Estimating the Rail-to-Truck Traffic Diversions Attributable to Increased Truck Size and Weight

Mark L. Burton
Appalachian Transportation Institute
Marshall University

burtonm@marshall.edu
(865) 898 8729

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The analysis and conclusions presented here do not necessarily reflect the positions of Marshall University. Instead all content is strictly attributable to the document's author.

1. INTRODUCTION

Each year, lawmakers are asked to loosen the controls that govern the weights and lengths of the trucks that blanket public highways. Doing so would measurably lower the costs of motor carriage and, thereby, benefit an identifiable subset of the nation's freight shippers and provide greater profits for carriers.

Unfortunately, relaxing these weight and size limits would also lead to increased crash-related casualties, unaffordable wear and tear on highways, and the diversion of freight traffic from congestion-reducing, environmentally friendlier non-highway alternatives to all-highway truck routings. Specifically, reduced truck size and weight guidelines would slash the use of all-rail and intermodal truck-rail freight shipping.

The research reported here provides estimates of reduced all-rail and intermodal freight traffic under five truck size and weight scenarios. These include –

• Increase maximum weights (gross vehicle) to 91,000 lbs. on six axles.	• Increase the allowed length of trailers used in double-trailer configurations to 33 feet with a maximum gross vehicle weight of 91,000 lbs.
• Increase maximum weights (gross vehicle) to 97,000 lbs. on six axles.	• Increase the allowed length of trailers used in double-trailer configurations to 33 feet with a maximum gross vehicle weight of 120,000 lbs. (requires additional axles).
• Increase the allowed length of trailers used in double-trailer configurations to 33 feet, while retaining 80,000 gross weights.	

Within economics, there are two common ways to derive traffic diversion estimates. The first, and more common method uses actual available data to estimate the responsiveness of modal choice to changes in the relative price(s) of transportation alternatives. These responsiveness or *elasticity* estimates are then used to simulate traffic shares under a hypothetical new rate structure.[1] In contrast, the US Department of Transportation uses a deterministic model that relies on fairly restrictive assumptions about the relationship between carrier costs, resulting rates, and shipper choices.[2]

The results reported here rely on data-driven econometric estimates (Method One) to gauge the diversion effects of changed truck sizes and weights. Additional research (as yet, unreported) is aimed at reconciling these econometrically-derived estimates with those obtainable through the USDOT methodology.

2. SUMMARY OF METHODS AND FINDINGS

The data-derived estimates of rail-to-truck traffic diversions rest on the completion of four analytical steps enumerated below. For estimation purposes, intermodal shipments of both containers and truck trailers of varying dimensions and content are treated as homogeneous. Subject railroad carload traffic is segregated into five commodity groups – Food & Kindred Products, Lumber & Wood Products, Pulp, Paper, & Paper Products, Primary Metal Products, and Motor Vehicles & Parts.[3]

[1] For a comprehensive discussion of econometrically estimated transportation demand elasticities see: Michel Beuthe, Bart Jourquin & Natalie Urbain (2014): Estimating Freight Transport Price Elasticity in Multi-mode Studies: A Review and Additional Results from a Multimodal Network Model, *Transport Reviews*.

[2] The USDOT estimates rely on an application of the Intermodal Transportation and Intermodal Cost (ITIC) model. For a full description, see "Modal Shift Comparative Analysis," *Comprehensive Truck Size and Weight Limits Study*, Vol. 2, U.S. Department of Transportation, June 2015.

[3] Some shipments of traditional bulk commodities, along with a variety of additional carload shipments are contained within the analysis. However, they are aggregated into a single commodity grouping.

1. The combination of rail intermodal and carload data with truck pricing to estimate the cross-elasticity (responsiveness) of demand of railroad traffic volumes given a small change in motor carrier rates;
2. The estimation of the rail traffic volumes that are subject to potential traffic diversion given commodity characteristics (e.g., weight and size) and shipment characteristics (e.g., overall annual traffic volumes and shipment distance);
3. The calculation of changes to motor carrier rates (costs) resulting from various changes to allowed truck size and weight; and
4. The calculation of diverted railroad traffic given shipper responsiveness, at-risk traffic volumes, and the changes in trucking costs under each scenario.

Diversions are allowed to take place over a 3-5 year period, reflecting shipper needs to adjust expectations, supply chain practices, and physical facilities**. Importantly, while the analysis includes extra weight penalties for additional truck axles where indicated, it ignores any changes to railroad operating and capital costs that may result from changes to container and/or trailer dimensions.** Based on this methodology, the study team estimates that, depending on scenario, modifications to truck size and weight limitations will result in the railroad traffic diversions summarized in Tables 1 and 2.

Not surprisingly, the diversion volumes vary significantly by scenario. For example, an increase in allowed total gross truck weights from 80,000 to 91,000 pounds (but with no change in trailer length) is estimated to result in the diversion of 2.6 million annual railroad carloads and 1.8 million intermodal units. Alternatively, a combined increase of truck weights to 120,000 pounds, combined with twin 33-foot trailers leads to a predicted diversion 7.5 million annual rail carloads and 8.5 million diverted intermodal shipments. These estimates are further decomposed in the sections that follow.

Table 1 – Summary of Carload Traffic Diversions

Gross Truck Weight (Pounds)	Configuration	Estimated Cross-Price Elasticity	Estimated Unit Cost Change	Total Diverted Carloads at 5-Years*	Percentage of Subject Carloads**
80,000	Twin 33-Foot	0.411	-16.0%	29,724	0.2%
91,000	Single 53-Foot	0.301	-15.0%	2,654,986	20.4%
97,000	Single 53-Foot	0.301	-25.7%	4,287,168	33.0%
120,000	Twin 33-Foot	0.301	-52.7%	7,517,974	57.8%

* Reflects cumulative annual total of diverted carload traffic after five-year period.

** Denominator = all carload traffic within selected commodity groups.

Table 2 – Summary of Intermodal Traffic Diversions

Gross Truck Weight (Pounds)	Configuration	Estimated Cross-Price Elasticity	Estimated Unit Cost Change	Total Diverted Intermodal Units at 5-Years*	Percentage of Subject Intermodal Units**
80,000	Twin 33-Foot	0.476	-16.0%	2,857,553	19.6%
91,000	Single 53-Foot	0.476	-15.0%	1,841,320	12.7%
91,000	Twin 33-Foot	0.476	-11.3%	3,691,558	25.3%
97,000	Single 53-Foot	0.476	-25.7%	3,042,936	20.9%
97,000	Twin 33-Foot	0.476	-15.3%	4,668,003	32.1%
120,000	Twin 33-Foot	0.476	-34.4%	8,507,972	58.4%

* Reflects cumulative annual total of diverted intermodal traffic after a five-year period.

** Denominator = all intermodal traffic.

3. A CLOSER LOOK AT THE INTERMODAL FINDINGS

The projected diversions are literally the product of the estimated components described above. This can be summarized by a simple equation –

$$\text{DIVERSIONS} = \Delta(R_{\text{TRUCK}}) \times \text{ELASTICITY} \times Q_{\text{RISK}}$$

Or in words, the realized diversions equal the product of the policy-induced reduction in motor carrier rates, the cross-price elasticity of demand for rail traffic, given a change in truck rates, and the quantity of rail traffic that is at risk of diverting, given commodity and shipment characteristics.[4]

The seemingly simple exercise of examining a small set of potential changes to truck size and weight controls based on this equation can, however, grow quite complex.

The research presented here treats the effects of five specific scenarios. However, some of the scenarios allow *both* vehicle sizes and weights to vary. Therefore, there are numerous potential changes to motor carrier rates [$\Delta(R_{\text{TRUCK}})$] that must be considered. In the real world, elasticities can vary substantially with market conditions. However, here, we have the luxury of treating the responsiveness of trucking customers [ELASTICITY] as fixed. Finally, the quantity of at-risk rail shipments [Q_{RISK}] varies by commodity. Within the current work, there are five carload commodity groups, plus intermodal traffic.

Tables 1 and 2 divide the results based on carload versus intermodal service. Generally, intermodal traffic is more suspectable to truck rail diversions than carload service. This is, in part, because, in the case of intermodal service, shipper choices can more easily be influenced by either greater available vehicle volumes or increases in allowed weights.[5] In the case of carload service (and excepting automobiles and parts), increases in vehicle volumes provide shippers little advantage unless they are accompanied by increases in allowed tonnage. The rows in Tables 1 and 2 that correspond with the introduction of twin 33-foot trailers, with no increase above the current 80,000-pound limit illustrate this point. The introduction of twin-33s with no corresponding weight difference, is predicted to lead to a meager diversion of 0.2% of subject carload traffic, whereas, the same scenario would lead to a 19 percent reduction in truck-rail intermodal movements.

Table 3 decomposes the diversions of rail-truck intermodal units to all truck routings based on whether relaxed weight restrictions or additional cubic feet are responsible for specific diversions. The influence of the form of the relaxed constraint meshes well with common sense. Heavier equipment loadings, without a change in equipment size, benefit shippers with heavy, dense loads. Conversely, longer trailer combinations, without weight increases, mostly benefit shippers that need more cubic feet for the movement of lighter, less dense freight. And finally, when both weight and size standards are relaxed simultaneously, both shippers with heavier goods and shippers who wish to move lighter loads will be inclined to divert large volumes of traffic from rail-inclusive to all-truck routings.

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[4] The public sector supply of highway infrastructure causes motor carriage to be very competitive so that it is easily possible to substitute changes in costs for changes in trucking rates.

[5] The ease of shifting between intermodal rail-truck and an all-truck routing is also heavily influenced by the fact that shippers are already originating and receiving shipments by truck. Therefore, a movement to all-truck carriage will require few, if any, changes to shipping and receiving infrastructures.

Table 3 – Intermodal Diversions by Form of Constraint

Scenario	Constraint	Estimated Unit Cost Change	Estimated Cross-Price Elasticity	Total Diverted Intermodal Units	Percent of Total
80,000 lbs. Twin 33s (Cube)	Cubic Feet	16.0%	0.4763	2,857,553	19.6%
91,000 lbs. Single 53' (Weight)	Weight	15.0%	0.4763	1,841,320	12.7%
91,000 lbs. Twin 33s (Weight)	Weight	6.6%	0.4763	834,006	5.7%
91,000 lbs. Twin 33s (Cube)	Cubic Feet	16.0%	0.4763	2,857,553	19.6%
97,000 lbs. Single 53' (Weight)	Weight	25.7%	0.4763	3,042,936	20.9%
97,000 lbs. Twin 33s (Weight)	Weight	14.7%	0.4763	1,810,450	12.4%
97,000 lbs. Twin 33s (Cube)	Cubic Feet	16.0%	0.4763	2,857,553	19.6%
120,000 lbs. Twin 33s (Weight)	Weight	52.7%	0.4763	5,650,420	38.8%
120,000 lbs. Twin 33s (Cube)	Cubic Feet	16.0%	0.4763	2,857,553	19.6%

4. CONCLUDING COMMENTS

Relative transportation costs and resulting shipper choices are greatly affected by the truck sizes and weights that policy makers allow on the roads and bridges that the public sector supplies. Currently, most trailers operated as "singles" are constrained to a length of 53-feet. Trailers used as "doubles" have a standard length of 28-feet and the gross truck weights of most configurations are not allowed to exceed 80,000 lbs.

Even though motor carriers and fleet operators pay fuel costs, federal sources question whether or not the revenues from those payments fully account for the roadway capacity and maintenance costs that trucks impose.[6] Nonetheless, there is continuous pressure from a subset of shippers and users to increase truck sizes and weights.[7] Specifically, proponents advocate the allowed use of 33-foot double trailers and gross truck operating weights of up to 120,000 pounds.

Common sense dictates that reduced trucking costs (and, thereby, rates) will cause a portion of rail-inclusive freight traffic to divert to all-highway routings. However, precisely calculating the extent of these rail-to-truck diversions is a difficult task. There are extensive and diverse arrays of commodity and shipment characteristics, related changes in other supply-chain costs, and numerous available truck size and weight policy options, all of which complicate the analytical landscape.

In the current work, reported here, we have opted for an empirical approach, using decades of actual truck and rail pricing and demand data to predict shipper and carrier responses, which provides very reasonable estimates of the implications of modified truck size and weight controls under a variety of scenarios suggested by proponents of relaxed rules. While this approach does not lend itself to the treatment of individual shipments, it does provide reasonable estimates of the aggregate implications of modified truck size and weight controls under a variety of plausible scenarios.

The results are compelling. In a setting where policy makers openly and even vigorously pursue intermodal and other non-highway freight transport as a means of reducing highway congestion, improving safety outcomes, and protecting environmental resources, allowing bigger and/or heavier trucks would be hugely counterproductive. As Tables 1 and 2 indicate, even lesser scenarios will

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[6] See: Congressional Budget Office, "Issues and Options for a Tax on Vehicle Miles Traveled by Commercial Trucks," October 2019, available at: https://www.cbo.gov/publication/55688#section1

[7] For example, Americans for Modern Transportation, a perennial advocate for 33-foot "pup" trailers, is heavily supported by customers and carriers like Amazon and FedEx. See: "Americans for Modern Transportation Push for Longer Pup Trailers," March 2019, available at: https://expressfreightfinance.com/americans-for-modern-transportation-push-for-longer-pup-trailers/

reduce intermodal traffic by 20-25 percent and railroad carload traffic by as much as 20 percent. More disruptive scenarios could reduce both intermodal and certain carload traffic by nearly 60%.

These estimation results do not rely on aggressive or unreasonable assumptions. To the contrary, for example, the work does not account for the equipment or infrastructure costs necessary for the rail network to accommodate 33-foot trailers. It is possible that the need for these investments could measurably diminish any rail industry response and/or lead to higher intermodal rates for 33-foot equipment. In either case, the results provided above almost certainly understate the extent of rail-to-truck traffic diversions.

In summary, the analysis described above demonstrates that even a modest relaxation of the standards that govern truck sizes and weights will produce a measurable diversion of rail freight traffic to all-truck routings. In the extreme, the most aggressive changes to truck size and weight standards could be ruinous to rail carriers and to the public sector policies designed to mitigate the growth of truck-related harms.