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The Economic Costs of Public Subsidies for Freight Transportation

MICHAEL F. GORMAN I SEPTEMBER 2025

Federal freight policy effectively incentivizes the most damaging and least efficient mode of freight transport—trucking—by underpricing access to public infrastructure. A restructured, mode-neutral cost system would encourage more efficient, safer, and environmentally sustainable freight transportation, better serving taxpayers, drivers, and the economy.

KEY TAKEAWAYS

- The federal government effectively provides a large subsidy for the trucking industry, which has significant negative externalities by increasing congestion, emissions, and incidences of highway accidents.
- The United States has 150,000 miles of freight railroads, and rail companies invest $23 billion annually to maintain them. Federal support is limited, covering mainly signals and gates at highway-rail crossings.
- The U.S. Army Corps of Engineers maintains 12,000 miles of navigable waterways—and in 2025, Congress appropriated $8.7 billion to the Corps, which it uses both to manage navigation and mitigate flood risks.
- The federal government spent $52 billion on roads last year, and about $20 billion of that came not from taxes on diesel fuel or gasoline (which approximate user fees for trucks and passenger cars) but from the general fund.
- To allocate federal investments in transportation infrastructure more efficiently, Congress should replace the diesel fuel tax with a vehicle miles traveled fee for trucks, so that they internalize the full infrastructure and any external costs they impose.
- Policymakers should reassess regulations that increase costs on the rail industry without measurable safety benefits.
- Policymakers also should prioritize investment in multimodal freight strategies, especially those that expand intermodal rail and reduce truck congestion in urban corridors.

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INTRODUCTION

The U.S. economy greatly depends on the functionality of its transportation infrastructure. Yet, the country has recently seen fragile transportation systems break down, resulting in production shortages and stoppages, and also price surges.

The United States moves almost $18 trillion worth of goods annually, and virtually all of it travels via three primary freight transportation modes: trucking, rail, and waterways.[1] (For the purposes of this discussion, we exclude pipelines and air, as pipelines carry only a few specific items and air transport is an essentially different service and transports a relatively small amount of goods.) Each mode operates under fundamentally different structural models that determine the service capabilities, cost structures, and growth patterns.

The structural differences begin with infrastructure ownership and funding. Trucking operates on a 4-million-mile public highway network created and maintained by the federal, state, and local governments.[2] Waterways utilize 25,000 miles of channels maintained by the Army Corps of Engineers.[3] Railroads, on the other hand, privately own and maintain 140,000 miles of track infrastructure.[4]

These three modes have different service capabilities, cost profiles, and competitive advantages. The national highway system provides trucking with a flexibility and capacity that enables door-to-door service to virtually every business in the country. Rail's private infrastructure produces operational efficiency through economies of scale; however, except for its well-established and growing intermodal (truck to train) option, which accounts for 25 percent of rail revenue, its service is largely limited to businesses that operate on or near a rail network.[5] Water transport, also heavily subsidized by public funds, enjoys economies of scale as well but has more severe geographic constraints that limit service scope.

Another factor that influences the relative costs of the three modes is the federal government providing trucking with an enormous operating subsidy, largely due to the diesel fuel tax of 22

cents per gallon not coming close to paying the cost of maintaining the roads used by trucks. In fiscal year 2025, the federal government will transfer over $40 billion from the general fund to the Highway Trust Fund, 40 percent of which is due to truck-related damage to roads.[6]

Of course, trucks share roads with passenger vehicles, but because of their weight, they do much more damage than cars do. They also impose considerable societal externalities from their use of roads: they greatly increase the risk of a passenger car getting in an accident—and of dying from an accident; they substantially increase congestion, which only lengthens commutes (the Texas A&M Transportation Institute estimates that the typical driver spends over 50 hours stuck in traffic each year).[7]

The congestion engendered by trucks also increases smog and carbon dioxide emissions; highway transportation accounts for 30 percent of all greenhouse gas (GHG) emissions in the United States and trucking accounts for a quarter of that. Rail is four times more fuel efficient, cutting on emissions dramatically.[8][9] Rather than subsidizing an entire sector that imposes such costs on the U.S. economy, it is time to consider a more efficient way to make trucks pay something at least approaching these costs.

COMPARING FREIGHT TRANSPORTATION NETWORKS

Table 1 shows that truck, rail, and water transportation operate on entirely different networks as a result of how they are owned, funded, and accessed.

Table 1: Infrastructure scale and investment characteristics

Mode	Network Miles	Annual Network Growth Rate	Ownership Model	Investment Source	Access Pattern
Highway	4,200,000[10]	+0.2%	Public ownership	User and taxpayer funded	Universal access
Rail	150,000[11]	-0.5%	Private ownership	Privately funded	Selective access
Waterway	12,000[12]	0.0%	Public ownership	Taxpayer funded	Limited access

The U.S. highway system provides trucking with a network that reaches virtually every domestic shipper and consumer in the country, financed by both fuel taxes and taxpayers. The network has grown steadily in the last few decades, as measured by miles of lanes.

Railroads reach fewer businesses: No railroad has a fully national presence, and they must often work with other railroads or trucking companies to provide service to customers that want to ship to a customer not on their network. Railroad networks have been slowly shrinking, with railroads continually evaluating the productivity of their entire lines and abandoning routes that have ceased being profitable.

This fundamental difference in expansion patterns reflects the markedly different accountability structures between public and private infrastructure investment. While it is all but impossible to grow the inland water network, and exceedingly costly to expand rail infrastructure, governments can find the money to expand road networks as the population grows in a particular region.

SERVICE MODEL DIFFERENTIATION

Service Attributes

Each transportation mode offers distinct service characteristics that are shaped by their infrastructure and funding models, as outlined in table 2.

Table 2: Service capability comparison

Service Attribute	Trucking	Rail	Water
Geographic Reach	Universal (road access)	Limited (rail-served locations)	Restricted (waterway access)
Delivery Speed	High (direct routing)	Moderate (terminal delays)	Low (channel restrictions)
Delivery Reliability	High	Moderate	Low
Shipment Size	Small to medium loads, truckload	Truckload and bulk volumes	Very large bulk shipments
Service Flexibility	High (door-to-door)	Moderate (terminal-to-terminal, some door-to-door)	Low (port-to-port)
Infrastructure Dependency	Public road network	Private track network	Public waterway system
2023 Ton Miles	2,337 billion[13]	1,493 billion[14]	535 billion[15]
2023 Market Share	54%	34%	12%

Trucking's universal service capability stems from an immense public investment in comprehensive highway infrastructure. The trucking industry benefits enormously from sharing a network with voters/car owners whose representatives curry favor by getting road investment projects in their districts, paid for by diesel fuel taxes, gas taxes, and—increasingly—general revenue funds. The firms in the trucking industry do not have to decide where to build network capacity, how much capacity to build, when to repair worn-out roads, or how to pay for such investment—the government does. The industry could not exist without the public's investment and ongoing support for highway infrastructure.

Contrary to trucking's universal reach, rail service limitations reflect the fact that the cost of maintaining a rail network is so high that it's cost-efficient to focus investments on a few main high-volume corridors. The cost of maintaining a railroad network is enormous because railroads must ensure that their tracks are in excellent condition: The potential liability of a major event—especially if it occurs near a populated area—can approach a billion dollars. Over recent

decades, rail has pushed for more point-to-point operations and fewer local operations to gain efficiency.

Intermodal rail entails using rail for long-haul transport and trucks for the "last mile." International intermodal connects ports to inland points more efficiently. While this combination increases the number of customers railroads can service, it entails costly labor-intensive handoffs between modes.

Water transport combines public infrastructure with geographic constraints that naturally limit service scope. Of course, the river network in the United States defines where water transport operates, which is primarily on the Mississippi River network, Great Lakes and St. Lawrence Seaway, and the Pacific Northwest. The Army Corps of Engineers maintains the infrastructure.

The market shares of each mode are a result of their service and funding features. Trucking generates almost 20 percent more freight than does rail measured in ton-miles.[16] While truck and rail market shares grew in the 2000s, the market for water-based freight has declined for decades, losing almost 50 percent of its traffic since the 1980s. Water transport now carries only 14 percent of all traffic.[17]

Cost Structures

The fundamentally different operating structures and capabilities of truck, rail, and water transport result in markedly different cost structures, which significantly impact operational flexibility and strategic decision-making. Trucks operate on public roads, for which they pay roughly four cents per mile driven via the diesel fuel tax.[18] Barge transport traverses a fixed river network maintained by the Army Corps of Engineers, and freighters pay a relatively small fuel tax thanks to high fuel efficiency and relatively low port fees and occasional dredging fees to support the river infrastructure. Table 3 describes these differences.

Table 3: Capital intensity comparison by transportation mode

Mode	Network	Motive Force	Conveyance
Trucking	▪ Public roads converted to variable expense via diesel fuel tax: $0.28 per gallon	▪ Tractors: $150,000	▪ Containers: $5,000 ▪ Chassis: $1,000
Rail	▪ Privately maintained and expanded: $2 per million miles	▪ Locomotives: $3 million	▪ Railcars: $150,000
Water	▪ Fixed network, publicly maintained: port fees, dredging, fuel tax	▪ Tugboats: $500,000	▪ Barges: $1 million

The rail industry maintains its own capital stock, which makes it one of the most capital-intensive industries in the world. Class I railroads invest $23 billion into their networks annually—nearly $170,000 per track mile—which represents a capital intensity six times that of a typical manufacturer as a share of revenue.[19]

Each mode also has a different capital structure for rolling stock (e.g., locomotives, tractors, tug boats). A small business can enter the trucking industry by purchasing a single truck, which can often be bought for less than $100,000. Tugboats, the typical conveyance for barges, start at about $500,000, and a small business can enter the market with a single tug. One locomotive, on the other hand, can cost millions of dollars, and even the smallest trunk line would cost multiple millions of dollars a year to purchase and maintain.

While capital costs are higher for locomotives and barges, they can move much more freight than trucks can. For instance, a single locomotive can move nearly 200 cars (though typically far fewer), and a railcar typically has four times the capacity of a freight truck.[20] A tugboat can convey several barges at a time, each of which has 15 times the capacity of a railcar.[21]

Trucking companies do not have to invest in any network roadway infrastructure, though are responsible for terminals and the like. While the diesel tax ostensibly functions as a user fee, it does not cover the cost of maintaining and expanding the highway system and alleviates the burdensome decision of how to expand the service network. The federal government allocates money from the general fund to cover necessary expenses.

Rail faces the highest fixed costs but achieves superior operating efficiency. Railroads invest approximately $23 billion annually in private infrastructure, which makes it one of the most capital-intensive industries in the United States.[22] For comparison, a typical manufacturing industry spends 3 percent of revenue on capital expenditures while rail spends 19 percent.[23]

This massive fixed investment creates economies of scale for high-volume routes but must be justified economically, forcing companies to make careful investment decisions to avoid stranded investments in fixed infrastructure. As a result, variable costs remain relatively low per ton-mile transported, allowing rail to earn a fair return on its capital investment.

Highways Get Most of the Subsidies for Public Infrastructure

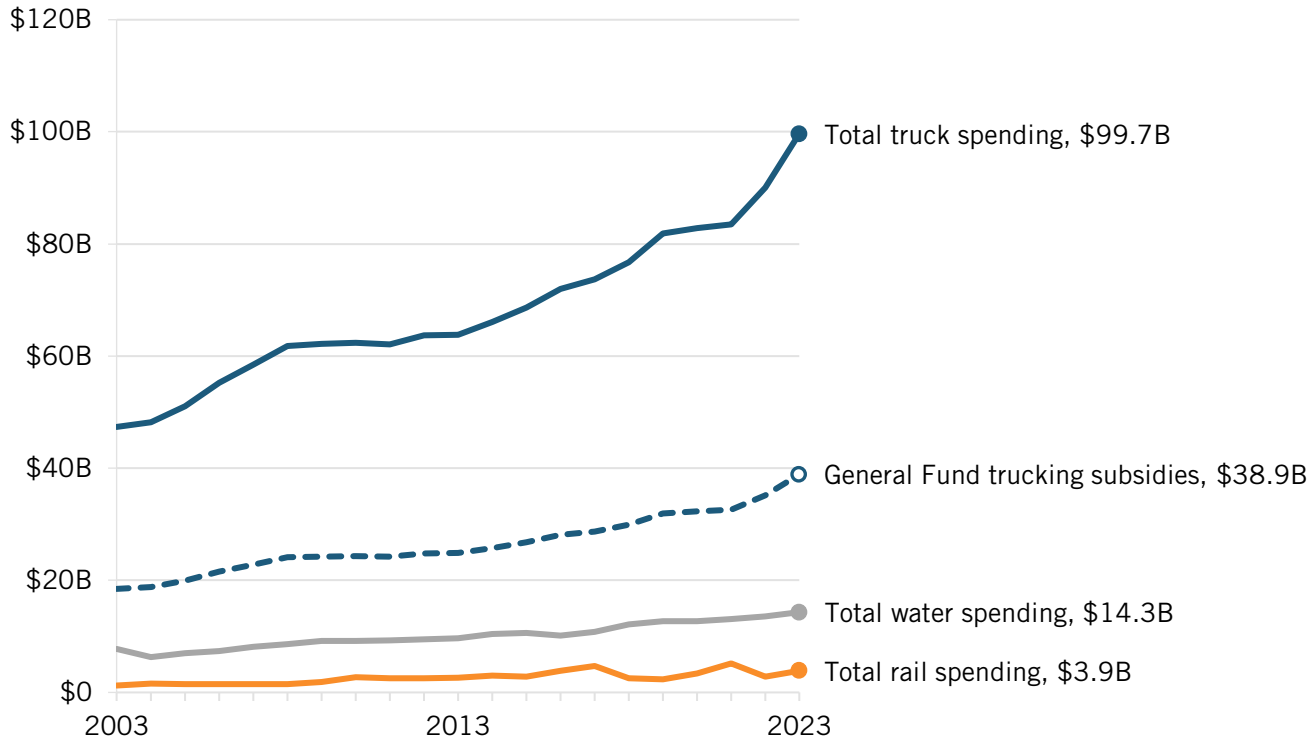
Waterways benefit from socialized infrastructure costs. Private operators maintain vessels and terminals while the waterway trust fund is designed to support river maintenance. This arrangement creates attractive economics for bulk commodity transport. However, routes cannot be easily expanded economically, which limits growth potential—and the relatively slow speed of barges means they are generally not a viable alternative to trucking.

The government funds and directs all spending on maintaining roads and waterways, while the rail industry receives a modest amount of funding from the federal government, primarily to fund investments that improve safety—such as crossing signals or gates or other for items such as environmental improvements—or mitigate rail-related vehicular traffic congestion.[24] The Department of Transportation grants that money to the localities that benefit themselves, not the railroads. Virtually none of the money spent by the federal government on freight rail is for the benefit of the railroads, but rather for public safety and road traffic mitigation.

Figure 1 compares the relative public spending (all levels of government) on the three freight modes of transportation. Government expenditures on building and maintaining U.S. highways swamp any investment in rail or water. The Congressional Budget Office estimates that federal, state, and local governments spend more than $100 billion on truck-related road maintenance and expansion annually, and nearly $40 billion of that is funded by taxpayers.[25]

The Federal Highway Administration estimates that truck freight is responsible for 40 percent of all spending on road maintenance, but the diesel taxes trucks pay don't come close to paying for that damage—today, the gas tax and diesel fuel tax cover only 80 percent of the cost of maintaining roads, and that proportion falls each year.[26] We calculate the subsidy as the amount over and above the money it collects from the diesel, gas, and other road use taxes. This amount represents the subsidies from the general public to support trucking, which is greater than the total public expenditures on the other modes.

Figure 1: Public spending on freight transportation infrastructure



Congress refuses to increase motor vehicle taxes, which have remained unchanged since 1993, and makes up for the increasing gap between Highway Trust Fund revenues and road expenditures by using tax revenue generated elsewhere. For instance, the 2022 JOBS Act allocated $350 billion to U. S. roadways.[27] Similarly, the Fixing America's Surface Transportation (FAST) Act in 2015 redirected $70 billion of revenue from the general fund to the Highway Trust Fund.[28]

Truck Transportation Imposes the Highest External Costs to Society

As summarized in table 4, each transportation mode generates external costs to the public. Truck transportation has by far the highest external costs borne by the rest of society. Trucking is by far the most dangerous mode, unsurprisingly, since trucks share the national road system with

passenger vehicles and there is no centralized control. Rail operates on a mostly closed network with central dispatchers, with railroads intersecting the road network relatively infrequently.

Nearly 40,000 people died on the nation's highways in 2024, and trucks were involved in nearly 12 percent of those deaths, and a similar proportion of all nonfatal injuries that occurred on roads.[29] Most of these fatalities were people in other vehicles, pedestrians, cyclists, or pedestrians. With more than six times as many fatalities when transporting hazardous materials and 18 times as many injuries per million gross ton miles (GTMs) than rail, trucking presents a far greater safety hazard to the public.[30]

Rail has experienced a 43 percent reduction in its accident rate since 2005.[31] Apart from fatalities and injuries, trucks have also caused nearly three times as much in property damage as rail incidents have since 2000.[32]

Water is by far the safest mode, due to its highly insulated network, very low operating speeds, and high tonnage per vehicle operated. Just five people died from accidents involving barges in 2023, the last year for which there is reliable data.[33]

Table 4: Modal nonfinancial externality comparison

Mode	Fatalities per Million GTMs[34]	Injuries per Million GTMs[35]	Ton Miles per Gallon[36]	External Costs per Ton Mile[37]
Trucking	2.54	56.05	145	$0.0397
Rail	0.39	3.32	477	$0.0078
Water	0.01	0.05	647	Not Available

Transporting freight by truck also generates more GHGs and pollutants than via rail or waterways. Moving goods by truck requires much more fuel per ton than the other modes do, as one railcar carries three to four truckloads worth of products. In addition, trucks carry a single container, while an intermodal freight train might operate with three locomotives and carry 200 or more containers, using markedly less energy per ton of freight transported. More energy burned corresponds to more pollutants and GHG emissions.

The constant braking by trucks also releases emissions of rubber, roadway particulates, and other pollutants in brake pads, and recent evidence suggests that this may be as harmful to people's health as smog.[38] Rail operates with steel wheels on steel rails, which gives it a much lower friction combination than does rubber on asphalt. Water transport is more fuel efficient and is less impactful on the environment than are truck and rail freight transport, although it does contribute to water pollution.

Trucks account for about 7 percent of all road miles traveled, but account for 28 percent of the total congestion time on the nation's roads, as they are bigger, slower, and more cumbersome to operate than a passenger vehicle.[39] Because railroads operate on a private, closed network, they have a minimal impact on congestion.

The Congressional Budget Office estimates that trucking has an average external cost of 4 cents per gross ton mile, while rail's external cost is just 0.8 cents per gross ton mile. Trucking is five times more expensive to the public than rail, yet, absurdly, it is subsidized.[40]

A WAY FORWARD

The federal government effectively allocates a subsidy of at least $10 billion a year to the freight trucking industry without taking into consideration as to whether the citizenry receives benefits anywhere near their contributions. Furthermore, there is nothing suggesting that the trucking industry generates positive externalities. In fact, an abundance of evidence suggests that the main effect of the subsidies results in more trucks on the nation's roads, which increases road congestion, emissions, and the number of accidents and deaths on highways.

At a time when the federal government is running a historically high deficit, the number of deaths on the nation's roads has spiked, and concern about GHG emissions has never been higher, a subsidy for truck freight makes no sense at all.

Congress has shown no appetite over the last 30 years for increasing the diesel tax, and the massive Highway Trust Fund deficit manifests that reluctance. A belated increase in the diesel tax could help lessen its annual shortfall, but it would almost surely not be sufficient to cover the full cost that freight transport imposes on our roads and the environment.

THE NEED FOR CHANGES

While privatizing the nation's roads is intractable, and implementing a VMT fee for trucks would take more political courage than currently exists, it should at least be possible in the next reauthorization of the surface transportation bill to make truck freight pay more to use the roads.

Private ownership of the nation's rail lines has created a network that is widely considered the largest, safest, and most cost-efficient freight system in the world.[41] Nevertheless, for the last decade, regulators have pushed for a plethora of new regulations on the industry—such as two-man crew restrictions and the Railway Safety Act—which will significantly increase rail transport costs while doing little to improve safety.[42] Rather than allow shippers or railroad workers' unions to dictate freight transport policy, Congress and regulators should consider what's best for taxpayers, drivers, and customers when making financing and regulatory decisions.

By subsidizing the trucking industry and overregulating the safer and more efficient railroad industry, the federal government has made the United States less competitive and saddled taxpayers with roads that are more congested and unsafe, higher-priced goods, and higher emissions while concomitantly costing taxpayers tens of billions of dollars. The United States should rethink its involvement in the freight transportation industry by ending all implicit subsidies given to the trucking industry.

Federal freight policy effectively incentivizes the most damaging and least efficient mode of freight transport—trucking—by underpricing access to public infrastructure. A restructured, mode-neutral cost system would encourage more efficient, safer, and environmentally sustainable freight transportation, better serving taxpayers, drivers, and the economy. An increase in the diesel tax or a vehicle mileage traveled fee would be a marked improvement on the status quo.

About the Author

Professor Michael F. Gorman holds the Niehas Chair of Operations and Analytics at the University of Dayton department of MIS, OPS, and Analytics. He has over 23 years of academic experience at University of Dayton, and 10 years' practical experience at BNSF Railway. He has over 60 academically reviewed publications and more than 100 conference and invited presentations. His specialty is in the applications of analytics, with a focus on transportation and logistics issues. He is the former editor in chief of the *INFORMS Journal on Applied Analytics* (formerly *Interfaces*) and serves on three editorial boards. He has been a finalist in the Edelman and Wagner Awards of *INFORMS* and has won the INFORMS Award for the Teaching of Applied Analytics and the POMS Wick Skinner award for teaching. He helped found the Analytics Society of INFORMS as its first president and created the Innovative Applications of Analytics Award. He has held numerous other elected and volunteer positions at *INFORMS*. Gorman has a Bachelor's degree in Computer Science and Economics from Xavier University, an M.S. in Economics, and a Ph.D. in Business and Economics at Indiana University.

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