. This changes the cubic capacity of some five- and six-axle tractor semitrailers. However, underlying the analysis is an implicit assumption that current trailers over 53 feet would continue to operate through the analysis Year 2000. The analysis assumes that there would be no impact on rail traffic, since the change affects only cube-limited freight. Most shippers currently use rail for heavy bulk shipments and deploy trucks for lighter shipments that fill the cube or volume of a trailer.

Figure IV-30 outlines assumptions regarding how freight currently traveling in trailers over 53 feet would likely respond to limitations on these

Figure IV-30. Likely Truck Configuration Impacts, H.R. 551 Scenario

Original Truck Configuration		Likely Reaction to the Scenario
Five-axle tractor semitrailer	ö	Less payload in a five-axle tractor semitrailer
Six-axle tractor semitrailer	ö	Less payload in a six-axle tractor semitrailer

Figure IV-31. Impacts of H.R. 551 Scenario on VMT by Different Vehicles



configurations.

Figures IV-31 and IV-32 summarize the diversion estimates for this scenario. Total heavy commercial truck VMT for the Year 2000 increases less than one-half a percent. Since the current population of trailers over 53 feet is very small, the impact of this scenario is minor on a national scale. The only two configurations impacted are the five- and six-axle tractor semitrailers.

Triple-Trailer Combination Nationwide Scenario

This scenario tests the impact of allowing seven-axle triple-trailer combinations to operate at 132,000 pounds nationwide. This vehicle is the scenario's configuration with the most cargo space and GVW. Therefore, any freight which could benefit from more space or more weight will divert to the triple-trailer combination.

Figure IV-32. Impacts of Triples Nationwide Scenario on Total Truck VMT

Scenario	Vehicle-Miles-of-Travel (in millions)
Base Case	128,288
Triples Nationwide Scenario	102,400
Percent Change	-20.2%

The analysis shows that substantial amounts of truckload traffic could divert from five-axle tractor-semitrailers to triple-trailer combinations under the liberal payload and access assumptions in this scenario. Five- and six-axle double-trailer combination LTL traffic would also divert as in the LCVs Nationwide Scenario. However, unlike the LCVs Nationwide Scenario, rail intermodal does not experience a substantial loss of traffic. The shift from rail intermodal is limited because each triple-trailer combination can only handle containers up to 28 feet in length and the majority of rail intermodal traffic is transported in containers or trailers 40 feet or longer.

Figure IV-34 outlines assumptions regarding how freight currently traveling in the impacted configurations would likely respond to the wider availability of triple-trailer combinations. Figures IV-35 and IV-36 summarize the resulting truck VMT.

Total heavy commercial truck VMT for the Year 2000 is estimated to decrease 20 percent due to

Figure IV-33. Use of the Intermodal Transportation and Inventory Cost Model to Analyze the H.R. 551 Scenario

Although the Intermodal Transportation and Inventory Cost Model is used to analyze truck-to-truck and rail-to-truck diversion for the majority of the scenarios, it is not used to analyze the H.R. 551 Scenario. This scenario requires a level of precision beyond the current truck data set.

The H.R. 551 Scenario requires data on the population of trailers over 53 feet. This small portion of the population, 1.16 percent of combination vehicle trailers (Truck Inventory and Use Survey, 1992), is not measured in the North American Truck Survey.

Figure IV-34. Likely Truck Configuration Impacts of Triples Nationwide Scenario

Original Truck Configuration		Likely Reaction to the Scenario
Five-axle tractor semitrailer	ö	Change to a triple-trailer combination
Five-axle double-trailer combination	ö	Change to a triple-trailer combination
Six-axle double-trailer combination	ö	Change to a triple-trailer combination
Triple-trailer combination	ö	More payload in a triple-trailer combination

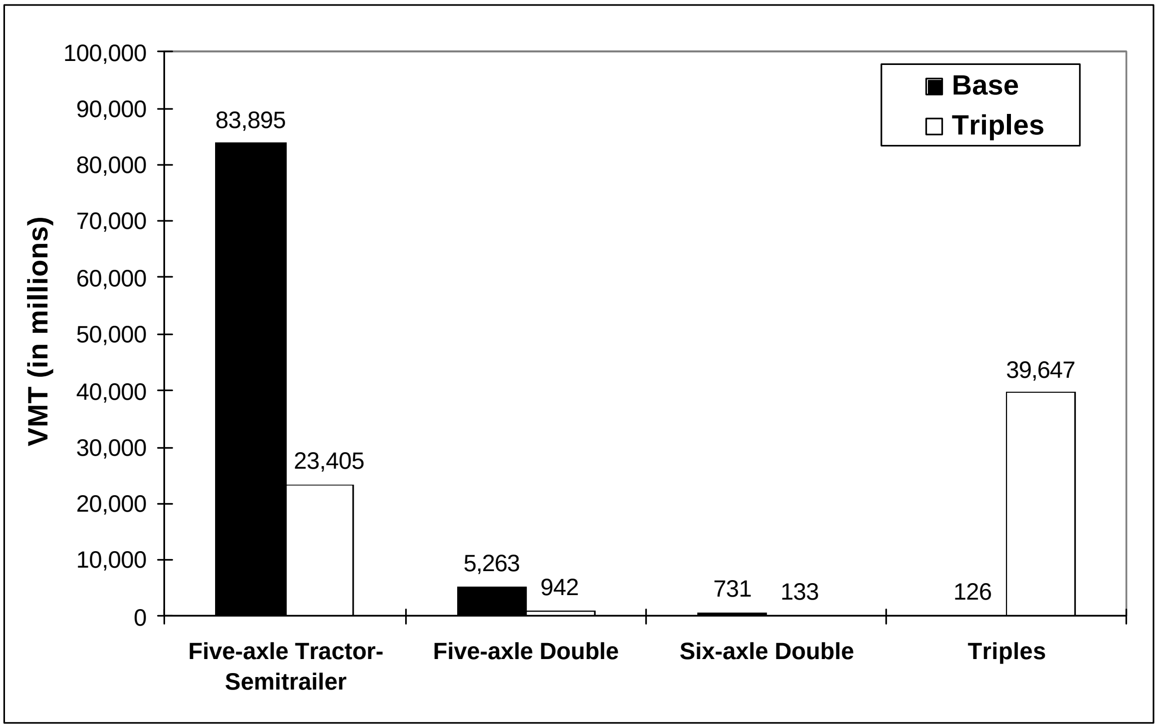
the change in truck operations from the five-axle tractor semitrailer to the triple-trailer combination. The five-axle tractor trailer's VMT decreases 72 percent from 83,895 million miles to 23,405 million miles. Significant traffic also shifts from five- and six-axle doubles to the triples combinations. Total triple-trailer combination VMT increases 31,366 percent from 126 million miles to 39,647 million miles. The following sections discuss the effects of truck-to-truck, rail carload-to-truck and rail intermodal-to-truck diversion.

Truck-to-Truck Diversion

Five-Axle Tractor Semitrailer

Significant freight shipped in five-axle tractor semitrailers is predicted to shift to the seven-axle triple-trailer combination under scenario assumptions. The triple-trailer combination offers both more cargo space and weight. As in the LCV analysis, it is assumed that 15 percent of the current five-axle tractor semitrailers are partially loaded and would not divert to the seven-axle triple-trailer combination. Little truckload freight currently is shipped in triples because other LCV doubles configurations are typically available in States that currently allow triples. Shippers and carriers might have to make significant adaptations to use triples for truckload shipments, but the line haul cost advantage of triples at 132,000 pounds compared to five-axle tractor-semitrailers is significant enough that many shippers and carriers could be expected to make those adaptations. If allowable weights were lower, access less liberal, or other alternative configurations available to haul truckload freight at comparable weights, triples likely would continue to be used primarily for LTL shipments.

Figure IV-35. Impact of Triples Nationwide Scenario on VMT by Different Vehicles



Five-and Six-axle Doubles

These trucks are used primarily for moving LTL shipments and all but 15 percent of this long-haul traffic is predicted to shift to triple-trailer combinations.

Rail Carload-to-Truck Diversion

Freight accounting for 5 percent of rail carload car miles is predicted to divert to triples under this scenario. The shipments which divert to the triple-trailer combination are short moves of such commodities as pulp, paper, and allied products, food and kindred products, lumber and wood products, primary metal industry products, and waste and scrap. Even though the scenario specifies significant increases for truck weights, there is limited diversion of carload freight to trucks.

Rail Intermodal-to-Truck Diversion

Freight accounting for one percent of current rail inter-modal car miles would divert to trucks. This is significantly less than the LCVs Nation-wide Scenario because the triple-trailer combination vehicle comprises short 28-foot trailers. Only TOFC/COFC shipments currently traveling in 28-foot 28-foot trailers or

Figure IV-36. Impacts of Triples Nationwide Scenario on Total Truck VMT

Scenario	Vehicle-Miles-of-Travel (in millions)
Base Case	128,288
Triples Nationwide Scenario	102,400
Percent Change	-20.2%

shorter containers or trailers were tested for diversion to the triple-trailer combination. This may be overly restrictive but without knowing the dimensions of the freight traveling in the longer containers or trailers it is impossible to accurately predict if it could be accommodated by a 28-foot or shorter box and the comparable rail variable cost.