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Report to Congressional Committees

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LONGER COMBINATION TRUCKS

Potential Infrastructure Impacts, Productivity Benefits, and Safety Concerns

GAO

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Economic Development Division

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Congressional Committees

This report on the economic impact of longer combination vehicles (LCVs) is our final report in response to the Intermodal Surface Transportation Efficiency Act of 1991 (P.L. 102-240), which directed us to report on the economic and safety impact of LCVs on shared highways. The act froze LCV routes to those existing on June 1, 1991. As agreed with your Committees' staff, this report discusses the potential costs that might be incurred and benefits that might accrue if the use of LCVs were expanded. It also summarizes the findings of our two previous reports that addressed safety concerns. This report contains matters for congressional consideration.

We are sending copies of this report to the Secretary of Transportation; the Administrators of the Federal Highway Administration and the Federal Railroad Administration; the Director, Office of Management and Budget; and interested congressional committees and subcommittees. We will make copies available to others upon request.

This work was performed under the direction of Kenneth M. Mead, Director, Transportation Issues, who can be reached on (202) 512-2834 if you or your staff have any questions. Major contributors to this report are listed in appendix III.

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Executive Summary

Purpose

At least 14 states and six turnpike authorities permit limited operation of long multiple-trailer trucks known as longer combination vehicles (LCV). LCVs transport cargo at less cost than shorter combination vehicles because fewer drivers and tractors are needed and less fuel is used. Some sectors of the trucking industry would like the Congress to permit a wider use of LCVs. However, concerns have been raised that expanding the use of LCVs would increase highway costs and pose a threat to traffic safety.

The Intermodal Surface Transportation Efficiency Act of 1991 directed GAO to report on the economic and safety impact of LCVs. This report focuses on the economic impacts, including (1) the impacts on infrastructure—pavements, bridges, and interchanges—that might result from expanded LCV operations and (2) the potential benefits from and industry's use of LCVs. This report also summarizes GAO's two previous reports on LCV safety issues in order to comprehensively discuss LCVs in one report.

Background

The most common LCVs are triples (a third 28-foot trailer added to two others), turnpike doubles (a second long trailer added to a 45- or 48-foot single), and Rocky Mountain doubles (a short trailer added behind a long one). LCVs normally operate at gross weights well above the 80,000-pound federal limit allowed on interstate highways primarily in 14 western states that have used "grandfather" exemptions from the 80,000-pound limit. Turnpike authorities in six other states also allow some LCV operations. The 1991 act froze LCV routes to those existing on June 1, 1991.

Results in Brief

While generating benefits in the form of lower transportation costs, LCVs could also generate costs for public authorities who provide and pay for the infrastructure used by the trucking industry. The analyses of the benefits from and costs attributable to LCVs have been somewhat theoretical because of the various assumptions used to analyze available data. LCVs would probably not increase pavement wear, but according to the Federal Highway Administration's (FHWA) analyses, nationwide use of LCVs on the interstate highway system could require additional investments of $2.1 billion to $3.5 billion to replace bridges, improve interchanges, and provide staging areas for the breakdown and assembly of LCVs. Much of the projected infrastructure costs would be incurred in the more densely populated areas of the country. If LCV expansion were limited to carefully selected routes away from major population areas, the cost impact would be limited, but the benefits would also be reduced.

An analysis for the trucking industry projected that nationwide use of LCVs on interstate and some primary highways would reduce annual trucking costs by about 3 percent ($3.4 billion). As annually recurring benefits, these would exceed the one-time infrastructure investment costs estimated by FHWA. However, expansion of the routes open to LCVs would benefit some sectors of the trucking industry more than others. One sector, the large companies that consolidate packages or shipments under 10,000 pounds, could benefit immediately from even a partial expansion of LCV routes. These companies have extensive terminal networks for the collection and distribution of shipments, and they use triple 28-foot trailers for trips between terminals, known as linehauls. The truckload sector, which moves cargo by the trailerload from a shipper's dock to a receiver's dock, might use double 48-foot trailers if a national network of highways were open to them. In the absence of such a network, large truckload companies have not adjusted their mode of operation to accommodate doubles.

Any decision to allow the expanded use of LCVs involves safety concerns as well as economic factors. The limited data available on the safety record of LCVs show that they have not been a safety problem on the western highways and eastern turnpikes where they currently operate. However, GAO's previous reports identified operational characteristics of LCVs that could make them a greater safety risk than single-trailer combinations if allowed on more-congested highways.

Principal Findings

LCVs Could Increase Infrastructure Costs If Allowed Nationwide

Because LCVs spread their higher gross weight over more axles, they generally do not increase pavement wear relative to shorter combinations and may actually be less damaging. However, the higher gross weight of LCVs (especially turnpike doubles) can pose a load capacity problem for some bridges. Because bridges are designed to support much higher loads than expected, there is room for disagreement on the margin of safety deemed necessary for loads on a bridge. At GAO's request, FHWA provided two different estimates of the number of bridges considered inadequate for LCV use and the cost to replace them. The Association of American Railroads, which views turnpike doubles as a threat to rail business, favors using a conservative bridge capacity rating to estimate the potential impact of LCVs. When FHWA used this rating, the analysis projected

replacement costs of over $5 billion for rural interstates and over $13 billion for urban interstates. The second analysis, using a capacity rating considered by FHWA to be closer to that used in most states, projected $248 million for rural interstates and $1.1 billion for urban interstates.

In addition to bridge replacements, nationwide use of LCVs would require improvements to some interchanges as well as the provision of staging areas adjacent to interstate highways where LCVs could be assembled and broken down. The cost depends on how many points of access to the interstate system are deemed necessary for effective LCV operations. In 1985, FHWA estimated these access costs at between $750 million and $2.2 billion. A later study sponsored by the trucking industry questioned whether such extensive access was really needed. It also noted that many of the access problems were in densely populated eastern states and that current states that allow LCVs already provided staging areas or let the private sector provide its own.

Several analyses have projected that LCVs (mainly turnpike doubles) would divert freight from railroads to highways, increasing trucking ton-miles from 5 to 16 percent. Most of these results were derived from a computer simulation model maintained by the Association of American Railroads; however, GAO believes that the model has significant shortcomings. Most importantly, the model makes no allowance for ongoing productivity gains by the railroads, which have been substantial in recent years. These gains have made the railroads more capable of preserving their market share against trucking competition. The model also assumes that the truckload sector will generally convert to using turnpike doubles, which is unlikely if LCV routes are expanded selectively.

Benefits and Industry's Potential Use of LCVs

According to a study done for the trucking industry, opening the interstate system and some primary highways to LCVs would lower annual trucking costs by $3.4 billion (about 3 percent). If the expansion of LCV routes were limited to highways with low traffic density, the potential benefits would be lower and would apply mostly to companies that use triple 28-foot trailers to transport consolidated small shipments between terminals. These less-than-truckload and package companies make extensive use of double 28-foot combinations, which are legal nationwide, and add a third trailer wherever these additions are legal.

On the other hand, companies that sell by the trailerload would have to change their mode of operation to use turnpike doubles. These truckload

companies' drivers often travel from shipper's dock to receiver's dock to another shipper's dock and so on until arriving at home. Such an operation is relatively simple with single-trailer combinations but would be more complex with turnpike doubles. Because turnpike doubles would be limited mainly to interstate highways, companies would have to organize pickup and delivery at a customer's dock by single trailer. In the current fragmented system of LCV routes, truckload companies have not found it practical to organize such operations.

Safety Concerns May Justify Limits on LCV Expansion

GAO has previously reported that LCVs have operational characteristics, such as trailer sway, that make maneuvering in traffic more challenging than for single-trailer vehicles. Although the data on LCV safety are quite limited, available data do not show that LCVs have been a safety problem in the areas of low traffic density where they currently operate. Trucking industry officials agree that to minimize the safety risks, LCVs need well-qualified drivers as well as proper loading and brake adjustment. However, GAO previously reported that most states that allow LCVs do little to monitor their operations, regulate drivers' qualifications, or inspect the vehicles. Considering these factors, any expansion of LCV routes should be subject to careful analysis and accompanied by better state supervision of LCV operations.

Matters for Congressional Consideration

Considering the need for additional infrastructure investment and the uncertainties about the safety of LCVs, GAO believes that if the Congress wishes to allow the expanded use of LCVs, it should authorize the Secretary of Transportation to consider exceptions to the freeze on LCV expansion only if requested by states and accompanied by the following:

- A state analysis of each proposed route to demonstrate its suitability in terms of the density of traffic, condition of bridges, and adequacy of interchanges. States should determine whether additional infrastructure costs would be generated and how these costs would be recovered.
- A certification that the state will enforce qualification standards for LCV drivers, ensure adequate inspection of LCV equipment, and monitor the experience of LCVs to identify any emerging safety problems or negligent carriers.

Agency Comments

GAO provided copies of the draft report to Department of Transportation (DOT) officials, who chose to provide oral comments. GAO met with various

DOT officials, including the Director, Office of Engineering and Highway Operations Research and Development, FHWA, and the Chief, Office of Economic Analysis, Federal Railroad Administration. These officials generally agreed with the report's findings, conclusions, and matters for congressional consideration. They gave GAO editorial and technical suggestions for clarifying and qualifying the report, which have been included in the text where appropriate. FHWA's Administrator has recently stated that FHWA would thoroughly reexamine all commercial vehicle size and weight issues.

Contents

Abbreviations

AAR	Association of American Railroads
AASHTO	American Association of State Highway Transportation Officials
DOT	Department of Transportation
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
GAO	General Accounting Office
ISTEA	Intermodal Surface Transportation Efficiency Act
LCV	longer combination vehicle
LTL	less-than-truckload

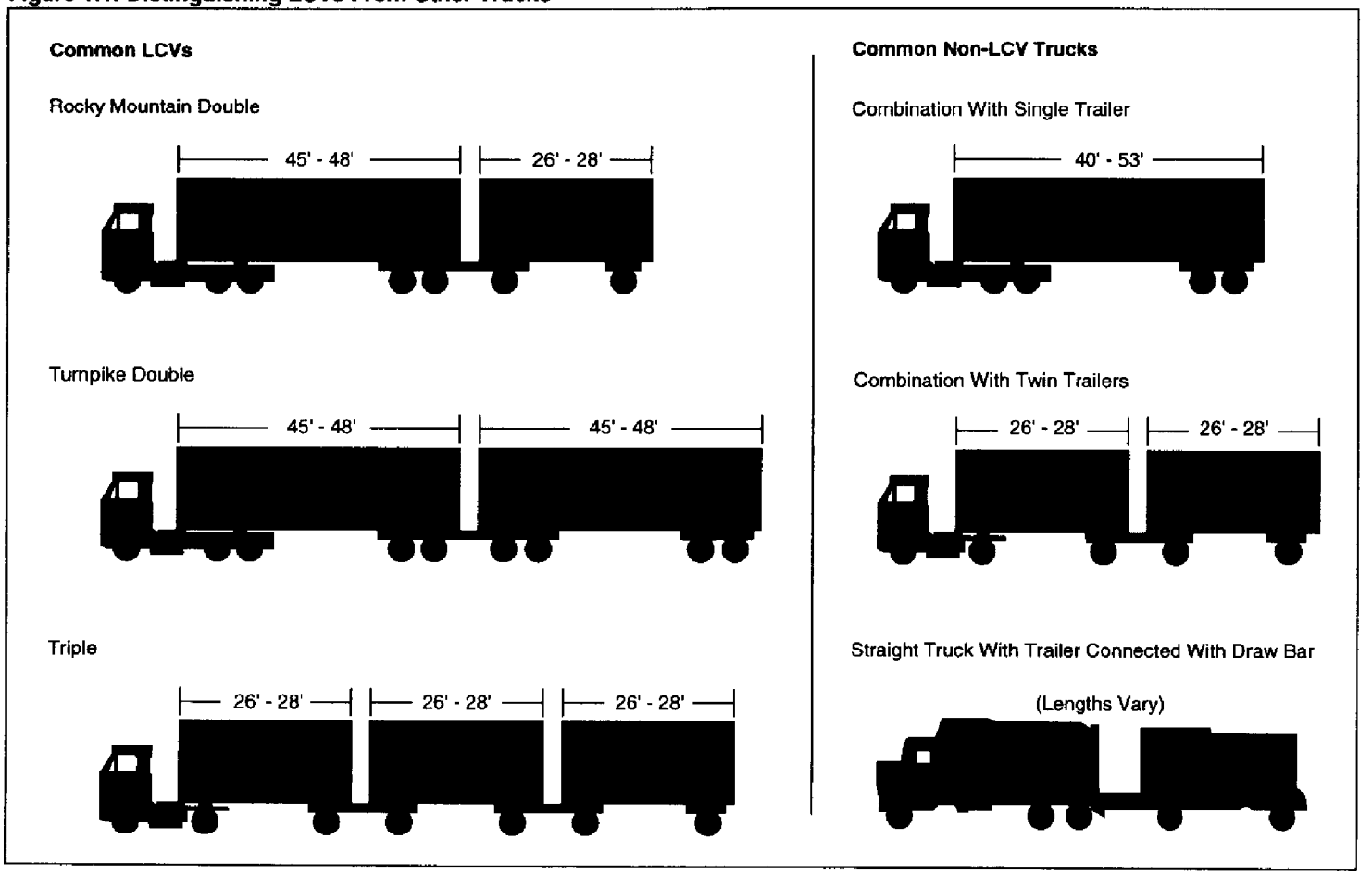
Introduction

Some states allow trucking companies to use long multiple-trailer combinations known as longer combination vehicles (LCVs). LCVs can transport a given amount of cargo at less cost than shorter combinations because fewer tractors and drivers are needed and less fuel is used. Some trucking companies favor the expansion of LCV routes to increase productivity. However, concerns have been raised that expanding LCV use would increase infrastructure costs and pose a threat to traffic safety. We have issued two previous reports on LCV safety issues.[1]

The most common LCVs are triples (a third 28-foot trailer added to two others), turnpike doubles (a second long trailer added to a 45- or 48-foot single), and Rocky Mountain doubles (a short trailer added behind a long one.) Figure 1.1 illustrates these LCVs and distinguishes them from combinations allowed to operate nationwide. Trucking companies, particularly in the West, also use variations of these configurations (particularly different types of trailers) for special transportation needs.

[1]Truck Safety: The Safety of Longer Combination Vehicles Is Unknown (GAO/RCED-92-66, Mar. 11, 1992) and Longer Combination Trucks: Driver Controls and Equipment Inspection Should Be Improved (GAO/RCED-94-21, Nov. 23, 1993).

Figure 1.1: Distinguishing LCVs From Other Trucks



Source: American Trucking Associations and Transportation Research Board.

LCVs Currently Operate in Limited Areas

Since 1974, federal law has limited gross vehicle weight on interstate highways to 80,000 pounds. However, 14 western states have allowed LCVs to operate at heavier gross weights under "grandfather" exemptions from the federal law. In addition, turnpike authorities in six other states allow some LCV operations. LCVs are often restricted to interstate highways, but Oregon allows triples on many state roads, and western states generally allow Rocky Mountain doubles to operate widely. Figure 1.2 shows 14 western states and six turnpike authorities that allow LCVs, and table 1.1 shows the LCV types that are authorized in those states. The Intermodal Surface Transportation Efficiency Act (ISTEA) required the Federal Highway Administration (FHWA) to identify state regulations allowing LCV

operations as of June 1, 1991. FHWA officials said that by using the technical definition of an LCV stated in ISTEA, their final rule will include some additional states allowing LCVs to operate, and would not include Florida because its turnpike is not designated as part of the interstate system.

Figure 1.2: States and Turnpike Authorities Allowing LCVs

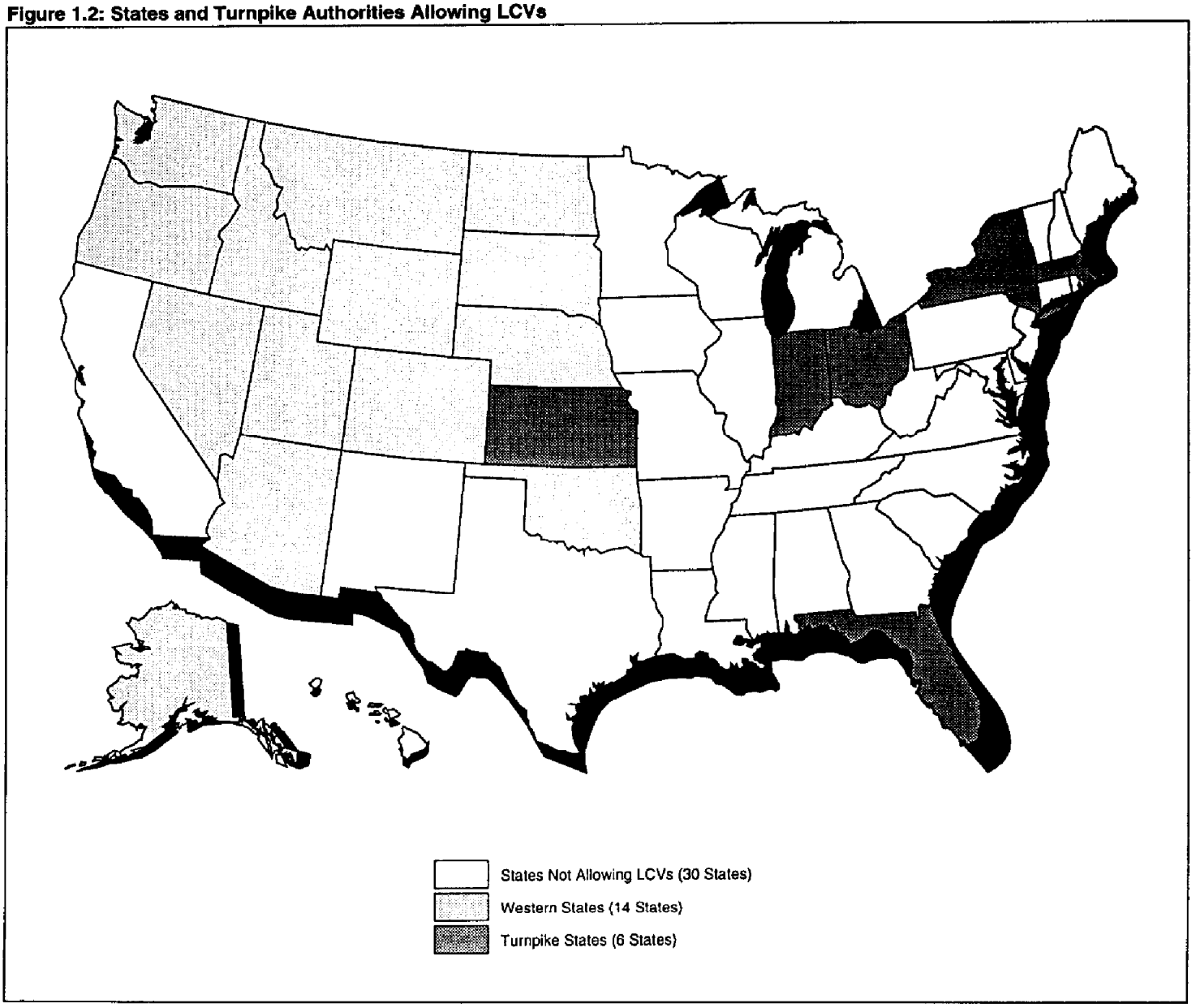


Table 1.1: LCV Configurations Permitted by 14 States and Six State Turnpike Authorities

States	Triples	Turnpike doubles	Rocky Mtn. doubles
Alaska	[a]	1984	1984
Arizona[b]	1976	1976	1976
Colorado	1983	1983	1983
Idaho	1968	1968	1968
Montana	1987	1972	1968
Nebraska[c]	1984	1984	1984
Nevada	1969	1969	1969
North Dakota	1983	1983	1983
Oklahoma	1987	1986	1986
Oregon	1967	[a]	1982
South Dakota	1988	1984	1981
Utah	1975	1974	1974
Washington	[a]	[a]	1983
Wyoming	[a]	[a]	1983
State turnpike authorities			
Florida	[a]	1968	1968
Indiana	1986	1956	1956
Kansas	1960	1960	1960
Massachusetts	[a]	1959	1959
New York	[a]	1959	1959
Ohio	1990	1960	1960

Note: Years shown are years in which the LCV type was first permitted.

[a]Not permitted.

[b]Arizona permits LCVs on one interstate crossing the northwest corner of the state.

[c]Nebraska permits LCVs only with empty trailers.

LCV Expansion Is Currently Frozen by Law

ISTEA froze LCV routes to those existing on June 1, 1991. If the freeze were lifted, states with grandfather rights allowing trucks to exceed the 80,000-pound limit on interstate highways could designate additional LCV routes or allow combinations that they had not previously permitted.[2] States without grandfather rights could not allow any trucks to exceed the 80,000-pound limit unless the Congress authorized new exceptions.

[2]An attorney for FHWA believes that some states may have exceeded their authority to issue permits for LCV operations and that if the freeze were lifted, FHWA might challenge the right of states to allow LCV expansion.

Trucking Industry Characteristics

The use of LCVs varies within the trucking industry, and consequently it is useful to recognize some of the divisions and characteristics within the industry. One major division is between private fleets and companies that offer for-hire trucking. Private fleets serve the needs of their parent companies, such as manufacturers, retailers, etc. They account for about half of intercity trucking tonnage. We found private fleets using both turnpike doubles and Rocky Mountain doubles, and in some situations triples might suit a private fleet's purposes.

Among the companies offering trucking for hire, several distinctions are important. Package companies handle very small shipments, while less-than-truckload (LTL) companies handle a range of larger shipments. The package and LTL companies have similar operations: they collect, sort, consolidate, transport, and distribute shipments through a dense network of terminals organized on the hub-and-spoke principle. These companies have come to prefer 28-foot trailers because of their flexibility in organizing shipments throughout their terminal networks. For example, a double 28-foot combination may leave Chicago with one trailer loaded for the company's terminal in Cleveland and another loaded for its terminal in Harrisburg, Pennsylvania. These companies often use triple 28-foot combinations where they are legal.

Customers shipping full trailerloads over 10,000 pounds to a destination generally employ truckload companies. Much of the truckload business is general freight carried in dry van trailers, but specialized segments include refrigerated vans, intermodal containers, tankers, flatbed trailers, automobile carriers, and household movers. Although truckload companies may have some regular round trips in some corridors, it is not uncommon for their drivers to travel progressively from shipper's dock to receiver's dock to another shipper's dock and so on until eventually arriving back home. This is especially true for large companies carrying general freight and operating nationwide. Truckload companies use 48-foot and 53-foot trailers, and the latter trailer is becoming more and more numerous. The truckload industry includes a host of small companies, many of which serve specialized markets or travel only a few routes. There are also many "owner-operators," who own a truck and may operate under contract to other companies or accept loads from freight brokers. The truckload sector is thus much more diverse than the LTL and package sectors. LCVs most appropriate to general use in the truckload sector would be turnpike doubles, if a national highway network were open to them. In the absence of such a network, some companies in the West have found a variety of uses for Rocky Mountain doubles.

Objectives, Scope, and Methodology

ISTEA directed us to report on the economic and safety impact of LCVs on shared highways. We discussed safety issues in two previous reports. This report focuses on the economic impact of LCVs, including (1) the infrastructure impacts—on pavements, bridges, and interchanges—that might result from expanded LCV operations and (2) the potential use and benefits of LCVs. In order to provide an overall perspective on factors to be considered in permitting LCV operations, chapter 4 summarizes our two previous reports on LCV safety issues.

In reviewing the potential impact of LCVs on the infrastructure, we reviewed existing studies and interviewed officials of FHWA, the Federal Railroad Administration (FRA), the Transportation Research Board, the American Association of State Highway and Transportation Officials (AASHTO), four states that allow LCV operations, and four state turnpike authorities. We discussed bridge studies with consultants, including Dr. Harry Cohen of Cambridge Systematics and Dr. Fred Moses of the University of Pittsburgh. At our request, FHWA analyzed National Bridge Inventory data to estimate potential costs to replace bridges if LCVs were allowed to operate nationwide. The analysis used two alternative load capacity ratings for bridges—the conservative inventory rating and an intermediate rating calculated by FHWA between the inventory rating and the more liberal operating rating. Unfortunately, FHWA did not provide results using the operating rating because it said the states had been too inconsistent in reporting operating ratings to the National Bridge Inventory. To assess potential diversion of freight from rail to highways, we reviewed analyses that had been done and, with the help of our economists, examined the documentation of the Association of American Railroad's (AAR) Intermodal Competition Model, which was used in most of these analyses. We also drew on our previous work on intermodal rail transportation.

Concerning the potential use and benefits of LCVs, we interviewed officials in the rail industry and 22 trucking companies. To get a first-hand impression of the uses and operational characteristics of LCVs, we observed LCV operations in Idaho, Indiana, Ohio, and Utah and rode in a triple on Interstate Route 15 in Utah. We also drew upon our previous work. Appendix II lists the states, organizations, and companies we contacted during this phase of our LCV work. The bibliography lists the studies we reviewed for this report. We conducted our review of economic impacts of LCVs from November 1992 through March 1994 in accordance with generally accepted government auditing standards.

LCVs Could Generate Substantial Infrastructure Costs Unless Their Operations Are Restricted to the Most Suitable Highways

There has been wide disagreement on the magnitude of potential infrastructure costs that could result from nationwide LCV operations. FHWA has made estimates of about $2.2 billion to $3.5 billion, while a study done for the trucking industry made lower estimates and one done for the railroad industry made higher estimates. Analyses of the potential impact of LCVs on the highway infrastructure have assumed that they would operate nationwide on the interstate system and on at least some primary highways. If allowed this broad scope of operations, LCVs could generate substantial infrastructure costs—primarily for bridge replacement, interchange widening, and the provision of staging areas for breaking down and assembling LCVs. Infrastructure costs could also increase if LCVs diverted freight from railroads to highways. Much of the projected cost would be incurred if LCVs were allowed to operate in the more densely populated areas of the country. However, the cost would be significantly reduced if LCV expansion were limited to carefully selected routes away from major population areas.

LCVs Should Not Increase Pavement Wear

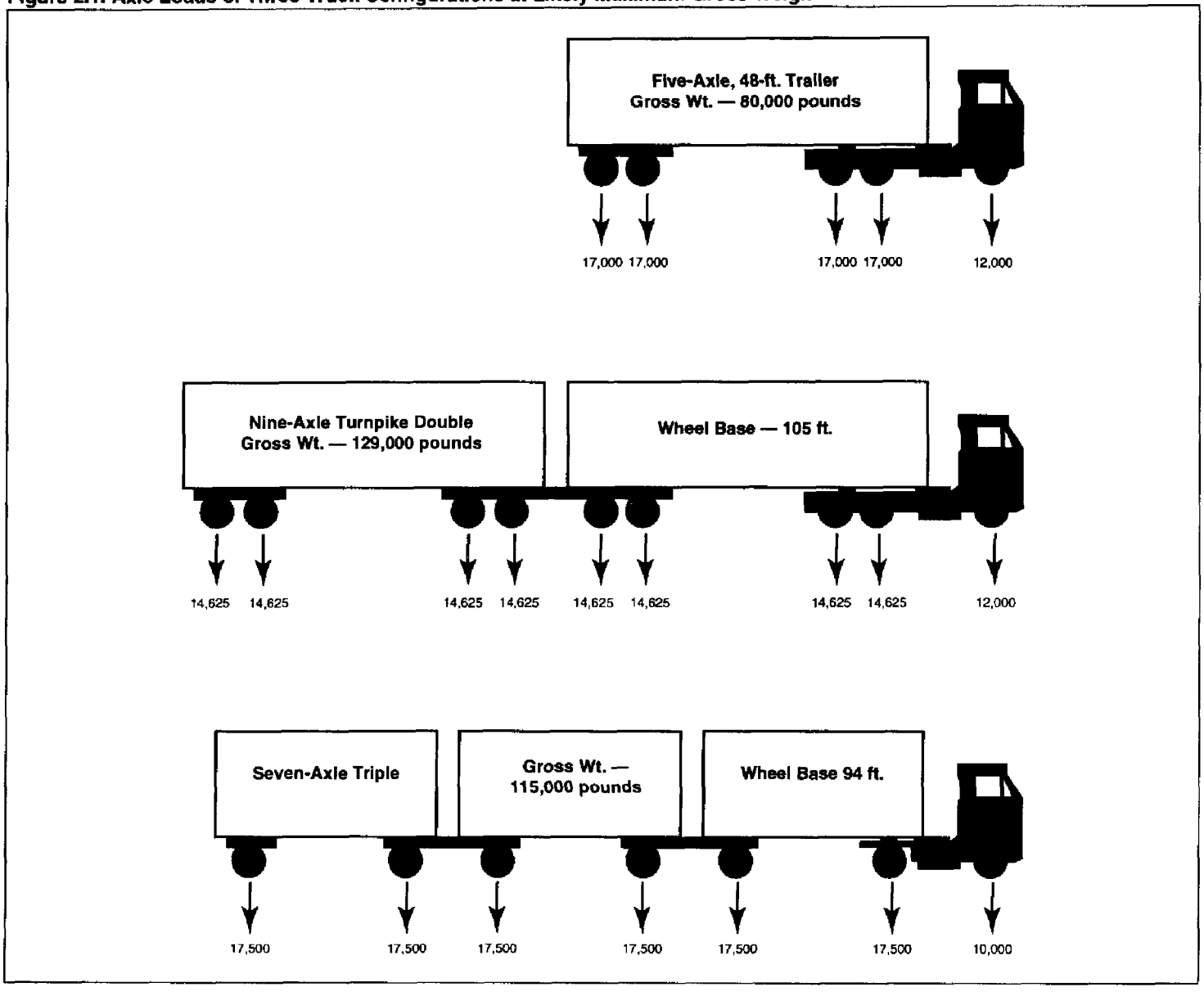
Although LCVs operate at substantially higher gross vehicle weights than truck combinations that are legal nationwide, their impact on pavement (as well as bridges) is mitigated by the length and number of axles over which the weight is spread. Because pavement wear is related primarily to axle loads, LCVs should not increase pavement wear as long as axle load limits are not increased. In fact, LCVs may reduce pavement wear from drive axles because they reduce the number of tractors on the highway. Also, LCVs often operate below axle load limits because of state regulations that limit their overall gross weight.

According to engineering principles of AASHTO, pavement wear (as distinct from environmental damage) results primarily from repeated passes of heavily loaded axles. As axle loads increase, the damage to pavements in the form of rutting and fatigue cracking increases exponentially to the fourth power.[1] The Surface Transportation Assistance Act of 1982 set weight limits on the interstate system at 20,000 pounds on a single axle, 34,000 on a tandem axle, and retained the 80,000-pound gross vehicle weight limit. As illustrated in figure 2.1, a five-axle tractor-trailer weighing 80,000 pounds might weigh 12,000 on the steering axle and 34,000 on each of the two tandem axles.

[1]The calculations differ somewhat for concrete pavements, which are more rigid than asphalt pavements. If the thickness of asphalt pavements is increased, they can hold up better to axle loadings.

It should be noted that both LCVs and conventional trucks often operate at less than maximum axle loads when they are carrying lighter-weight cargo. In addition, LCVs often operate below legal axle loads because states have limited their gross weights. State regulations have often limited turnpike doubles to 129,000 pounds or less, resulting in average loads of less than 30,000 pounds on each of the four tandem axles. (See fig. 2.1.) In 1986, FHWA calculated that turnpike doubles weighing 129,000 pounds would cause 24 percent less pavement damage per thousand cargo tons than single-trailer combinations at 80,000 pounds. Rocky Mountain doubles weighing 111,000 pounds were calculated to cause 3 percent less pavement damage.

Figure 2.1: Axle Loads of Three Truck Configurations at Likely Maximum Gross Weights



Note: In actual practice, axle loads will vary somewhat because of uneven trailer loading.

If heavily loaded, triples could be more damaging than five-axle tractor-trailers because they use single axles rather than tandems under

their shorter trailers. (The same could be said of the double 28-foot trailers that triples would replace, but triples would use 33 percent fewer tractors.) However, the federal bridge formula would limit the triple in figure 2.1 to a gross weight of 115,000 pounds, and several states impose lower limits. At the gross weights shown in figure 2.1, triples would have comparable axle loads to single, 80,000-pound combinations, and turnpike doubles would average lower axle loads.

LCV Expansion Could Generate Additional Bridge Costs

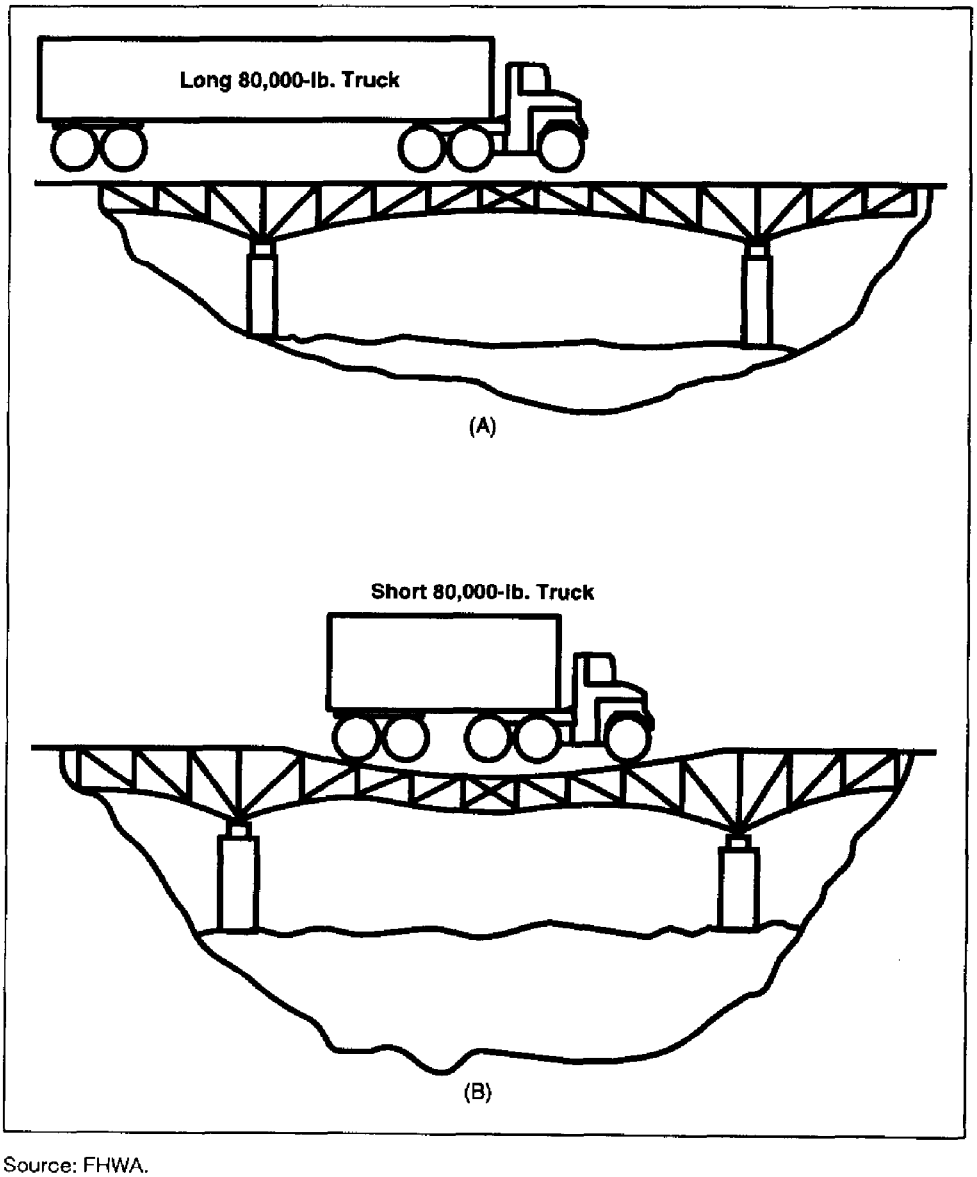
Nationwide use of LCVs could generate additional costs to reconstruct bridges because the gross weights of LCVs may exceed levels considered safe on some bridges. There is substantial disagreement on the amount of these costs because analysts have made different assumptions about the appropriate margin of safety to allow for loads crossing a bridge. The larger the safety margin used, the greater the number of bridges that would be considered inadequate for the heavier gross weights of LCVs.

Heavy loads put stress on the horizontal members of bridge spans, with maximum bending stress occurring at the center of a span. In designing the strength of horizontal members, an engineer must take account of the length of the spans and the amount of load expected to be exerted on each span. The highest anticipated load includes both the dead weight of the bridge itself and the live load of vehicles passing over it. In calculating live load, a factor is included to account for dynamic load increases caused by high speeds, poor suspensions, or the roughness of pavements. Once the highest anticipated load is calculated, a margin of additional strength is designed into the bridge as a contingency. This margin is substantial, reflecting uncertainty about the actual strength of materials in the bridge and about what loads might actually occur on the bridge—illegal overweight trucks, permitted overweight trucks, or simultaneous loading by multiple trucks.

As seen in figure 2.2, a load that is concentrated over a short distance is potentially more damaging than a load spread over a longer distance. For this reason, a vehicle's weight is regulated not only by gross weight and axle load but also by a bridge formula. A bridge formula allows more gross weight as the vehicle's wheel base lengthens. In other words, longer trucks can safely carry more weight over bridges than shorter trucks. This gives LCVs an advantage on short-span bridges, but as span length increases, an LCV's weight is more concentrated relative to the length of the span. Interestingly, bridges with very long spans must be designed to support

such a heavy dead load that the live load of vehicles becomes less of a factor.

Figure 2.2: Heavy Short and Long Trucks on a Bridge Span



Source: FHWA.

State transportation agencies rate bridges to determine what loads they can accommodate with acceptable risk. Some states use the most conservative approach, called the inventory rating. Under the inventory rating, no vehicle should produce a stress in a bridge member greater than 55 percent of yield stress.[2] However, AASHTO's guidelines permit states to use stress levels as high as 75 percent of yield stress (the operating rating) to analyze bridge capacity, and at least 26 states do so.

Several analyses have been done of the National Bridge Inventory, which contains data submitted by the states, to estimate the potential need for bridge replacements if LCVs (or other heavier trucks) were allowed to operate nationwide. We noted only two studies that focused clearly on LCVs to the exclusion of other changes in weight limits. One, sponsored by the AAR, used the conservative inventory rating and estimated that LCVs would place many rural interstate bridges at risk. FHWA did an analysis in 1991 using an intermediate rating equivalent to 65 percent of yield stress and found a much lower impact from LCVs. We asked FHWA to update its analysis with recent bridge data and also to generate comparative results using both the inventory and operating ratings. Unfortunately, FHWA could not use the operating ratings in the database because states had not reported them consistently.

Key results of FHWA's analysis for turnpike doubles and triples combined are shown in table 2.1. The table shows in the middle column the replacement costs for bridges with inadequate capacity ratings for currently legal trucks. Using FHWA's intermediate rating, the estimated cost to replace those bridges is $428 million for rural interstates and $2.1 billion for urban interstates. The additional cost to replace bridges rated inadequate for LCVs, shown in the right column, is estimated at $248 million for rural interstates and $1.1 billion for urban interstates. If the inventory rating is used, as in the study sponsored by AAR, bridge replacement costs attributable to LCVs are estimated at over $5 billion for rural interstates and over $13 billion for urban interstates.

[2]Yield stress is the load level at which a bridge component would yield and become deformed.

Table 2.1: How Bridge Cost Estimates Vary With Different Ratings

Dollars in millions

Bridge rating criteria[a]	Bridge replacement costs for current trucks[b]	Additional costs for turnpike doubles and triples[b]
Intermediate rating		
Rural interstates	$ 428	$ 248
Urban interstates	2,125	1,078
Total	**2,553**	**1,326**
Inventory rating		
Rural interstates	819	5,095
Urban interstates	3,444	13,234
Total	**4,263**	**18,324**

[a]The inventory rating is 55 percent of yield stress, the intermediate rating is approximately 65 percent, and the operating rating (not used in the analysis) is 75 percent. AAR has sponsored a study using the inventory rating to project the impact of LCVs on bridges. The majority of states use the operating rating to post bridges, and FHWA calculated this intermediate rating to make what it considered a reasonable estimate of potential bridge replacement costs.

[b]Bridge replacement costs were calculated from the unit costs furnished by the states in 1993. FHWA's results are for a turnpike double weighing 129,000 pounds and a triple weighing 115,000.

Source: FHWA analysis of National Bridge Inventory for GAO (1993).

The experts we consulted considered it reasonable to use the operating rating or FHWA's intermediate capacity rating in estimating bridge replacement costs. If the operating rating had been used in the analysis, projected costs would have been somewhat lower than those resulting from FHWA's intermediate rating. According to a survey done for the Transportation Research Board in 1989, 26 of 46 states responding used the operating rating to determine legal load limits for bridges, 8 states use the inventory rating, and 12 use an intermediate rating. It is thus reasonable to conclude that LCVs would not require bridge replacement costs any higher than those estimated by FHWA when it used its intermediate rating.

Since states differ in their choice of ratings to use in establishing legal load limits for bridges, it could be expected that some states would not consider any of their bridges to be at risk from LCV operations. The turnpike and state officials we interviewed did not believe that LCV operations had adversely affected any of their bridges.

According to FHWA, there were 54,161 bridges in the interstate system in 1992. On the basis of state inspection reports, 3,697 were considered structurally deficient, and 10,028 were considered functionally obsolete. State estimates of the backlog of work needed on all interstate bridges in 1992 totaled $22.7 billion. Combining FHWA's estimated replacement costs in table 2.1 for rural and urban interstates, the impact of LCVs would total about $1.33 billion, involving 680 bridges.[3] An FHWA official did not believe these bridges were among the deficient and obsolete bridges identified through the state inspections. It can be seen in table 2.1 that confining LCVs to rural interstates would significantly moderate their cost impact on bridges. The impact could be further reduced by allowing LCVs only on highways where all or most bridges are capable of accommodating them with an acceptable safety margin.[4]

Interchange Reconstruction and Staging Areas Could Be Costly if Extensive Access to the Interstate System Is Desired

The longer LCVs have difficulty negotiating some interchange ramps and also need staging areas where they can be assembled or broken down for delivery as shorter combinations. Modifying interchanges and building staging areas to provide LCVs regular access to and from the interstate system could be a costly undertaking, depending on the number of access points deemed necessary. Options exist for lowering these infrastructure costs, such as restricting LCV access points to those most needed and allowing the trucking industry to provide its own staging areas, as some western states have done.

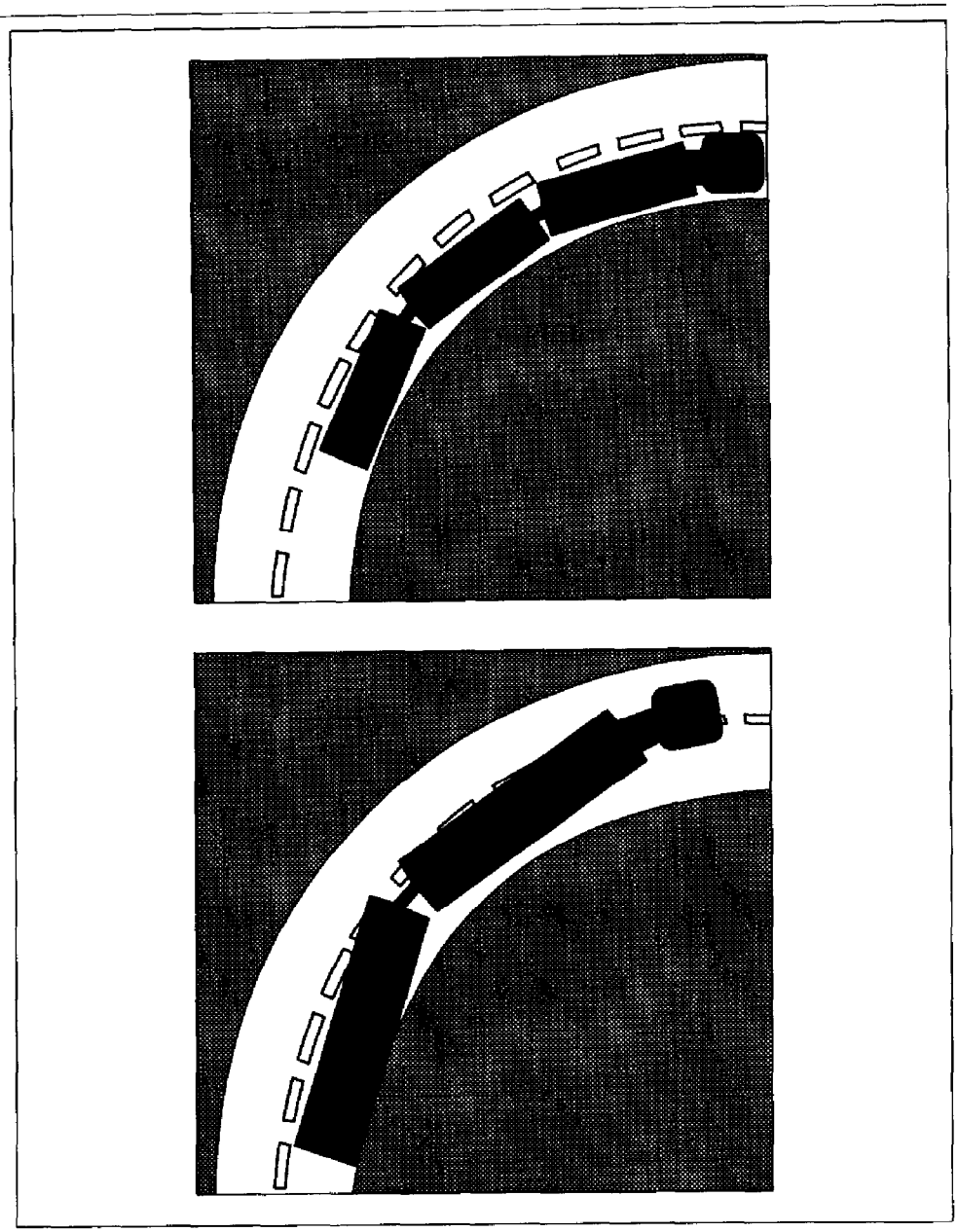
Because of their length, some LCVs off-track, or "cut corners," more than single combinations. This restricts their ability to negotiate intersections and is a reason for confining LCVs to interstate or other major highways. Because of off-tracking, the longer LCVs also have difficulty with some interchange ramps. Turnpike doubles have the most problems with off-tracking. Triples, with their short trailers, can maneuver better around curves than turnpike or Rocky Mountain doubles (or even 48- and 53-foot single trailers) and can thus negotiate many interchanges without causing damage. Figure 2.3 illustrates the difficulty that a turnpike double has with cloverleaf interchanges and the better tracking of a triple. According to a survey done by AASHTO in 1985, state highway officials estimated that as

[3]An FHWA official pointed out that replacing bridges to accommodate LCVs would also generate substantial costs to the public in the form of delays, increased fuel usage, and pollution during reconstruction. FHWA is sponsoring a study to develop a method for estimating such costs.

[4]FHWA cautioned that its analysis was intended to provide a reasonable estimate of potential bridge cost impacts of national LCV use, not to pinpoint bridges needing replacement. States must individually inspect and evaluate bridges to determine the loads they are capable of supporting on a regular basis.

many as 75 percent of the interchanges on the interstate system were inadequate for turnpike doubles, 66 percent were inadequate for Rocky Mountain doubles, and 57 percent were inadequate for triples. It should be noted that respondents considered half the current interchanges to be inadequate for 48-foot trailers as well. According to a study for the Trucking Research Institute, many of these access problems are in densely populated areas of the eastern United States.

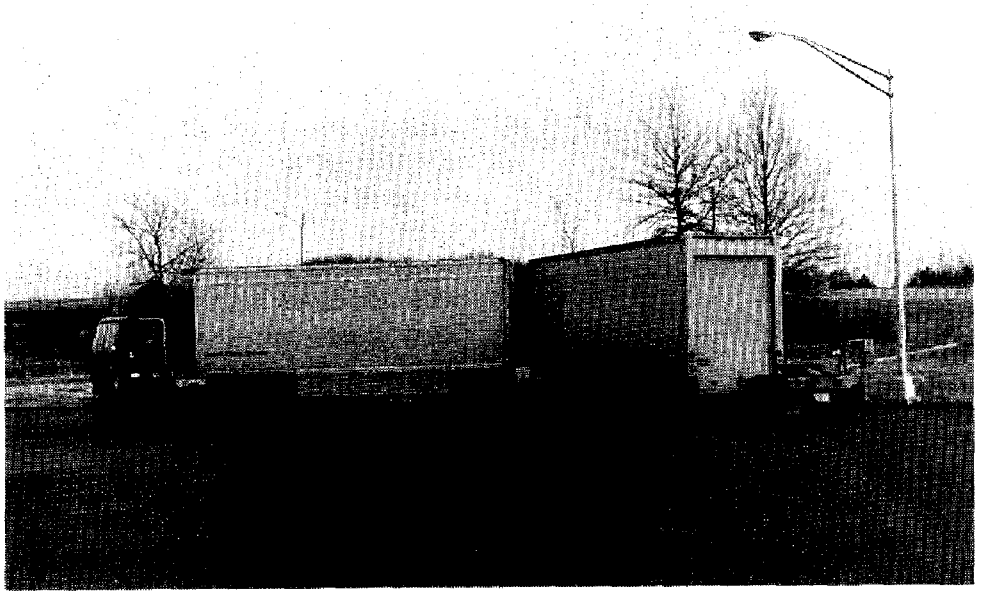
Figure 2.3: Triple and Turnpike Double on Cloverleaf Interchange



Staging areas, either on or off the interstates, would be needed for LCVs, depending on the access they are allowed to other primary highways. A staging area is simply a parking lot where LCVs can be broken down or assembled, so that pickup and delivery to customers can be done with

shorter combinations. Figure 2.4 shows triples at staging areas on the Ohio Turnpike. Triples operation could be expanded with few new staging areas. LTL and package delivery companies often stage triples at their own terminals, which are usually located near interchanges outside metropolitan areas. LTL terminals serve as collection and distribution points for small shipments, and triples can be used for linehauls between terminals in the same way that double 28-foot trailers are used. Truckload companies, however, would need staging areas to assemble and break down turnpike doubles. Truckload companies do not organize their trips with terminals but rather travel from customer dock to customer dock. They would have to bring loads by single trailer to a staging area, combine them into a turnpike double, and then deliver them by single trailer at the end of the linehaul.

Figure 2.4: Assembly of Triples at an Ohio Turnpike Staging Area



In 1985, FHWA estimated the nationwide cost of improving interchange ramps and building staging areas for LCVs at between $750 million and $2.2 billion, depending on the number of access points to the interstate system deemed necessary. FHWA's estimate was not based on a site-specific analysis but, rather, estimated the number of access points needed by assuming regular spacing in rural areas and relating the number of urban access points to the size of urban areas. A 1990 study for the Trucking Research Institute pointed out that a number of western states and several eastern turnpikes were already accommodating LCVs with either public or private staging areas. This study concluded that the practical demand for staging areas and access points would actually be much less than assumed in FHWA's analysis and that staging areas could be built by the trucking industry itself.

As is the case with bridges, the cost impact of staging areas and interchange improvements is related to the types of LCVs that are allowed and the extent of the highway network open to them. Cost would be greatest in heavily populated areas. Restricting LCVs to those routes most suitable for their operation, such as rural interstates mainly west of the Mississippi River, would significantly reduce both the costs and benefits projected from LCVs' use nationwide.

State and Turnpike Officials Do Not View LCVs as Costly to Infrastructure

We discussed infrastructure impacts with officials of four states and four state turnpike authorities that allow LCVs. Most had not done actual studies of impact and could not cite any evidence that LCV operations had increased pavement damage. Nevada, however, had observed that LCVs were averaging higher axle loads in the state than conventional tractor-trailers and, consequently, were assumed to be causing more pavement damage. Some state officials believe LCVs have beneficial effects on the highways because they reduce the number of truck tractors needed. The Oregon Department of Transportation estimated in 1992 that if triples were banned in a state referendum, the resulting increase in trucks on state highways would generate $2.5 million annually in additional pavement costs.

None of the officials contacted cited any examples of bridge damage from LCV operations. Idaho had done specific analyses of the bridges on its LCV network and concluded that all were capable of safely accommodating vehicles up to at least 129,000 pounds. With regard to staging areas, the turnpike authorities had provided them, while the western states had generally left this to the trucking interests.

Potential Diversion of Freight From Rail to Highway Does Not Appear Significant

If LCVs diverted freight from rail to highway, pavement wear could increase, resulting in additional infrastructure costs. We identified five estimates of diversion, four of which were based on a computer simulation model of rail-truck competition maintained by the AAR. We have reservations about the usefulness of the model, which are discussed in appendix I. There are also reasons to believe that turnpike doubles, viewed as the principal source of diversion, will not be as widely used as assumed. Considering this, the substantial recent improvements in railroads' productivity, and the trend of intermodal cooperation between railroads and truckload companies, it is unlikely that selective expansion of LCV routes would have a significant impact on rail traffic.

The existing estimates of rail diversion used differing assumptions about such variables as the amount of cargo weight that turnpike doubles would carry and the extent of the highway network they would be allowed to use. As seen in table 2.2, the various analyses have projected that LCVs would divert from 4 to 11 percent of rail ton-miles of cargo, increasing trucking ton-miles from 5 to 16 percent.

Table 2.2: Analyses Projecting That LCVs Would Divert Freight From Railroads, Increasing Use of Highways

Source of study	Type of LCV	Waybill sample used[a] (year)	Rail ton-miles diverted (percent)	Increased trucking ton-miles (percent)
Association of American Railroads	Turnpike doubles	1988	11	16
Association of American Railroads	Turnpike doubles	1990	10	14
Department of Transportation	All LCVs	1981	9	12
Transportation Research Board	Turner Trucks[b]	1987	4	6
Trucking Research Institute[c]	Turnpike doubles	1987	4	5

Note: Some differences occur because of rounding.

[a]The waybill sample is a sample of rail shipments reported to the Interstate Commerce Commission.

[b]The Transportation Research Board published in 1990 a study of the "Turner Trucks," hypothetical intermediate single and double combinations with extra axles to allow additional weight to be carried.

[c]The Trucking Research Institute is an affiliate of the American Trucking Associations Foundation.

AAR views turnpike doubles, which would be used by truckload companies, as the principal LCV threat to rail traffic. However, as explained in more detail in chapter 3, the truckload companies would have to significantly change their mode of operation to use turnpike doubles. None of the large truckload companies we contacted were currently using turnpike doubles in the absence of a national network open to them, except for one company that reported occasional use. Instead, such companies have increasingly turned to 53-foot trailers and intermodal rail service to improve productivity. If LCV route expansion occurred piecemeal, in only certain areas of the country, there would be few opportunities to use turnpike doubles as an alternative to rail traffic.

On the other hand, LTL and package companies could expand their use of triples even with selective additions to the LCV network. These companies do not compete directly with railroads, but they do use intermodal rail service for some longer trips as well as for seasonal surges in traffic and for managing unbalanced markets. If triples could be used on a wider basis, some of these intermodal shipments might return to the highway. However, the LTL companies account for a very small percentage of intermodal rail business, so they would have little impact on rail ton-miles. The dominant package carrier that has been a major intermodal customer for many years told us that it has no intention of changing its basic intermodal strategy. Company officials said they would use triples to complement rather than replace their intermodal service.

The estimates based on AAR's model are susceptible to the limitations of the model, which are discussed in detail in appendix I. The fundamental problem with these analyses is that they used data from past years and assumed that turnpike doubles were introduced to compete for rail traffic while railroad productivity remained the same. In recent years, however, railroads have won labor concessions that have significantly reduced their costs. They have improved their technology and service, and truckload companies have increasingly sought to reduce their costs by using intermodal rail service for longer hauls.

The president of AAR has pointed out that railroads have had the most gains in productivity in the past 5 years of any of the 176 industries tracked by the Bureau of Labor Statistics. Intermodal shipments increased 134 percent and carload ton-miles 22 percent from 1980 to 1993, despite the transition of the truckload industry to 48-foot and increasingly to 53-foot trailers. It is possible that railroads would have captured more market share had the longer trailers not been allowed. However,

considering the improving competitive position of the railroads and the obstacles to general use of turnpike doubles, it does not appear that selective expansion of LCV routes would significantly affect rail traffic.

LCV Route Expansion Would Have Varying Impacts on the Trucking Industry and Its Customers

Expansion of the routes open to LCVs would benefit some sectors of the trucking industry more than others. LTL and package companies could derive an immediate benefit from even a partial expansion of routes. Officials of large truckload companies, however, see little opportunity in using turnpike doubles in the absence of a nationwide highway network open to them. Even with such a network, it is questionable whether turnpike doubles would be widely used in the truckload industry. Small companies and owner-operators would have particular difficulty in managing the logistics of operating doubles. In some situations, however, small truckload companies and private fleets have used turnpike doubles or Rocky Mountain doubles profitably, and selective expansion of LCV routes would probably create some new opportunities.

LTL Companies Could Immediately Benefit From LCV Expansion

As discussed in our previous reports on LCVs, triples are used primarily by large national and regional LTL and package companies. On the Ohio Turnpike, for example, four of these companies accounted for 82 percent of the tractor permits issued for operating triples. Such companies use hub-and-spoke terminal systems to gather and distribute the small freight shipments they specialize in, and they have found the 28-foot trailer to be the most useful container for organizing shipments between terminals. They routinely use twin 28-foot combinations for this purpose and can easily add a third trailer wherever these are permitted. LTL company officials told us that they could benefit from even a piecemeal expansion of LCV routes.

According to a study done for the Trucking Research Institute,[1] LTL and package companies would be the principal beneficiaries of any expansion of LCV routes. However, because a majority of the expenses of these companies involves collecting, consolidating, sorting, and distributing functions, the savings derived from using triples between terminals are small compared with total revenues. The authors of the study estimated that triples would reduce LTL and package company costs by $1.1 billion in 1988 dollars if used on interstates and some primary highways. This would represent just over 4 percent of the $26.6 billion in LTL and package company domestic revenues reported in 1988. The following are two examples of how LTL and package companies told us they benefit from using triples:

[1]SYDEC, Inc., and Jack Faucett Associates. Productivity and Consumer Benefits of Longer Combination Vehicles. Final Report Submitted to the Trucking Research Institute. Arlington, Va.: May 14, 1990.

- Company A, a nationwide LTL company, operates triples about 15 million miles a year in 14 states. This results in a 7.5-million-mile reduction in vehicle miles traveled and a fuel saving of 900,000 gallons. The company estimated its current savings from triples at $12 million a year, or about 0.5 percent of its $2.2 billion in 1992 revenues.
- Company B said its triples have average axle loads that are more than 4,000 pounds below the legal limits and use 27 percent less fuel than other combinations for the same amount of cargo. The company estimated its savings from triples at $30 million a year and believed this would reach $100 million if triples were legal nationwide. Had the $100 million been saved in 1992, it would have represented 0.8 percent of the company's $12.6 billion in revenues.

These current and projected savings from triples operation are thus not a large percentage of the industry's revenues. From the perspective of an individual company, however, the savings could be important if they helped improve profitability. The LTL industry has experienced considerable pressure on its profit margins in recent years and would welcome an opportunity to make wider use of triples.

Wide Use of Turnpike Doubles Appears Unlikely

Certain characteristics of the truckload industry favor the use of single tractor-trailer combinations because of their flexibility. Large truckload companies have made little use of turnpike doubles in the absence of a national network of highways open to them. A number of truckload companies have sought productivity improvements from using longer trailers and from intermodal cooperation with railroads. It seems unlikely that LCV route expansion, if done selectively by states, would result in significant growth in the use of turnpike doubles. Some new routes might present opportunities for successful use of turnpike doubles, and some additional uses might be found for Rocky Mountain doubles.

Large Truckload Companies Do Not Currently Use Turnpike Doubles

Truckload companies generally sell their service by the trailerload, quoting a price per mile from the shipper's dock to the consignee's dock. While truckload companies may have some regular round-trip business on major routes, often their drivers progress around the country picking up and delivering a sequence of loads before returning home. This is done in order to minimize the miles traveled empty. Truckload freight is often time-sensitive, especially as manufacturers and distributors have increasingly emphasized just-in-time deliveries to reduce inventories. These factors would make it somewhat difficult to effectively use turnpike

doubles, which would require truckload companies to restructure their operations into major linehaul routes with feeder runs by single-trailer combinations.

In some situations, truckload companies have found profitable uses for double or even triple combinations. However, none of the large companies we contacted were using turnpike doubles in the current situation (one company mentioned occasional use). Some pointed out that without a national network of highways open to turnpike doubles, it is not practical to realign operations in order to use doubles.[2] They also noted that under pressure from customers, many companies are transitioning to 53-foot trailers. Even if the interstate system were open to turnpike doubles, the following questions would remain about their use:

- Would customers accept a return to 48-foot trailers?
- Would enough interchanges accommodate turnpike doubles to give them sufficient access to markets?
- How long would a linehaul have to be to generate enough savings to compensate for the cost of managing extra drivers and tractors in feeder service?
- Would turnpike doubles be able to compete in long hauls with intermodal rail service?
- How often could loads be combined—from a single customer or two customers—and still meet expectations of timely delivery?

Several company officials pointed out that competition and customer demands drive the service they offer. If a competitor began successfully using turnpike doubles in a particular corridor, other truckload companies would be forced to use them as well. This type of competitive pressure is currently causing many truckload companies to offer intermodal rail service as a way to reduce costs and to reduce drivers' long absences from home. With the current fragmented network of highways open to turnpike doubles and the improbability of a federally mandated national LCV network, it appears that truckload companies are seeking other ways to improve productivity. An official of the Interstate Truckload Carriers Conference said that while widespread use of turnpike doubles was unlikely, some corridors might be suitable for their use and would contribute to national productivity.

[2]The study done for the Transportation Research Board of the hypothetical Turner Truck, an intermediate double with extra axles for additional weight, reported skepticism from truckload carriers similar to the logistical concerns we heard.

Some Smaller Companies and Private Fleets Find LCVs Useful

In the western states, there are numerous examples of small trucking companies that use Rocky Mountain doubles or some type of long double configuration to haul minerals, gravel, bulk liquids, asphalt, or similar products on regular routes. Oregon, for example, has permitted 1,200 different companies to use Rocky Mountain doubles. Figures 3.1 and 3.2 show LCV configuations used for special hauling purposes in Idaho. Small companies may find specific situations where the regularity of round trips and relatively short hauls makes it practical and profitable to use some form of LCV. However, for wide area operation, the logistical problems that would confront large truckload companies in managing doubles, such as organizing pickup and delivery with staging areas, would be even more difficult for smaller companies. Similarly, the Owner-Operator Independent Drivers Association views turnpike doubles as a threat to its members and opposes lifting the freeze on LCV routes.

Figure 3.1: Dry Bulk Trailers in Idaho Configured as Rocky Mountain Double

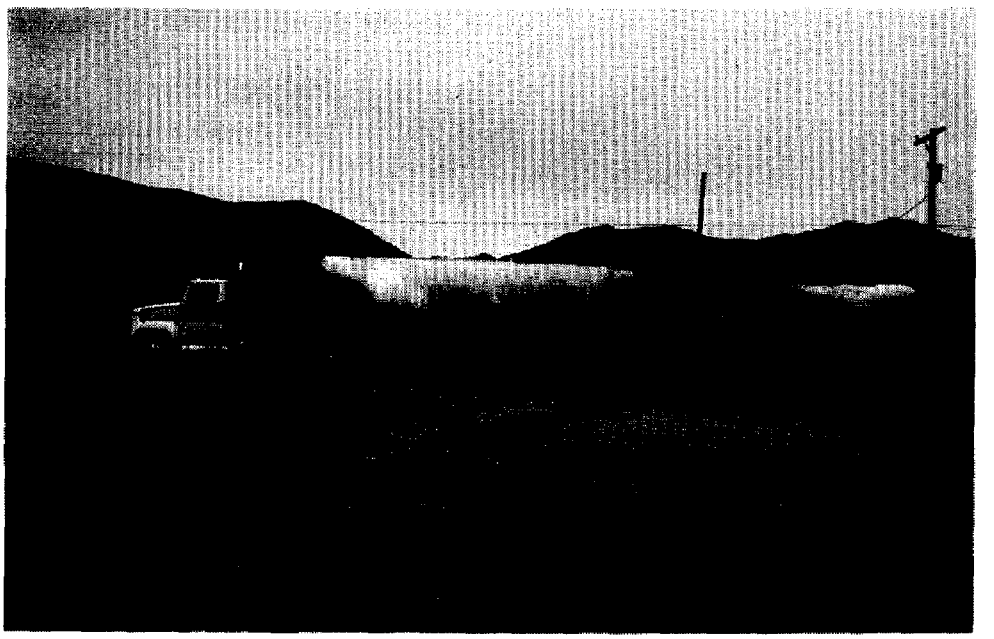
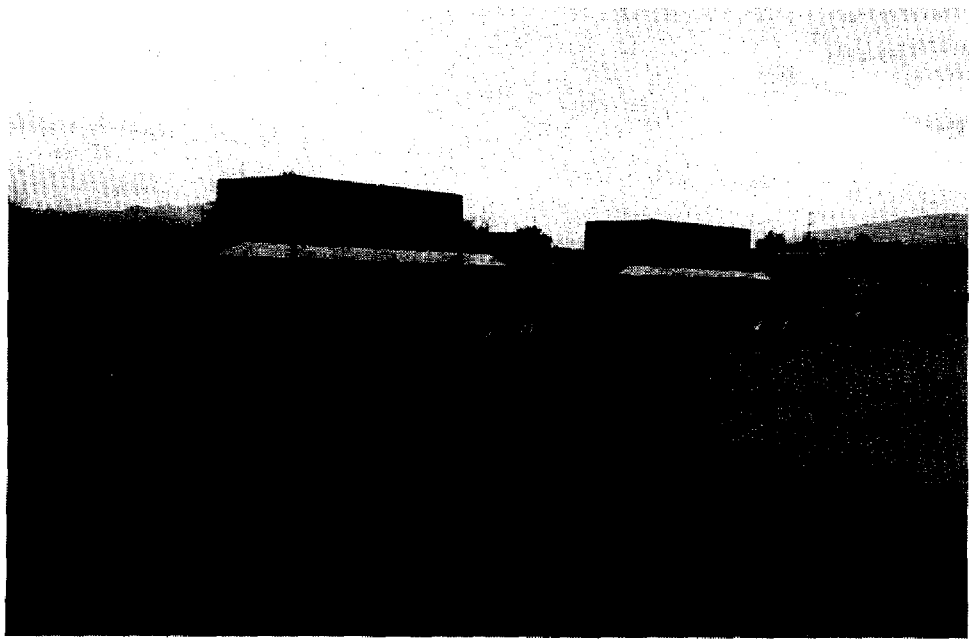


Figure 3.2: Turnpike Double Configuration Used by Paving Company in Idaho



As mentioned in chapter 1, private fleets are maintained by many companies to serve their own transportation needs. They are likely to have regular routes, and it is not uncommon for their trucks to return empty from trips. For these reasons, some private fleets find it worthwhile to use LCVs where they are legal. We discussed private fleet operations with two grocery distribution companies, a snack food company, and a company that supplies paving materials. One of the grocery distributors was using both turnpike and Rocky Mountain doubles to deliver to stores in rural areas in the West. Company officials believe their costs would increase 25 percent if they could not use LCVs. The snack food company was operating on the Kansas Turnpike, and its light-weight cargo filled trailers long before reaching their maximum weight. Officials said the extra cargo space provided by turnpike doubles generated considerable cost savings. Figures 3.3 and 3.4 show LCVs used in private fleets.

Figure 3.3: Turnpike Double Used by Private Fleet on Ohio Turnpike

Figure 3.4: Rocky Mountain Double Used by Private Fleet in Utah

Wider Use of LCVs Would Likely Result in Lower Freight Charges, but the Overall Effect Would Be Small

Even if LCVs were allowed nationwide, their potential use would not have a large impact on overall trucking costs. Whether the savings achieved would result in lower freight charges and eventual benefits to consumers would depend on the intensity of competition between trucking companies. Recent experience in the trucking industry suggests that much of the cost savings would be passed through, probably in the form of discounts.

A 1990 study for the Trucking Research Institute estimated that opening the interstate system and some primary highways to LCVs would lower the nation's annual trucking costs by $3.4 billion, or 2.8 percent, by 1995. This included $716 million in savings from turnpike doubles, an estimate that seems optimistic, considering the problems the truckload industry would face in using them. While it may seem surprising that LCVs would not have a greater impact on overall trucking costs, it should be recognized that these longer vehicles would be used essentially for linehauls on interstate highways. For shipments that involve substantial mileage on other highways with single trailers, the use of LCVs for the linehaul portion of the trip may not reduce total costs very much.

Whether the customers of trucking companies would benefit from LCV expansion would depend on the extent to which competition forces companies to pass along the productivity savings. There is evidence that competition has restrained rate increases since the partial deregulation of trucking in 1980. From 1980 through 1992, revenue per ton-mile increased only 24 percent in the LTL sector and only 5 percent in the truckload sector. In the same period, consumer prices increased 70 percent and producer prices 40 percent. Thus, trucking industry prices lagged behind the general rate of inflation.

One truckload company executive pointed out that deregulation led initially to overcapacity in the truckload industry, while the current decade may see more balance between capacity and demand. If that occurs, truckload companies may not be forced to pass along all the cost savings but might instead be able to improve their rates of return. The LTL industry, on the other hand, has continued to experience price discounting from intense competition. It is reasonable to expect that this competition would force LTL companies to pass along to customers a substantial portion of the cost savings from the use of triples, although the impact on total transportation costs would be small.

Safety Concerns May Justify Limits on LCV Expansion

Current LCV use is confined primarily to areas of low traffic density in the West and certain toll roads in six eastern and midwestern states. Because of certain operational characteristics, LCVs could pose greater safety risks than single-trailer trucks if their use were expanded to more heavily traveled highways. These characteristics make it important that drivers be well trained and that trucks be properly maintained and loaded. Our two previous reports on LCVs noted that little meaningful data are available to determine LCVs' safety or to monitor their operations. We suggested that safety could be enhanced by adopting standards for drivers' qualifications and by assuring that LCVs, especially doubles, receive an adequate number of roadside inspections.

Some Operational Characteristics of LCVs Increase Their Safety Risk

LCVs have operating characteristics that can reduce their stability and maneuverability compared with those of single-trailer combinations. Stability is more of a concern for triples than for doubles, but heavier doubles can present problems when merging into traffic because of their slow acceleration and can also be very slow-moving on grades.

Triples operating at highway speeds tend to exhibit trailer sway—a side-to-side movement of their multiple, relatively short trailers. This can be caused by a driver's sudden steering movements, poor maintenance of the converter dollies that connect trailers, rutted highways, or wind gusts. Rearward amplification of trailer sway—often called the "crack the whip" effect—is usually initiated when drivers make sudden steering movements to avoid obstacles and is also more pronounced for triples. The converter dollies used in the United States have a single connection point with the trailer ahead, which allows greater trailer sway and rearward amplification than the dollies with two connection points used in Canada. Turnpike doubles, with their longer wheelbase trailers and fewer connecting joints, are more stable than triples, but these heavier LCVs are slower to accelerate and move with traffic. Unless tractor power is significantly increased, speed differentials can present a hazard in traffic, especially on grades.

There has been some disagreement about LCVs' stability during braking and the distance required to stop. Under controlled test conditions with experienced drivers, recommended equipment, properly adjusted brakes, and properly distributed loads, LCVs have been shown to stop in fairly short distances—comparable to single-trailer trucks. Part of their recommended equipment is a device that allows brakes on the rear trailer to be applied first, thus "stretching" the vehicles to facilitate a straight

stop. Under less-than-ideal conditions, however, LCV braking can be less effective. Out-of-adjustment brakes, the most commonly found defect in roadside inspections, would be more serious for LCVs because of the greater number of brakes that must be properly adjusted and must work in proper sequence. Also, if the last trailer is empty or lightly loaded, chances are greater that the trailer's brakes will lock and cause it to swing out to the side.

Data on LCV Safety Are Limited but Have Not Shown a Problem on Currently Authorized Routes

Many traffic databases fail to identify LCV configurations, making it difficult to determine their safety record. The limited data available from a few states and several large companies indicate that LCVs have not been a safety problem on the turnpikes and western highways where they have operated. Whether this record could be maintained in heavier traffic is open to question.

We reported in March 1992 that efforts to study the accident rates of multiple-trailer trucks had reached differing conclusions concerning the safety of LCVs. Weaknesses in the data at both the national and state levels as well as differing study approaches contributed to the differences. For example, the lengths of trailers are rarely recorded on accident forms, making it impossible to separate accidents involving turnpike or Rocky Mountain doubles from those involving the double 28-foot trailers operated nationwide. Also, very little mileage data on LCVs are available, thus making it difficult to compare accident rates of LCVs with those of single-trailer trucks.

On the basis of the limited data available from a few states and several large companies, triples appear to have relatively good safety records. Triples are operated primarily by large national and regional LTL companies with good safety records and experienced drivers, mainly on limited-access highways. In contrast, little is known about the safety of doubles, particularly Rocky Mountain doubles. The latter are operated by a more diverse group of smaller companies that often haul a variety of heavier commodities on a wider network of roads—many of them two-lane roads.

LCV use has generally been limited to less-congested highways. One or more types of LCVs are currently allowed on less than one-fourth of the interstate system and about one-fifth of the other highways in the national truck network. The 1991 average traffic volume on rural and urban interstates in the 14 western states that allow LCVs was less than half of

that in the remaining states. Except for Rocky Mountain doubles, LCVs have often been restricted to interstate highways or other limited-access highways, which have lower accident rates than other types of highways.

State Regulation of LCV Operations Has Been Uneven

We reported in November 1993 that the regulation of LCV operations varies widely in the states that allow LCVs. Few states have specific requirements for LCV drivers, despite widespread acknowledgement that experienced drivers are important to LCV safety. States have not done special inspections of LCVs, and some evidence suggests that the longer combinations have been underrepresented in roadside inspection programs.

State officials considered their LCV controls adequate, although data on which to base this conclusion were limited in most states. While guidelines from both the Western Highway Institute and the Western Association of State Highway and Transportation Officials recommend that drivers be experienced and have good safety records, very few western states have any special requirements for drivers. In addition, because traffic citations do not specify vehicle configuration, states cannot monitor the performance of LCV drivers and their compliance with permit requirements. FHWA is in the process of establishing minimum training requirements for LCV drivers and agreed with us that drivers' experience and driving records should also be considered.

We reported in November 1993 that most states had not used data from the roadside inspections performed under the Motor Carrier Safety Assistance Program to monitor the condition of LCVs or the drivers' adherence to safety regulations. We found that the out-of-service rate[1] for doubles combinations exceeded that for all trucks inspected in 8 of 12 western states, while the rates for triples were lower. Both doubles and triples appeared to be underrepresented in roadside inspections, although FHWA argued that further study was needed to determine whether LCVs were getting adequate attention under the program.

[1]Trucks and drivers are placed out-of-service (not allowed to continue operating until violations have been corrected) if violations deemed critical to safe operation are discovered during roadside inspections.

Conclusions, Matters for Congressional Consideration, and Agency Comments

Conclusions

Any decision to allow the use of LCVs involves safety concerns as well as economic factors. While LCVs may require some additional public investment in the highway infrastructure, these costs appear to be exceeded by the recurring annual benefits in the form of lower transportation costs. The safety issues are less easily answered. As we have previously reported, the apparently good safety record of LCVs to date must be viewed in the context of the less-congested highways where they have operated and the use of triples mainly by large LTL and package companies with good safety records. A wider use of LCVs could bring them in proximity of major metropolitan areas and on more-heavily traveled highways, which would entail greater risks to the passenger traffic with whom trucks share the highways.

Analyses that have addressed the costs and/or benefits of LCVs have assumed that these longer combinations would operate on a national network of highways. If, for safety reasons, LCVs were kept off the more-congested highways east of the Mississippi River, this would significantly reduce both the infrastructure costs and potential benefits from LCVs. The most favorable cost-benefit ratios could be achieved through selective designation of suitable routes, taking account of traffic density, the capacity of bridges, the adequacy of interchanges, and the need for staging areas. To the extent that additional infrastructure costs are identified, states must decide how to recover them.

Triple-trailer combinations would show the most obvious economic benefit under selective route expansion because (1) they can be accommodated more easily by the existing infrastructure, (2) they can often operate out of company terminals with few new staging areas, and (3) LTL and package companies could expand the use of triples incrementally if additional states authorized them. Specific, limited uses can be found for turnpike doubles in a fragmented network, but substantial use of these combinations would require a national network of highways open to them. Even with such a network, it is questionable whether these long doubles would be a viable alternative to the current trends in the truckload industry, which involve using longer single trailers and intermodal rail service.

Matters for Congressional Consideration

Considering the need for additional infrastructure investment and the uncertainties about the safety of LCVs, we believe that if the Congress wishes to allow expanded use of LCVs, it should authorize the Secretary of

Transportation to consider exceptions to the freeze on LCV expansion only if requested by states and accompanied by the following:

- A state analysis of each proposed route to demonstrate its suitability in terms of the density of traffic, condition of bridges, and adequacy of interchanges. States should determine whether additional infrastructure costs would be generated and how these costs would be recovered.
- A certification that the state will enforce qualification standards for LCV drivers, ensure adequate inspection of LCV equipment, and monitor the experience of LCVs to identify any emerging safety problems or negligent carriers.

Agency Comments

We provided copies of the draft report to DOT officials, who chose to provide oral comments. We met with various DOT officials, including the Director, Office of Engineering and Highway Operations Research and Development, FHWA, and the Chief, Office of Economic Analysis, FRA. These officials generally agreed with the report's findings, conclusions, and matters for congressional consideration. They gave us editorial and technical suggestions for clarifying and qualifying the report, which we have included in the text where appropriate. On June 14, 1994, in hearings before the Subcommittee on Surface Transportation, House Committee on Public Works and Transportation, the FHWA Administrator stated that FHWA's last study on truck size and weight was 30 years old and that FHWA would initiate a study to thoroughly reexamine all commercial vehicle size and weight issues.

Evaluation of the Use of the Association of American Railroads' Model in Projecting Freight Diversion by Turnpike Doubles

Sensitivity of the Model to Assumptions

The Association of American Railroad's (AAR) model uses a sample of rail shipments reported to the Interstate Commerce Commission and assumes that for each, an alternative truck movement was available. Using various sources of data, the model calculates the total logistics cost to a shipper (payment to the carrier plus other costs of using rail or truck) and calculates for each shipment a probability that it would go by rail. The higher the probability (closer to 1.0), the more likely that all such shipments would go by rail (coal, for example, would have a high probability). A reduction in truck costs (such as the ability to use turnpike doubles) would lower the probabilities, which the model interprets as a directly proportional shift of traffic from railroads to trucks. For example, a reduction from 0.57 to 0.53 would represent a 4-percentage-point loss of the rail traffic in question. The model includes an interim step in which the railroad may lower its profit margins in an attempt to retain the business. The impact on railroad revenues is thus greater than just the loss of ton-miles.

The results generated by the AAR model depend considerably on the assumptions made about the total logistics costs for rail and truck moves. For example, assumptions must be made about the highways that would be open to turnpike doubles, which would affect the amount of extra cost incurred to assemble pairs of trailers and then deliver them to customers after their linehaul. Another question is whether the cost of infrastucture improvements would be recovered from the operators of longer combination vehicles (LCV), thus decreasing somewhat the cost advantage they would gain.

Apart from the sensitivity of the model to these kinds of cost assumptions, an important question arises regarding the extent to which turnpike doubles would actually be used. A key assumption of the model is that a trucking alternative (in this case, a turnpike double alternative) is available for every rail shipment. As discussed in the body of this report, the truckload industry may not be as likely to use turnpike doubles as these diversion analyses have assumed.

Limitations of the Model

As used in the diversion analyses, the AAR model has two basic limitations. The first is that it is static—it calculates diversion that would have occurred if the lower-cost truck option had been available at the time of the rail shipments in the database. Analysts did not attempt to provide for ongoing competitive improvements in the rail and trucking industries that would determine whether future shipments would actually shift to the

highway. For example, many train crews have been reduced from three or four to two as a result of settlements following a 1991 strike. The model could apparently be programmed to anticipate changes such as this, but none of the LCV diversion studies took account of this reduction in rail costs. Unless the Congress were to mandate a nationwide LCV network, expansion would likely take place slowly as states designated routes open to LCVs. Throughout such a period, railroads would have time to introduce further productivity improvements to counter the threat from LCVs. While not all improvements would be as dramatic as the crew reductions, railroads are continually improving such things as train and car control, locomotive efficiency, and railcar capacity.

In commenting on a draft of this report, a Federal Railroad Administration official pointed out that each time the AAR model is run with updated waybill data, the railroad costs reflect productivity improvements that have occurred. This is true; in fact, AAR's analysis with 1990 data predicted slightly less diversion than its analysis with 1988 data. Our point is, however, that whichever year is chosen, the analyses have held railroad productivity constant, while introducing a quantum leap in trucking productivity as if it had already happened. As noted above, this is very different from what could be expected in the real world.

A second important limitation of the AAR model is that it computes diversion in only one direction, from railroads to trucks. Since the model does not have a database of truck shipments comparable to the waybill sample of rail shipments, it does not compute the amount of diversion from truck to rail that might occur if rail costs decreased. The improvements in intermodal rail service that have occurred in recent years, including the wider use of double-stack container cars, have helped railroads regain some market share in long-haul corridors and have led many truckload companies to seek intermodal relationships with railroads. The AAR model is not constructed to capture changes such as this that divert freight from highways to railroads.

Organizations Contacted by GAO

Federal Agencies	Federal Highway Administration Federal Railroad Administration Interstate Commerce Commission National Transportation Safety Board
LCV States	Idaho Nevada Oregon Utah
Toll Road/Turnpike Authorities	Indiana Department of Transportation, Toll Road Division Kansas Turnpike Authority New York State Thruway Authority Ohio Turnpike Commission
Industry Organizations	American Road and Transportation Builders Association American Shortline Railroad Association American Trucking Association Association of American Railroads Institute of Transportation Engineers International Bridge, Tunnel and Turnpike Association International Brotherhood of Teamsters Interstate Truckload Carriers Conference National Industrial Transportation League National Private Truck Council Owner-Operator Independent Drivers Association Regular Common Carrier Conference Trucking Research Institute Western Highway Institute
Other Organizations	American Association of State Highway and Transportation Officials Cambridge Systematics, Inc. Transmode Consultants, Inc.

	Transportation Research Board SYDEC, Inc. Texas Research and Development Foundation
Less-Than-Truckload Companies	Churchill Truck Lines Roadway Express United Parcel Service (package company) Utah-Wyoming Freight Line Yellow Freight System
Private Companies	Associated Food Stores Associated Wholesale Grocers Frito Lay Idaho Asphalt Supply
Truckload Companies	Bannock Paving Co. Best Way Express Builders Transport Contract Freighters Inc. Crete Carrier Corp. CRST Inc. Doug Andrus Distributing Handy Truck Line Heartland Express Hi-Way Dispatch J.B. Hunt Transport Mercer Transportation Co. Missouri-Nebraska Express M.S. Carriers Schneider National Swift Transportation Werner Enterprises

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